DEPARTMENT OF THE INTERIOR

NITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 218

R-SUPPLY INVESTIGATIONS IN ALASKA, 1906-1907

OME AND KOUGAROK REGIONS, SEWARD PENINSULA; FAIRBANKS DISTRICT, YUKON-TANANA REGION

BY

RED F. HENSHAW AND C. C. COVERT

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WATER-SUPPLY INVESTIGATIONS IN ALASKA, 1906-1907.

By Fred F. Henshaw and C. C. Covert.

INTRODUCTION.

SCOPE OF WORK.

For a number of years the United States Geological Survey has made systematic measurements and studies of the water supply as one of the great resources of the country. These data are now available for all 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 developments.

There is a great tendency in Alaska to push forward the construction of ditches without first making sure of the primary requisite of their successful operation—an adequate water supply. The results of such a policy were forcibly shown during last summer in Seward Peninsula, in some parts of which a severe drought caused much loss and inconvenience to mining operators. These conditions are apt to occur in any portion of Alaska, and too much stress can not be laid on the importance of stream-flow data. The low-water period lasts only a part of the season and the water supply is usually sufficient at other times, but in view of the other unfavorable conditions—the shortness of the season, the frozen ground, the distance from base of supplies and 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. The cost of the useless machinery and ditches which can be seen in some parts of Alaska amounts to hundreds of thousands of dollars, and most of this could have been saved by a preliminary investigation of conditions by a competent engineer.

Hydraulic developments have been carried farthest in the Nome region of Seward Peninsula, which has been an important producer of placer gold since 1899. Hundreds of miles of mining ditches have been built at a great expense. When it was decided in 1906 to extend stream-gaging work to Alaska, the Nome region was accordingly selected as the first district to be studied. A reconnaissance was made and gaging stations were established by John C. Hoyt in the early summer of 1906, and the work was then carried on until the end of the season by Fred F. Henshaw. During last season the work was continued by Mr. Henshaw, assisted by Raymond Richards, and was extended into the Kougarok region, north of the Kigluaik Mountains, in the central portion of Seward Peninsula. Altogether the parties were in Seward Peninsula from June 11 to October 3, 1906, and from June 11 to October 14, 1907.

The collection of stream-flow records was begun in the Fairbanks district of the Yukon-Tanana region by C. C. Covert in 1907. The work was largely that of reconnaissance, but a few regular stations were established.

The work of collecting the data and preparing this report was done under the direction of the water resources branch by 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 to cover properly the large extent of country on which it was desirable to obtain records. It was possible to obtain daily gage readings only through the hearty cooperation of mining operators, ditch companies, and others. Those to whom special acknowledgment is due are named below:

In the Nome region, to the officers and employees of the Miocene Ditch Company, Wild Goose Mining and Trading Company, Cedric Ditch Company, Pioneer Mining Company, Gold Beach Development Company, and the United Ditch Company; to W. L. Leland, of the Three Friends Mining Company; to J. E. Styers, superintendent of construction for the National Wood Pipe Company; and to Arthur Gibson, George Ashley, William E. Morris, J. Potter Whittren, Mark N. Alling, and George M. Ashford, civil and mining engineers, Nome.

In the Kougarok region, to the officers and employees of the Kougarok Mining and Ditch Company, Taylor Creek Ditch Company, Pittsburg-Dick Creek Mining Company, Irving Mining Company, Cascade Mining and Ditch Company, Ottumwa Gold Mining Company, and to others for information and accommodations in camp.

In the Fairbanks district, to John Zug, superintendent good roads commission; A. D. Gassaway, general manager of the Chatanika Ditch Company; Falcon Joslin, president of the Tanana Mines Railroad Company; Herman Wobber, Fairbanks Creek; C. D. Hutchinson, electrical engineer, Tanana Electric Company, and Martin Harris, Chena.

EXPLANATION OF DATA AND METHODS.

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

In the consideration of industrial or mining enterprises which use the water of streams, it is essential to know the total amount of the 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 conserved 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

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

arising from its use, it has been defined by law in several States. The California miner's inch is in most common use in the United States and was defined by an act approved March 23, 1901, as follows: "The standard miner's inch of water shall be equivalent or equal to 1½ cubic feet of water per minute, measured through any aperture or orifice." This miner's inch corresponds to the so-called "6-inch pressure" and is one-fortieth of a second-foot. The inch in most common use in Seward Peninsula is the "old California inch," which was the standard in that State prior to the passage of the above act and is equivalent to 1.2 cubic feet per minute, or one-fiftieth of a second-foot.

Following is a list of convenient equivalents for use in hydraulic computations:

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.

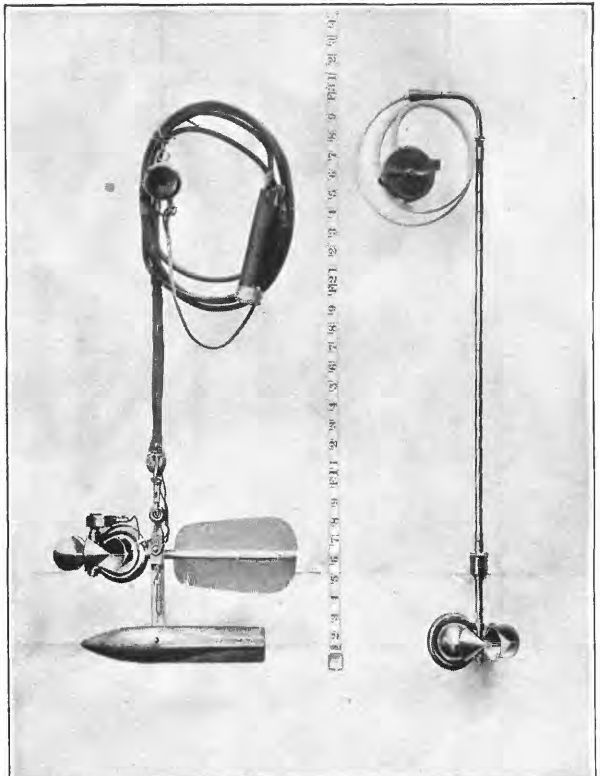
1 horsepower equals 746 watts.

1 horsepower equals 1 second-foot falling 8.80 feet.

1⅓ horsepower equal 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.

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



A. PRICE CURRENT METERS.

B. MEASURING GRAND CENTRAL RIVER.

surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

All current-meter measurements are made by the engineers of the Survey, 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 the surface velocity 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 (see Pl. I, *A*) was used exclusively in the work in Alaska. Measurements were made by wading, except on Kruzgamepa River, where a cable and car were installed for use during high stages.

In making a measurement a tape line is stretched across the stream (see Pl. I, *B*) and depth and velocity are measured at regular intervals (from 1 to 5 feet apart, 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.

Three 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 taken as the mean. In the third method the meter is held at mid depth and about 0.1 of the total depth below the surface and above the bottom, and one-fourth of the sum of the top and bottom and twice the mid depth is used as the mean. 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, or gage height, and that it will be the same whenever the stage or gage height of the stream 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.

Water to be of use for mining purposes must be available under considerable pressure, or when diversion is necessary it must be taken at an elevation high enough to allow it to be carried over the divides. The gaging stations, therefore, were so established as to obtain measurements at points whose elevations were sufficient to permit the stream to be diverted for use in mining on the ground already prospected. Such stations were established on all the important streams in the area. At some of the locations it was impossible to secure gage readers to take the daily observations of river height, and for these stations, therefore, it is possible only to give the flow at the time of the actual discharge measurements.

THE NOME REGION.

By Fred F. Henshaw.

DESCRIPTION OF AREA.

The area to which the term "Nome region" is applied is, in a general way, 15 to 20 miles wide and stretches 40 miles inland from the town of Nome, which is situated on the southern coast of Seward Peninsula. Most of the measurements recorded in this paper were made about 20 to 25 miles from the coast, at points where the altitude is sufficiently high to make the water available for mining high-level placers, but some trips were also made into the adjacent regions to the east and west.

The region embraces three types of topography, which, from south to north, are (1) a coastal plain, (2) an upland, and (3) a mountain mass.

Bordering the coast line between Cape Nome and Cape Rodney is an area of low relief, which stretches back to the foothills with a width of 2 to 5 miles. This lowland, known as the "Nome tundra," is made up in general of wet, moss-covered ground, rising with a gentle slope to an elevation between 200 and 300 feet at the southern margin of the upland.

The ridges that constitute the upland trend in a general way north and south, rising from about 700 feet near the coast to 2,000 feet 30 miles inland. These ridges are separated by the broad U-shaped valleys of the larger drainage courses. Thirty miles from the coast the ridges are united by an east-west ridge, which presents a steep escarpment toward a broad depression to the north. This depression separates the upland from the Kigluaik Mountains.

The east-west ridge is broken by broad, low gaps, a feature of great importance to the engineer who contemplates tapping the water resources of the Kigluaik Mountains. North of the depression the Kigluaik Mountains, locally known as the Sawtooth Range, rise abruptly, constituting a rugged east-west mass, sharply dissected, with serrated crest line. As these mountains have been the center of local glaciation in recent times, their valleys are characterized by cirques, which form important sources of water for the district.

Most of the area here considered drains southward to Bering Sea through Nome and Snake rivers, whose sources lie close to the ridge which forms the northern boundary of the upland. A part of the waters of the upland also flows southward to Bering Sea through Eldorado, Flambeau, Cripple, and Penny rivers. The valleys of all of these streams are of about the same type—broad and deep in the upland, with gentle slopes for 300 to 600 feet, then with steeper walls which rise to crest lines ranging from 800 to 1,500 feet in altitude. Their floors are usually covered with gravels. Some of the smaller tributaries occupy sharply incised trenches and have but a thin coating of gravel on their rock floors.

The east-west depression which separates the upland from the mountains to the north is drained in part by streams flowing westward to Sinuk River, which empties into Bering Sea, and in part by streams flowing eastward to Kruzgamepa River, which discharges into Imuruk Basin. The streams draining the southern slope of the Kigluaik Mountains are all tributary to one or the other of the two systems. Many of them head in glacial cirques and flow through steep-walled rock-bound valleys, and all have torrential courses.

The general character of all the drainage areas is the same. (See Pl. II.) The streams have little slope, except in their extreme upper portions, and spread over wide gravelly beds, in which many of them divide into several channels or disappear in the gravel. The channels are also subject to considerable shifting during floods. For 1,000 to 3,000 feet on either side of this gravelly bed extend level or gently sloping bottom lands, from which the hills rise abruptly. The drainage basins are from 4 to 12 miles wide. Most of the tributary streams are short and flow in narrow ravines having steep sides. Their slope is great, and many of them are made up of a series of rapids, waterfalls, and pools.

Practically the whole country to an elevation of 1,000 feet is covered with a thick turf, commonly known as "tundra." (See Pl. III, *A*.) In the summer this turf carries a rank growth of grass dotted with wild flowers of many varieties, and in some areas there is considerable moss. There are no trees with the exception of scattered patches of scrub willow and alder, which in the absence of better fuel can be used for firewood. Much of the ground remains frozen within 2 feet of the surface throughout the year. The soil in the lowlands is mostly gravel, overlain with muck, which contains a large percentage of water, and, when it thaws out in summer, becomes very soft. Considerable areas are underlain by clear ice. The hills are composed largely of schist and limestone rock, mantled with loose slide and gravel.

The Nome region has been an important producer of placer gold since 1899. During the first two or three years operations were confined largely to the shallower and richer creeks and to the present beach. They were carried on by the primitive methods of rocking and shoveling in, and the producing creeks themselves usually furnished an adequate sluice head.

During the last five or six seasons the operations have been of two widely different kinds, namely, underground and hydraulic mining.

TYPICAL TOPOGRAPHY, SEWARD PENINSULA.

The ancient beaches, notably the so-called third beach, have yielded the largest production during the last four years. The work is carried on underground, by shaft and drift, largely in the winter, the material being sluiced with water derived from the melting snow in the spring. Owing to the small yardage moved and the high tenor of the gravels, the problem of obtaining a water supply for sluicing is relatively unimportant. Pumping by gasoline engine is often resorted to and does not materially increase the total cost of mining. In hydraulic mining the conditions are radically different. The chief requirements are a large body of gravel carrying values and an abundant supply of water under a high head.

The stream-gaging work of the Survey in this district has been carried on for the purpose of obtaining accurate information in regard to its water resources, developed and undeveloped, and their adaptation both for placer mining and power. Most of the work in the Nome region in 1907 was done by Raymond Richards, and much credit is due him for the careful and thorough manner in which he carried it on.

The work has been confined to the comparatively small area from which water has been or can be diverted for working the rich placer deposits near Nome. The gaging stations were so located that the measurements would show the water available in this important area. The additional water supply below the points of measurement may on many streams have a local value, and all the streams in the vicinity of the gold-bearing ground of Seward Peninsula are of more or less economic importance, but it was impossible to measure them all on account of inadequate funds.

The results obtained in 1906 have been published, but are included in this report in order to bring all the records up to date.[a]

The data obtained give a fair idea of conditions of flow that may be expected from other areas in the vicinity, provided allowance is made for difference in rainfall, topography, and soil. For this purpose a summary of the flow from different areas has been prepared. (See p. 95.)

CONDITIONS AFFECTING WATER SUPPLY.

Three sources of water supply contribute to the run-off of Seward Peninsula—summer rains, melting of accumulated snow, and melting of the frozen ground.

Comparatively few data concerning the rainfall are available for years prior to 1906, when rainfall records were begun by the Geological Survey in connection with the investigations of stream flow.

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[a] Hoyt, J. C., and Henshaw, F. F., Water supply of Nome region, Seward Peninsula, 1906: Water-Supply and Irrigation Paper No. 196, U. S. Geological Survey. The edition of this paper is completely exhausted.

Records were received from three stations in 1906 and from six in 1907. The daily and monthly rainfall at these points is given on pages 136 to 138.

In the opinion of the mining operators at Nome, the season of 1907 was one of the best for water supply since the settlement of the region, whereas 1906 was about the poorest. An examination of the tables of rainfall will reveal the fact that this difference must have been due less to the greater total rainfall of 1907 than to its more even distribution through the season. A brief statement of climatic conditions for the last nine years is given on page 135.

At Salmon Lake the total rainfall from June to September was greater in 1906 than in 1907 by nearly 2 inches, but as almost half of the total fell in six days during the heavy storms of July 8 to 10 and September 19 to 21, the minimum flow was smaller and lasted longer than in 1907.

The record of snowfall for the winter of 1906-7 at Nome is the only one available. The total (88.7 inches) was abnormally high, and was perhaps double that of some other years. The snowfall in the Kigluaik Mountains is probably much larger than that on the coast.

In 1906 most of the snow in this region had melted before the 1st of June. Only the drifts in the gulches and along the north sides of the hills and the ice banks along the beds of the rivers remained after the 15th. The spring of 1907 was much later and the snowfall of the previous winter was heavier. On June 15 the ground in the mountains was still largely covered with snow, and the daily fluctuation of Nome River, due to the more rapid melting of the snow in the daytime, continued until about July 20.

With the exception of Sinuk and Nome rivers, which have their sources in the mountains a short distance apart, the streams flowing into Bering Sea rise in the foothills of the Kigluaik Range. Their drainage areas have a southern exposure and the snow on them melts early in the season. They are, therefore, dependent for their water supply mostly on the summer rains. The cirques in the Kigluaik Mountains are more protected and hold their snow later in the season, so that the flow of the streams which rise in them is much better sustained.

Some water finds its way into the streams from the melting of the frozen ground. The frozen muck and ground ice, which carry a large amount of water, are protected with a thick coating of moss, through which the heat of summer hardly penetrates, and therefore they thaw very little. The gravelly and sandy soils, which often thaw to a considerable depth, contain much less water. This source of water supply is of minor importance.

In the Nome region there is much ground which becomes thawed and takes up the rain as ground storage, especially late in the season.

A. TUNDRA BETWEEN BEACH AND FOOTHILLS.

B. MIOCENE DITCH AT GLACIER CREEK.

The coming of the frosts, however, checks the flow of the ground water.

Owing to the steep slopes, the thinness of the surface covering, and the shallow depth to which the ground thaws, the water from the rains finds its way into the streams in a very short time, and the streams rise and fall very rapidly. (See fig. 1.) During the heavy

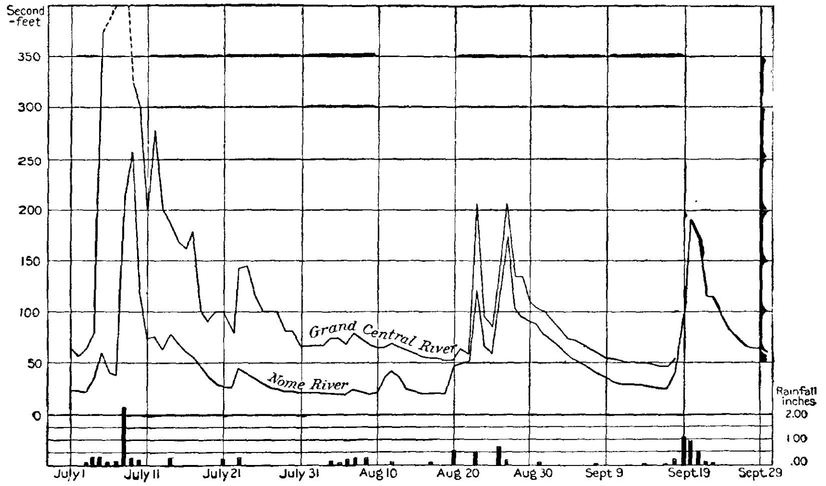


FIG. 1.—Diagram showing flow of Nome River above Miocene intake and of Grand Central River below the forks in 1906.

storm of July 8, 1906, it was noted that although all supply gates of the Miocene ditch were closed and the waste gates were open, the ditch was running full from the rain water coming in from the slopes above. Owing to this lack of ground storage, which is one of the important factors in maintaining a well-sustained stream flow in warmer climates, the streams depend in great part on the rainfall and melting snow for their supply and respond very quickly to an increase or decrease in either. If two or three weeks pass with hardly any rain, as during the last week in July and the first half of August in both 1906 and 1907, the streams will fall rapidly.

A notable feature of many drainage basins is the occurrence of limestone springs. These tend to produce a very uniform flow, and when the entire flow is from this source, as in the case of Hobson Creek, the variation in discharge is small. Other streams deriving much of their discharge from springs are Morning Call Creek and Grand Central River in the Nome region, North Fork and Budd Creek in the Kougarok region, and many creeks in the Solomon and Casadepaga regions.

GAGING STATIONS.

The following list gives the points in the Nome region at which gages were established or discharge measurements made in 1906 and 1907. The numbers refer to Pl. IV.

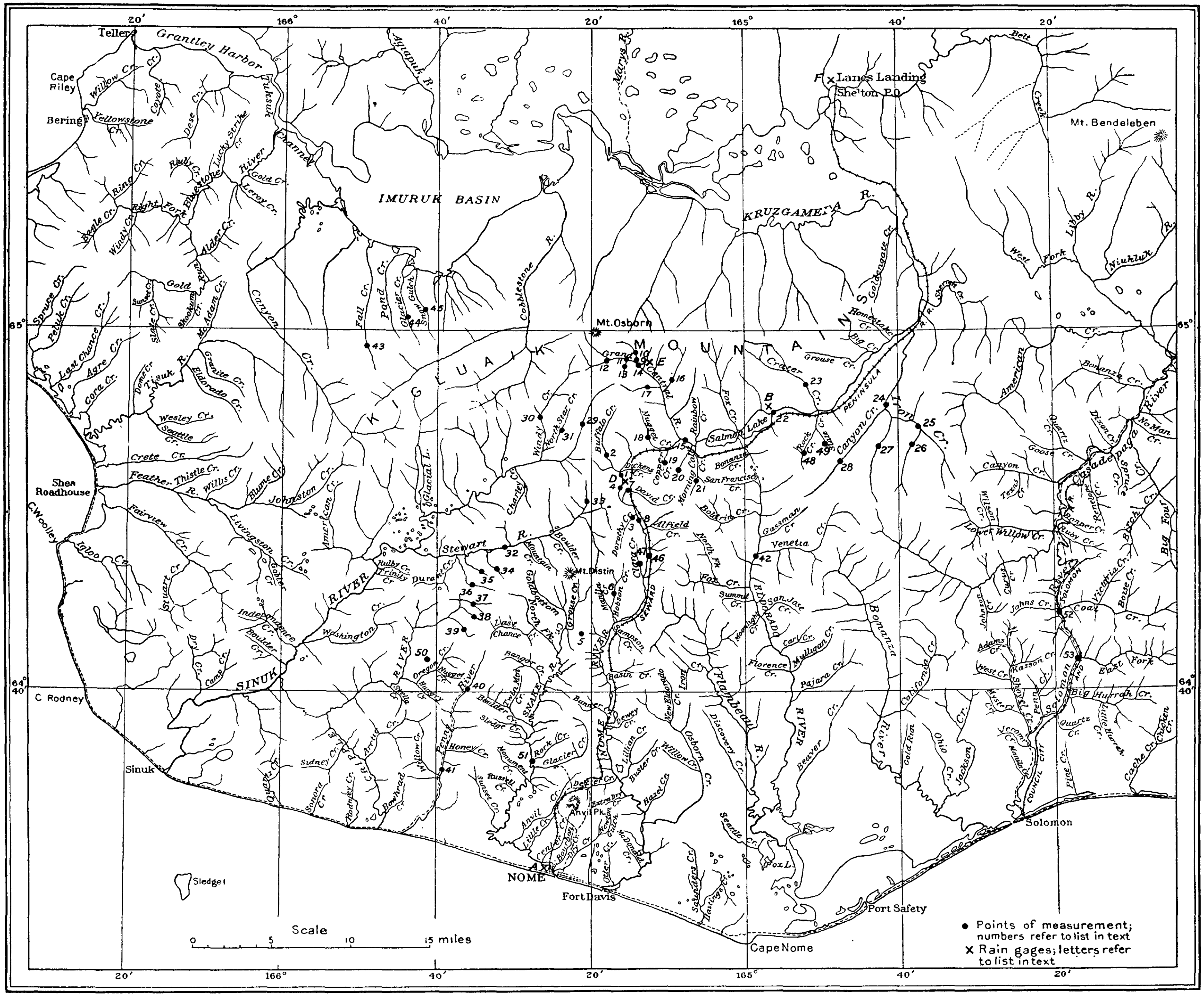
Gaging stations in Nome region.

1. Nome River above Miocene intake.
2. Buffalo Creek.
3. Dorothy Creek.
4. Miocene ditch at Black Point.
5. Miocene ditch at flume.
6. Hobson Creek at Miocene ditch crossing.
7. David Creek ditch intake.
8. Seward ditch intake.
9. North Fork of Grand Central River at elevation 750 feet.
10. North Fork of Grand Central River at elevation 1,030 feet.
11. West Fork of Grand Central River at elevation 860 feet.
12. West Fork of Grand Central River at elevation 1,010 feet.
13. Crater Lake outlet.
14. Grand Central River below forks.
15. Grand Central River below Nugget Creek.
16. Gold Run.
17. Thompson Creek.
18. Nugget Creek.
19. Copper Creek.
20. Jett Creek.
21. Morning Call Creek.
22. Kruzgamepa River at outlet of Salmon Lake.
23. Crater Creek.
24. Iron Creek below mouth of Canyon Creek.
25. Iron (Dome) Creek.
26. Eldorado Creek.
27. Discovery Creek.
28. Canyon Creek.
29. Sinuk River.
30. Windy Creek.
31. North Star Creek.
32. Stewart River.
33. Slate Creek.
34. Josie Creek.
35. Irene Creek.
36. Jessie Creek.
37. Upper Oregon Creek.
38. Slate Creek.
39. Aurora Creek.
40. Penny River at elevation 420 feet.
41. Penny River at elevation 120 feet.
42. Eldorado River.
43. Fall Creek.
44. Glacier Creek.
45. Snow Gulch.
46. Nome River at Pioneer intake and Pioneer ditch.
47. Miocene ditch at Clara Creek.
48. Rock Creek.
49. Slate Creek.
50. Cedric ditch above penstock.
51. Snake River above Glacier Creek.
52. Solomon River below Johns Creek.
53. Solomon River below East Fork.

NOME RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Nome River is formed by the junction of Buffalo and Deep Canyon creeks, which have their sources in the Kigluaik Range. It has a drainage area of 150 square miles and flows in a general southerly direction through a valley having a length of about 40 miles and a width ranging from 4 to 6 miles. The elevation at the headwaters is between 3,000 and 4,000 feet, and the altitude of the ridges that bound the valley on the east and west averages 1,000 feet. The principal tributaries are David, Sulphur, Darling, Buster, and Osborn



MAP SHOWING LOCATION OF GAGING STATIONS IN NOME REGION.

creeks from the east and Divide, Dorothy, Clara, and Hobson creeks from the west.

Nome River is the most important source of water for use in hydraulicking the rich placer deposits on the old beach lines back of Nome. Four ditches have been built to divert water for mining purposes. These systems, with the elevations of their intakes, are the Campion, 610 feet; Miocene, 572 feet; Seward, 407 feet; and Pioneer, 330 feet.

Any additional water supply that may be obtained in other high-level streams can best be brought to the mines by way of the valley of Nome River. During the seasons of 1906 and 1907 the waters of Nugget, Copper, and Jett creeks were diverted over the Nugget divide by branches of the Miocene system.

Discharge measurements made in this drainage area are given in the following pages.

NOME RIVER ABOVE MIOCENE INTAKE.

This station, elevation about 575 feet, is located between the junction of Buffalo and Deep Canyon creeks and the intake of the Miocene ditch. At low water the river at this point has a width of about 30 feet, a depth of 1½ feet, and a mean velocity of 1 foot per second. The gage was read twice daily by employees of the Miocene Ditch Company.

The flow at this station is affected by four ditches—the Campion ditch, which diverts water above the station, and the Jett Creek, David Creek, and Grand Central ditches, which bring in water above the station from areas outside the Nome River basin. In order to obtain the natural flow of the river, the mean flow of the Campion ditch has been added to the flow at the gaging station and the flow of the other three ditches subtracted.

Discharge measurements of Nome River above Miocene intake in 1906-7.

[Elevation, 575 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
June 17 [a]		39	June 22	1.25	141
June 28	0.15	28	June 30	1.09	95
July 3	.00	21	July 10	.95	120
July 5	.45	54.7	July 12	.78	74
July 14	.40	50.5	July 17	.60	43
Do	82	117	August 4	.44	37
August 3	—.01	21.4	Do	.36	37
August 23	.87	121	August 7	.25	25
Do	.70	87	August 17	.75	82
			Do	.68	72
1907.			September 4	.53	48
June 21	1.25	135	September 9	.96	124

a One-half mile above Dorothy Creek

Daily gage height and discharge of Nome River at Miocene intake, 1906-7.

[Drainage area, 15 square miles.]

Day.	1906.						1907.							
	July.		August.		September.		June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Ft.	*S.ft.*	*Ft.*	*S.ft.*	*Ft.*	*S.ft.*	*Ft.*	*S.ft.*	*Ft.*	*S.ft.*	*Ft.*	*S.ft.*	*Ft.*	*S.ft.*
1	....	23	0.02	22	0.61	78	....	....	1.19	122	0.51	38	0.57	54
2	....	23	.00	21	.57	72	....	....	1.06	88	.49	36	.50	47
3	0.00	21	-.01	21	.52	65	....	....	1.03	80	48	35	.50	47
4	.25	35	-.02	20	.46	57	....	....	.94	117	.45	33	53	50
5	.48	59	-.04	20	.42	52	....	....	.94	117	.33	32	.48	45
6	.31	40	-.04	20	40	49	....	....	1.08	168	.33	32	.46	42
7	.28	37	+ 09	25	.36	45	....	....	1.04	152	.27	27	41	38
8	1.31	214	+ 04	23	.36	39	....	....	.90	103	28	28	44	40
9	1.50	260	-.02	20	.27	37	....	....	.84	87	27	27	92	113
10	.85	119	.00	21	.21	32	....	....	.88	97	.22	24	1.68	320
11	.58	73	+.26	36	.18	30	....	....	.92	110	.22	24	1.29	204
12	.60	76	.34	43	.18	30	....	....	.78	74	.22	24	.90	109
13	.50	62	.28	37	.18	30	....	....	.80	78	.20	23	.79	88
14	.61	78	.10	25	15	28	....	....	.75	68	24	25	.77	85
15	.56	70	.04	23	.12	26	2.14	384	.65	53	.20	23	.78	86
16	.49	61	.03	22	.10	25	1.44	192	.65	53	.51	48	.66	66
17	.45	56	.02	22	.10	25	1.29	149	.64	52	.74	79	60	58
18	.38	47	.00	21	.32	41	2.12	378	.64	52	.70	72	58	56
19	.26	36	.00	21	.70	92	1.60	237	.72	63	.64	64	.58	56
20	.16	29	+.38	47	1.22	194	1.36	169	.80	78	.60	58	50	47
21	14	27	.41	50	1.12	172	1.26	141	.94	117	.52	49	51	48
22	.13	27	.42	52	.83	115	1.29	149	.70	60	.50	47	32	31
23	.36	45	.87	123	.82	114	1.28	146	.71	62	.46	42	42	39
24	.31	40	.53	66	.74	99	1.66	253	.69	59	.46	42	43	39
25	.26	36	.48	59	.65	84	1.56	225	.66	54	.42	39	.38	35
26	.18	30	80	110	.60	76	1.55	222	.64	52	62	61	.35	33
27	.12	26	1.14	176	.54	68	1.38	174	.56	43	.67	68	32	31
28	.09	25	.78	106	.52	65	1.26	141	.50	37	.60	58	31	30
29	.06	23	.72	96	.52	65	1.31	155	.48	35	62	61	.32	31
30	04	23	.70	92	.50	62	1.20	124	.52	39	.78	86	.36	34
31	02	22	.62	79	....	....	....	....	.56	43	.62	61	....	....
Mean at gaging station	....	56.2	....	49.0	....	65.6	....	202	....	77.8	....	44.1	....	66.7
Mean of Campion ditch	....	5.2	....	14.4	....	15.8	....	0	....	7 3	....	12.9	....	12.5
Total	....	61.4	....	63.4	....	81.4	....	202	....	85 1	....	57 0		79.2
David Creek ditch	....	a6	....	6	....	a7	....	....	....	5.5	....	11.8	....	9.0
Jett Creek ditch	....	a1	....	a3	....	a5	....	....	....	3 1	....	6.1	....	2 8
Grand Central ditch	....	a3	....	a4	....	a5	....	....	....	4.3	....	6.2	....	9.0
Total	....	10	....	13	....	17	....	....	....	12.9	....	24 1	....	20.8
Natural flow of Nome River	....	51.4	....	50.4	....	64.4	....	202	....	72.2	....	32.9	....	58.4
Run-off per square mile	....	3 43	....	3.36	....	4.29	....	13.5	....	4 81	....	2.19	....	3.89
Run-off, depth in inches	....	3.95	....	3.87	....	4 79	....	8.03	....	5 54	....	2.52	....	4.34

a Approximate.

NOTE.—Discharges for 1907 were computed from three rating curves, covering June 15 to July 3, July 4 to August 4, and August 5 to September 30. The channel below the gage was scraped out with horses on July 1 to 7 and August 4.

Natural daily discharge, in second-feet, of Nome River at Miocene intake, 1907.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		122	26	43	18	378	46	57	41
2		88	26	38	19	237	53	45	43
3		80	25	36	20	169	66	37	40
4		117	24	40	21	141	100	29	35
5		117	23	35	22	149	49	30	22
6		168	23	34	23	146	48	29	18
7		159	19	29	24	253	44	28	31
8		108	22	29	25	225	39	25	30
9		88	22	101	26	222	37	50	30
10		101	19	307	27	174	29	56	28
11		112	19	200	28	141	26	44	27
12		70	19	112	29	155	23	46	26
13		76	18	79	30	124	30	75	18
14		63	20	74	31		33	49	
15	384	51	16	85					
16	192	52	34	63	Mean	202	72.2	32.9	58.4
17	149	43	63	57					

NOME RIVER AT PIONEER INTAKE AND PIONEER DITCH.

These stations were established to obtain the total discharge of Nome River available for the three ditches. Both were located about one-fourth mile below the diversion dam of the Pioneer ditch.

Gage heights were obtained for only a short period in August, when readings were made by employees of the Pioneer Mining Company.

To obtain the natural flow of the river, the discharge of the Seward ditch at intake and of the Miocene ditch at Clara Creek has been added, and that of the two ditches discharging over Nugget divide subtracted. The run-off per square mile thus obtained is slightly greater than that of the river at the Miocene intake for the same period. The discharge at this station can, therefore, be conservatively estimated at the same rate per square mile as that at the upper station.

Discharge measurements of Nome River at Pioneer intake and Pioneer ditch, 1907.

[Elevation, 330 feet.]

NOME RIVER.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec. ft.*		*Feet.*	*Sec. ft.*
July 9	1.89	132	August 20	1.39	25
July 18	1.58	58	August 29	1.49	46
August 9	1.13	3			

PIONEER DITCH.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
July 18	1.22	18.7	August 20	1.41	24.3
July 24	1.35	22.2	August 29	1.44	25.6
August 9	1.19	16.8			

Daily gage-height and discharge of Nome River and diversions at Pioneer intake, August, 1907.

[Drainage area, 38 square miles.]

Day.	Nome River. Gage height.	Nome River. Discharge.	Pioneer ditch. Gage height.	Pioneer ditch. Discharge.	Seward ditch.	Miocene ditch.	Total.	Diverted over Nugget divide.	Net total.	Nome River at Miocene intake.
	Feet.	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*
21	1.40	29	1.43	25.0	29.0	34.0	117	17.5	100	29
22	1.30	16	1.40	24.0	26.9	34.0	101	15.5	86	30
23	1.30	16	1.42	24.7	27.9	34.0	103	14.2	89	29
24	1.25	12	1.42	24.7	27.9	33.0	98	16.2	82	28
25	1.25	12	1.48	26.8	29.0	34.6	103	14.9	88	25
26	1.55	52	1.48	26.8	29.0	35.2	143	14.2	129	50
27	1.60	62	1.40	24.0	27.2	35.2	148	14.9	133	56
28	1.57	55	1.38	23.4	27.2	35.2	140	15.6	124	44
29	1.52	47	1.30	20.8	27.9	35.2	131	16.9	114	46
30	1.75	95	1.39	23.7	28.6	35.2	183	14.9	168	75
31	1.55	52	1.36	22.7	28.6	35.2	139	14.9	124	49
Mean		40.7		24.2	28.1	34.6	128	15.4	112	41.9
Run-off per square mile									2.95	2.80

BUFFALO CREEK.

Buffalo Creek rises in a high U-shaped valley on the south side of the Kigluaik Mountains, and after a steep descent joins Deep Canyon Creek, forming Nome River. Measurements were made as follows:

Discharge measurements on Buffalo Creek in 1906.

[Elevation, 800 feet; drainage area, 4.4 square miles.]

	Second-feet.
June 28	18.1
July 6	23.3
August 3	9.1

DAVID CREEK.

David Creek is the first large tributary of Nome River below the junction of Buffalo and Deep Canyon creeks. Its valley has a northwestward exposure, and holds a considerable amount of snow well into the summer.

The discharge of the David Creek lateral of the Miocene ditch (see p. 33) is equal to that of the creek at the point of diversion at times of low water. This has been compared with the natural flow of Nome River for five such periods, as follows:

Comparison of flow of David Creek and Nome River at Miocene intake, 1907.

Date.	Nome River.	David Creek.	David Creek in per cent of Nome River.
	Sec. ft.	*Sec. ft.*	
July 25-31	31	14.3	46
August 1-16	22	10.4	47
August 19-25	32	13.8	43
September 3-8	34	11.9	35
September 19-30	32	11.2	35

The above table shows that the discharge of David Creek was from 47 to 35 per cent of that of Nome River. The discharge for other periods than those given has therefore been taken as 45 per cent of that of Nome River for July, 40 per cent for August, and 35 per cent for September.

Monthly discharge of David Creek at Miocene intake, 1907.

[Drainage area,4.3 square miles.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
July	76	10.9	32.2	7.49	8.64
August	30	8.9	14.2	3.30	3.80
September	107	8.3	20.7	4.81	5.37
92 days	107	8.3	22.4	5.20	17.81

DOROTHY CREEK.

Dorothy Creek, which enters Nome River from the southwest, is a short, precipitous stream. It receives water from the Campion ditch, as noted on page 35. The following discharge measurements were made above the outlet of the ditch:

Discharge measurements on Dorothy Creek in 1906.

[Elevation, 500 feet; drainage area, 2.7 square miles.]

	Second-feet.
June 16	5.1
July 29	3.0
August 18	2.9

HOBSON CREEK.

Hobson Creek is one of the most interesting and valuable streams in the Nome region. It rises south of Dorothy Creek, flows southward and discharges into Nome River about 18 miles from the seacoast. It is about 4 miles long and very steep. Its only important tributary is Manila Creek, which becomes dry at low water. Hobson Creek is notable for the large limestone springs from which it receives its water. The highest of these springs emerges just above the dam at the Miocene ditch crossing. Above them a trench has been dug across the stream to solid rock, and no flow was intercepted. Between the dam and the mouth of Manila Creek there are many springs, none of them very large, but giving an aggregate discharge nearly equal to that above the Miocene intake.

At low water the Miocene ditch obtains nearly half its water supply from Hobson Creek. Laterals have also been built to the other ditches, that to the Seward lying on the east bank and the Pioneer branch on the west bank.

The water from Hobson Creek is valuable not only on account of its remarkably uniform flow but also on account of its high temperature, which prevents the formation of slush ice during cold nights and makes it possible to run the ditches somewhat longer than they could be with Nome River water alone.

In the opinion of employees of the Miocene Ditch Company the extreme range of the discharge of the upper springs is from 8 to 32 second-feet during the summer season. During the winter they probably run somewhat lower, but always remain open.

Daily discharge, in second-feet, of Hobson Creek at Miocene intake, 1907.

[Elevation, 500 feet; drainage area, 2.6 square miles.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		25.5	20.4	17.7	20		22.6	14.3	19.5
2		24.9	18.7	17.3	21		23.0	15.4	19.7
3		23.8	19.1	17.3	22		21.1	14.7	18.3
4		22.7	19.3	17.7	23		22.3	14.3	22.3
5		22.7	19.2	17.3	24		23.5	16.8	20.6
6		21.1	18.9	16.9	25		22.7	18.3	19.5
7		19.6	19.4	16.5	26		24.2	17.3	19.3
8		25.8	17.3	17.9	27		21.8	17.3	17.7
9		24.5	18.1	16.6	28	26.7	21.4	17.3	19.0
10		22.7	18.2	18.2	29	25.8	20.2	17.7	19.3
11		23.0	16.2	20.0	30	25.0	20.9	17.7	19.7
12		24.0	16.7	26.5	31		21.2	17.7	
13		23.0	16.4	21.0					
14		23.0	16.4	21.9	Mean	25.8	22.6	17.1	19.1
15		19.7	16.3	20.3					
16		23.1	16.9	20.6	Run-off per square mile	9.92	8.69	6.58	7.35
17		21.4	14.7	20.6					
18		23.2	14.7	20.7	Run-off, depth in inches	1.11	10.02	7.59	8.20
19		22.3	14.3	20.3					

NOTE.—These discharges were obtained by subtracting those of the Miocene ditch above the dam from the flow of the ditch below the dam, and adding the amount spilled from the waste way, as estimated by C. A. McDermith. Some water was being spilled from July 16 to 26 and September 12 to 30.

Discharge measurements of Hobson Creek below Manila Creek and diversions, 1907.

[Drainage area, 5.1 square miles.

Point of measurement.	July 2.	July 9.	July 19.	Aug. 9.	Sept. 28.
	Sec. ft.	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*
Miocene intake	24.9	24.5	22.3	18.1	19.0
Seward lateral	0.0	5.2	5.2	4.3	4.5
Pioneer lateral	0.0	0.0	0.0	0.0	5.8
Hobson Creek below Manila Creek	25.0	21.0	17.7	10.7	5.0
	49.9	50.7	45.2	33.1	34.3

THE MIOCENE DITCH SYSTEM.

GENERAL DESCRIPTION.

The Miocene ditch system includes 31 miles of main ditch and 31 miles of lateral feeders and distributing ditches, 8 miles of which are under construction. (See Pl. III, *B*, and Pl. V.) This ditch diverts water from upper Glacier Creek, upper Snake River, Nome River and

ROCK CUT AROUND CAPE HORN ON MIOCENE DITCH.

its tributaries, and from the Grand Central River drainage for use on claims along lower Glacier, Dexter, and Anvil creeks.

The first section of this system was built in 1901, from upper Glacier Creek to Snow Gulch, this being the first ditch in Seward Peninsula. In 1902 an extension was made from Ex to Hobson Creek, and in 1903 the ditch was extended to the head of Nome River, these three sections constituting the main line of the system, with a length of 31 miles. The elevation of the intake is 572 feet and that of the lower end 420 feet, giving a fall of 152 feet. This fall varies at different points along the ditch, ranging from 3.17 to 7 feet per mile. There are two siphons, one at Dorothy Creek, 24 inches by 300 feet, which carries about 40 second-feet, and one at Manila Creek, 40 inches by 1,000 feet. Below Willow Creek there is a 1,100-foot flume. The main ditch has an average width of 8 feet above and 10 feet below Hobson Creek, and a capacity of 60 second-feet. The mean flow is about 40 second-feet.

The water is delivered from the end of the ditch on claims along Glacier Creek; on Anvil Creek by a tunnel 1,800 feet long and 4 by 6 feet in cross section, built in 1903 and 1904; and on Dexter Creek by a ditch from Ex around the south side of King Mountain.

The lateral feeders, in order up the ditch, are: (1) From upper Glacier Creek to Ex (this was the upper portion of the first section of the main ditch); (2) from Grouse and Cold creeks to flume; (3) from upper New Eldorado Creek to Buster Creek (it was originally intended to connect this feeder with the main ditch by a siphon across Nome River, but in 1907 it was extended to producing ground on Buster Creek); (4) the David Creek ditch, which empties into Nome River above the intake; (5) the Jett Creek ditch, which takes water from Jett and Copper creeks and carries it over the Nugget divide; (6) the Grand Central ditch, which is under construction (this ditch diverts water from Nugget Creek and will tap the headwaters of Grand Central River).

As a rule water can not be turned into ditches in this region before July 1, as there is too much frost in the ground. In 1906 the water of Hobson Creek was turned into the ditch about June 20 and that of Nome River about June 26, but before July 1 it was turned out frequently to permit repairs. The ditch was also out of use on account of a break from July 8 to 11, inclusive, after which the water ran almost continually. The Nome River water was turned out October 12, and the Hobson Creek water on the morning of the 13th. This season was somewhat longer than usual. In 1907 the Hobson Creek water was turned in on June 27 and that from Nome River on July 3, but the ditch was not run to its full capacity until July 27. All water was turned out on October 3. A break occurred just below Hobson

Creek on September 10 and all water turned out for thirty-three hours; this was practically the only interruption in the flow.

During 1906 two gaging stations were maintained on the ditch—one at Black Point, about 1 mile below the intake, to determine the amount of water diverted from Nome River, and one at the flume, which gives practically the total amount delivered at the mines.

In 1907 three additional stations were established—at Clara Creek, above Hobson Creek, and below Hobson Creek. The difference in discharge at the last two gives the flow of the creek (p. 24). The difference between the flow at any of the other stations and that at the one below it gives the loss by seepage in that portion of the ditch. The Grouse Creek lateral joins the main ditch between Hobson Creek and the flume and sometimes causes an increased discharge at the flume as compared with that at the creek station. Measurements of this lateral are given on page 35. The distances by ditch between stations are as follows: Black Point to Clara Creek, 7.1 miles; Clara Creek to Hobson Creek, 4.9 miles; Hobson Creek to the flume, 4.2 miles; the flume to the Ex, 9.5 miles. Measurements at the Ex are given on page 30. The flow of the Glacier Creek lateral about equals the seepage below the flume.

The results of measurements at the above-named stations are given in the following pages. All the gages were read by employees of the Miocene Ditch Company from two to four times a day. Gage readings taken after September 30 were unreliable, on account of the slush ice that was running, and the discharge for the last few days in September may be slightly too large, for the same reason.

Discharge measurements of Miocene ditch at Black Point, 1906-7.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec. ft.*	1907.	*Feet.*	*Sec. ft.*
July 7	0.80	31.8	July 4	0.51	21.8
July 13	.89	34.1	July 10	.57	24.0
July 21	.71	27.5	July 17	.79	29.6
July 27	.68	25.7	August 2	.96	36.4
July 29	.46	20.6	August 6	.62	25.1
August 2	.39	18.1	August 16	.91	33.5
August 11	1.20	44.7	Do	1.13	42.5
August 23	1.30	48.3			
September 11	.85	30.7			
September 25	1.10	38.2			

Daily gage height and discharge of Miocene ditch at Black Point, 1906–7.

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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	0.70	27	0.40	18.8	1.20	43.5	......	....	1.05	38.8	1.15	42.2
2	.70	27	.38	18.5	1.20	43.5	......	....	.98	36.5	1.15	42.2
3	.60	24	.35	18	1.20	43.5	0.52	22.3	.91	34.2	1.15	42.2
4	.85	31.5	.34	17.8	1.20	43.5	.50	21.7	.85	32.2	1.15	42.2
5	.95	34.8	.33	17.7	1.20	43.5	.50	21.7	.80	30.7	1.15	42.2
6	.88	32.4	.34	17.8	1.20	43.5	.45	20.4	.68	27.0	1.15	42.2
7	.85	31.5	.52	21.6	1.17	42.4	.40	19.2	.61	24.9	1.04	38.4
8	......	0	.48	20.6	1.04	37.9	.48	21.1	.64	25.8	1.08	39.8
9	......	0	.37	18.3	1.00	36.5	.48	21.1	.61	24.9	1.10	40.5
10	......	0	.40	18.8	.98	35.8	.50	21.7	.52	22.3	.80	30.7
11	.50	21	.81	30.3	.82	30.6	.50	21.7	.52	22.3	.48	21.1
12	1.00	36.5	.82	30.6	.80	30	.50	21.7	.52	22.3	.98	36.5
13	1.00	36.5	.96	35.1	.80	30	.50	21.7	.50	21.7	1.15	42.2
14	1.00	36.5	.60	24	.76	28.8	.50	21.7	.55	23.1	1.08	39.8
15	1.20	43.5	.50	21	.72	27.6	.80	30.7	.45	20.4	1.00	37.1
16	1.10	40	.50	21	.66	25.8	.80	30.7	.90	33.8	1.00	37.1
17	1.10	40	.45	19.9	.64	25.2	.80	30.7	1.15	42.2	1.00	37.1
18	1.10	40	.39	18.6	.78	29.4	.80	30.7	1.15	42.2	1.00	37.1
19	.92	33.7	.46	20.1	.80	30	.80	30.7	1.15	42.2	1.08	39.8
20	.70	27	.86	31.8	.58	23.4	.80	30.7	1.16	42.6	1.15	42.2
21	.70	27	1.12	40.7	.69	26.7	.80	30.7	1.16	42.6	1.08	39.8
22	.62	24.6	1.03	37.6	.92	33.7	.80	30.7	1.16	42.6	1.15	42.2
23	.85	31.5	1.17	42.4	1.00	36.5	.80	30.7	1.10	40.5	1.15	42.2
24	.95	34.8	1.19	43.2	.96	35.1	.80	30.7	1.08	39.8	1.06	39.1
25	.92	33.7	1.20	43.5	1.05	38.2	.85	32.2	1.02	37.7	1.00	37.1
26	.75	28.5	1.17	42.4	1.06	38.6	.86	32.6	1.15	42.2	1.04	38.4
27	.62	24.6	1.16	42.1	1.22	44.2	1.00	37.1	1.16	42.6	.98	36.5
28	.54	22.2	1.20	43.5	1.20	43.5	.94	35.1	1.16	42.6	.94	35.1
29	.50	21	1.20	43.5	1.20	43.5	.94	35.1	1.16	42.6	1.02	37.7
30	.45	19.9	1.20	43.5	1.20	43.5	.96	35.8	1.15	42.2	1.12	41.2
31	.42	19.2	1.20	43.5	......	....	1.10	40.5	1.15	42.2	......	....
Mean	......	27.4	......	29.2	......	35.9	......	28.0	......	34.4	......	38.7

Discharge measurements of Miocene ditch at Clara Creek, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 9	0.50	18.2	August 20	0.91	35.2
July 18	.79	27.7	August 29	.92	34.7
August 9	.60	21.1	September 27	.88	34.0

Daily gage height and discharge of Miocene ditch at Clara Creek, 1907.

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	......	......	0.89	33.5	0.92	35.2
2	......	......	.85	31.5	.92	35.2
3	......	a 18.0	.84	31.0	.92	35.2
4	......	a 19.0	.80	29.0	.92	35.2
5	......	a 19.0	.78	28.1	.92	35.2
6	......	a 19.0	.66	23.1	.91	34.6
7	0.52	18.8	.60	21.0	.89	33.5
8	.55	19.6	.58	20.4	.88	33.0
9	.50	18.2	.55	19.6	.92	35.2
10	.54	19.3	.52	18.8	.69	24.2
11	.56	19.9	.50	18.2	.70	24.5
12	.46	17.2	.50	18.2	.88	33.0
13	.50	18.2	.48	17.7	.95	37.0
14	.51	18.5	.52	18.8	.95	37.0
15	.71	25.0	.48	17.7	.94	36.4
16	.82	30.0	.72	25.4	.91	34.6
17	.75	26.8	.92	35.2	.91	34.6
18	0.82	30.0	0.91	34.6	0.91	34.6
19	.79	28.6	.90	34.0	.92	35.2
20	.79	28.6	.91	34.6	.85	31.5
21	.81	29.5	.90	34.0	.95	37.0
22	.82	30.0	.90	34.0	.88	33.0
23	.80	29.0	.90	34.0	.88	33.0
24	.80	29.0	.88	33.0	.92	35.2
25	.80	29.0	.91	34.6	.90	34.0
26	.82	30.0	.92	35.2	.92	35.2
27	.88	33.0	.92	35.2	.88	33.0
28	.88	33.0	.92	35.2	.84	31.0
29	.83	30.5	.92	35.2	.88	33.0
30	.89	33.5	.92	35.2	.88	33.0
31	.92	35.2	.92	35.2	......	......
Mean	......	25.4	......	28.7	......	33.7

a Estimated from Black Point records.

Discharge measurements of Miocene ditch above Hobson Creek, 1907.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 9	0.88	17.6
July 19	1.25	25.7
August 9	.98	18.8
August 29	1.38	35.4
September 27	1.36	31.7
September 28	1.30	31.8

Daily gage height and discharge of Miocene ditch above Hobson Creek, 1907.

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	......	......	1.37	33.1	1.38	33.5
2	......	......	1.31	31.0	1.38	33.5
3	0.80	14.7	1.30	30.6	1.38	33.5
4	.90	17.3	1.20	27.0	1.38	33.5
5	.90	17.3	1.18	26.3	1.38	33.5
6	.90	17.3	1.04	21.5	1.38	33.5
7	.93	18.1	.97	19.3	1.35	32.4
8	.77	13.9	.95	18.7	1.31	31.0
9	.89	17.0	.99	19.9	1.39	33.8
10	.90	17.3	.90	17.3	1.42	34.9
11	.89	17.0	.88	16.8	......	0
12	.85	16.0	.86	16.3	1.34	32.0
13	.89	17.0	.84	15.7	1.40	34.2
14	.89	17.0	.92	17.9	1.40	34.2
15	1.22	27.7	.80	14.7	1.37	33.1
16	1.17	25.9	1.02	20.8	1.36	32.8
17	1.21	27.4	1.39	33.8	1.36	32.8
18	1.20	27.0	1.38	33.5	1.37	33.1
19	1.20	27.0	1.38	33.5	1.38	33.5
20	1.16	25.6	1.38	33.5	1.35	32.4
21	1.21	27.4	1.38	33.5	1.39	33.8
22	1.21	27.4	1.38	33.5	1.39	33.8
23	1.23	28.1	1.37	33.1	1.29	30.2
24	1.24	28.4	1.29	30.2	1.39	33.8
25	1.22	27.7	1.30	30.6	1.39	33.8
26	1.22	27.7	1.38	33.5	1.39	33.8
27	1.33	31.7	1.38	33.5	1.35	32.4
28	1.33	31.7	1.38	33.5	1.27	29.5
29	1.28	29.9	1.38	33.5	1.30	30.0
30	1.27	29.5	1.38	33.5	1.35	32.4
31	1.38	33.5	1.38	33.5	......	......
Mean	......	23.6	......	27.4	......	31.8

Discharge measurements of Miocene ditch below Hobson Creek, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 2	1.60	24.8	July 24	2.38	49.4
July 9	2.08	39.1	September 27	2.38	52.0
July 19	2.30	46.8			

Daily gage height and discharge of Miocene ditch below Hobson Creek. 1907.

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			1.63	25.5	2.46	53.5	2.40	51.2
2			1.60	24.9	2.36	49.7	2.39	50.8
3			1.74	28.3	2.36	49.7	2.39	50.8
4			2.10	40.0	2.27	46.3	2.40	51.2
5			2.10	40.0	2.25	45.5	2.39	50.8
6			2.05	38.4	2.11	40.4	2.38	50.4
7			2.03	37.7	2.06	38.7	2.34	48.9
8			2.09	39.7	1.98	36.0	2.34	48.9
9			2.14	41.5	2.04	38.0	2.38	50.4
10			2.10	40.0	1.95	35.5	2.45	53.1
11			2 10	40.0	1.89	33.0		0
12			2.10	40.0	1.89	33.0	2.33	48.5
13			2.10	40.0	1.86	32.1	2.40	51.2
14			2.10	40.0	1.93	34.3	2.37	50.1
15			2.30	47.4	1.83	31.0	2.30	47.4
16			2.29	47.0	2.03	37.7	2.30	47.4
17			2.31	47.8	2.33	48.5	2.30	47.4
18			2.32	48.2	2.32	48.2	2.31	47.8
19			2.31	47.8	2.31	47.8	2.31	47.8
20			2.30	47.4	2.31	47.8	2.34	48.9
21			2.30	47.4	2.34	48.9	2.33	48.5
22			2.33	48.5	2.32	48.2	2.32	48.2
23			2.38	50.4	2.30	47.4	2.33	48.5
24			2.38	50.4	2.29	47.0	2.38	50.4
25			2.34	48.9	2.34	48.9	2.35	49.3
26			2.38	50.4	2.39	50.8	2.37	50.1
27			2.46	53.5	2.39	50.8	2.37	50.1
28	1.68	26.7	2.45	53.1	2.39	50.8	2.33	48.5
29	1.64	25.8	2.37	50.1	2.40	51.2	2.35	49.3
30	1.60	25.0	2.38	50.4	2.40	51.2	2.37	50.1
31			2.49	54.7	2.40	51.2		
Mean		25.8		43.8		45.3		47.9

Discharge measurements of Miocene ditch at flume, 1906–7.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
July 4	0.95	29.8	July 2	1.58	36
July 27	1.08	36.5	July 3	1.51	32
August 2	.81	28.3	July 19	1.99	50
September 11	1.50	43.9	July 23	2.09	55
September 25	1.85	58.2	August 10	1.63	33
September 26	1.65	48.5	August 29	2.05	51
			September 28	2.02	50

Daily gage height and discharge of Miocene ditch at flume, 1906-7.

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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	0.98	31.6	0.82	27.2	1.71	51.5	1.56	33.5	2.05	52.0	2.02	50.8
2	.95	30.8	.81	27	1.71	51.5	1.56	33.5	2.00	50.0	2.00	50.0
3	.92	29.9	.84	27.8	1.70	51.2	1.56	33.5	1.92	46.8	2.00	50.0
4	1.00	32.1	.89	29.1	1.70	51.2	1.74	39.6	1.86	44.4	2.00	50.0
5	1.08	34.3	.90	29.4	1.70	51.2	1.75	40.0	1.82	42.8	2.00	50.0
6	1.09	34.5	.91	29.7	1.69	50.9	1.75	40.0	1.78	41.2	2.00	50.0
7	1.12	35.3	.93	30.2	1.66	50.1	1.70	38.0	1.70	38.0	1.99	49.6
8	(*a*)	0	.98	31.6	1.68	50.6	1.77	40.8	1.68	37.3	1.98	49.2
9	(*a*)	0	.90	29.4	1.63	49.2	1.80	42.0	1.69	37.7	2.04	51.6
10	(*a*)	0	.88	28.9	1.54	46.7	1.86	44.4	1.63	35.6	2.10	54.0
11	.79	26.4	1.01	32.4	1.49	45.3	1.77	41.0	1.58	34.0	(*a*)	0
12	1.10	34.8	1.13	35.6	1.46	44.5	1.80	42.0	1.56	33.5	1.98	49.2
13	1.26	39.1	1.23	38.3	1.45	44.2	1.85	44.0	1.54	32.9	2.02	50.8
14	1.29	39.9	1.02	32.6	1.41	43.2	1.85	44.0	1.58	34.0	2.12	54.8
15	1.28	39.7	.94	30.5	1.40	42.9	1.92	46.8	1.50	31.8	2.10	54.0
16	1.39	42.6	.92	29.9	1.34	41.3	1.80	42.0	1.71	38.4	2.10	54.0
17	1.35	41.6	.91	29.7	1.31	40.5	1.95	48.0	1.96	48.4	2.10	54.0
18	1.35	41.6	.87	28.6	1.47	44.8	1.95	48.0	1.95	48.0	2.11	54.4
19	1.28	39.7	.86	28.3	1.48	45.1	1.95	48.0	1.92	46.8	2.12	54.8
20	1.19	37.2	1.10	34.8	1.52	46.2	1.95	48.0	1.94	47.6	2.10	54.0
21	1.16	36.4	1.29	39.9	1.58	47.8	2.00	50.0	1.95	48.0	2.13	55.2
22	1.11	35.1	1.28	39.7	1.65	49.8	2.00	50.0	1.93	47.2	2.08	53.2
23	1.19	37.2	1.32	40.7	1.61	48.7	2.02	50.8	1.92	46.8	2.04	51.6
24	1.09	34.5	1.40	42.9	1.60	48.4	1.99	49.6	1.92	46.8	2.09	53.6
25	1.26	39.1	1.44	44	1.71	51.5	2.01	50.4	1.95	48.0	2.09	53.6
26	1.17	36.7	1.55	47	1.63	49.2	2.05	52.0	2.00	50.0	2.08	53.2
27	1.07	34	1.34	41.3	1.75	52.6	2.08	53.2	2.04	51.6	2.08	53.2
28	.98	31.6	1.46	44.5	1.76	52.9	2.06	52.4	2.01	50.4	2.03	51.2
29	.95	30.8	1.51	45.9	1.79	53.7	2.04	51.6	2.04	51.6	2.03	51.2
30	.91	29.7	1.56	47.3	1.80	54	2.00	50.0	2.06	52.4	2.04	51.6
31	.88	28.9	1.50	45.6	......	....	2.03	51.2	2.03	51.2	......	....
Mean	......	*b* 31.8	......	35.2	......	48.4	......	45.1	......	44.0	......	50.4

a Ditch broken by heavy rains. *b* For 28 days, 35.2 second-feet.

NOTE.—About 28 second-feet turned in June 28, 1907.

Discharge measurements of Miocene ditch below the Ex, 1907.

Date.	Glacier branch.	Dexter branch.	Total.
	Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*
June 26	8.8	0.	8.8
July 6	27.6	16.0	43.6
July 19	31.5	14.0	45.5
September 4	34.3	13.0	47.3

JETT CREEK DITCH.

The Jett Creek ditch was constructed during 1906 to divert water from Jett and Copper creeks over the Nugget divide. In 1906 the water was turned in from Copper Creek July 20 and from Jett Creek August 18, and was turned out September 25. The ditch carries the total flow of these creeks above the intake up to a maximum of about 10 second-feet. In 1907 a gage was established below Copper Creek and read by A. D. Jett.

Discharge measurements on Jett Creek ditch at outlet, 1906–7.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
1906.			1906.		
July 21		2.4	September 14		3.9
August 11		.8	1907.		
August 29		4.6	July 31	1.59	8.1
August 31		7.3	Do	1.38	5.3
September 2		9.2	Do	1.21	3.6
September 7		7.2	Do	.75	0.0
September 10		5.3			

Daily gage height and discharge of Jett Creek ditch, 1907.

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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			1.59	8.1	1.50	6.9	18	1.18	3.2	1.60	8.2		
2			1.50	6.9	1.50	6.9	19	1.19	3.3	1.60	8.2		
3			1.45	6.2	1.50	6.9	20	1.30	4.4	1.55	7.6		
4			1.40	5.6	1.45	6.2	21	1.42	5.9	1.50	6.9		
5			1.35	5.0	1.45	6.2	22	1.22	3.6	1.45	6.2		
6			1.33	4.8	1.45	6.2	23	1.32	4.6	1.45	6.2		
7			1.33	4.8	1.45	6.2	24	1.38	5.4	1.50	6.9		
8			1.33	4.8	1.50	6.9	25	1.40	5.6	1.50	6.9		
9			1.25	3.9	1.60	8.2	26	1.45	6.2	1.45	6.2		
10			1.25	3.9		0	27	1.45	6.2	1.50	6.9		
11			1.25	3.9		0	28	1.42	5.9	1.55	7.6		
12	1.15	3.0	1.25	3.9	1.60	8.2	29	1.45	6.2	1.55	7.6		
13	1.35	5.0	1.30	4.4	1.60	8.2	30	1.50	6.9	1.50	6.9		
14	1.32	4.6	1.30	4.4	1.60	8.2	31	1.59	8.1	1.50	6.9		
15	1.15	3.0	1.30	4.4									
16	1.20	3.4	1.55	7.6			Mean		4.9		6.1		6.1
17	1.15	3.0	1.50	6.9									

GRAND CENTRAL DITCH.

The completed portion of the Grand Central ditch diverted water from Nugget Creek at an elevation of 785 feet from June 27 to September 29, 1906, and from July 9 to October 2, 1907. In 1907 a gage was installed just below Nugget Creek and read by A. D. Jett. The entire flow of the creek was diverted except on September 11 and 12 and possibly a few other days of high water. For measurements during 1906 see page 50.

Discharge measurements of Grand Central ditch, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 9	1.39	5.4	July 9	1.18	1.27
Do	1.28	3.7	Do	1 47	6.6

Daily gage height and discharge of Grand Central ditch, 1907.

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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	......	......	1.34	4.4	1.50	8.0	18	1.40	5.6	1.55	9.3	1.70	13.4
2	......	......	1.34	4.4	1.50	8.0	19	1.46	7.0	1.55	9.3	1.60	10.6
3	......	......	1.32	4.0	1.45	6.8	20	1.48	7.5	1.60	10.6	1.60	10.6
4	......	......	1.32	4.0	1.45	6.8	21	1.65	12.0	1.60	10.6	1.60	10.6
5	......	......	1.32	4.0	1.45	6.8	22	1.47	7.3	1.55	9.3	1.55	9.3
6	......	......	1.30	3.6	1.45	6.8	23	1.48	7.5	1.50	8.0	1.55	9.3
7	......	......	1.30	3.6	1.45	6.8	24	1.46	7.0	1.55	9.3	1.55	9.3
8	......	......	1.28	3.3	1.50	8.0	25	1.40	5.6	1.50	8.0	1.50	8.0
9	1.45	6.8	1.28	3.3	1.60	10.6	26	1.38	5.2	1.50	8.0	1.50	8.0
10	1.34	4.4	1.25	2.8	1.70	13.4	27	1.36	4.8	1.50	8.0	......	8.0
11	1.34	4.4	1.25	2.8	......	0	28	1.33	4.2	1.50	8.0	......	8.0
12	1.38	5.2	1.28	3.3	......	0	29	1.32	4.0	1.55	9.3	......	8.0
13	1.38	5.2	1.27	3.1	1.70	13.4	30	1.32	4.0	1.50	8.0	......	8.0
14	1.45	6.8	1.30	3.6	1.70	13.4	31	1.34	4.4	1.50	8.0	......	......
15	1.35	4.6	1.30	3.6	1.70	13.4							
16	1.35	4.6	1.50	8.0	1.70	13.4	Mean	......	5.7	......	6.2	......	9.0
17	1.31	3.8	1.50	8.0	1.70	13.4							

DAVID CREEK DITCH.

David Creek enters Nome River from the east a short distance below the intake of the Miocene ditch. It has a well-sustained flow which is diverted at an elevation of about 590 feet by a ditch that discharges into Nome River just above the Miocene intake. In 1906 the water was running in this ditch before gagings were made on Nome River. Except during extreme high water, it carried the entire flow of David Creek up to its capacity of about 14 second-feet. When the ditch was cleaned out in 1907 it was enlarged from 4 feet to 5 feet on the bottom, increasing its capacity to nearly 20 second-feet. The gage was read by employees of the Miocene Ditch Company during August, 1906, and July to September, 1907.

Discharge measurements of David Creek ditch, 1906–7.

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
1906.			1906.		
July 3	....	3.5	August 29	0.81	13.7
July 29	....	6.4	Do	.68	11.4
August 3	....	4.4			
August 23	0.51	7.9	1907.		
August 29	.41	5.4	July 17	.50	8.9
Do	.49	7.6	July 25	.79	13.0
Do	.63	10.1	Do	.83	13.7
Do	.78	13.7	August 4	.69	11.5

Daily gage height and discharge of David Creek ditch, 1906-7.

[Drainage area at point of diversion, 4.3 square miles.]

Day.	1906.		1907.					
	August.		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.*
1					0.75	12.4	0.70	11.6
2					.70	11.6	.65	10.9
3					.80	13.2	.80	13.2
4	0.35	4.4			.69	11.5	.80	13.2
5	.35	4.4			.67	11.2	.72	11.9
6	.35	4.4			.62	10.5	.70	11.6
7	.42	5.8			.60	10.2	.68	11.3
8	.38	5.0			.56	9.6	.60	10.2
9	.37	4.8			.56	9.6	.60	10.2
10	.37	4.8			.52	9.1	.50	8.9
11	.38	5.0			.52	9.1	.55	9.5
12	.40	5.4			.52	9.1		0
13	.38	5.0			.52	9.1		0
14	.35	4.4			.50	8.9		0
15	.34	4.3			.50	8.9		0
16	.33	4.1			.80	13.2		0
17	.39	5.2	0.50	8.9	.82	13.5		0
18	.31	3.7	.52	9.1	.80	13.2	.90	14.9
19	.29	3.3	.50	8.9	.90	14.9	.99	16.5
20	.40	5.4	.60	10.2	.90	14.9	.85	14.0
21	.38	5.0	.60	10.2	.95	15.8	.85	14.0
22	.50	7.5	.60	10.2	.95	15.8	.73	12.1
23	.52	7.9	.80	13.2	.72	11.9	.68	11.3
24	.48	7.1	.80	13.2	.70	11.6		10.6
25	.54	8.3	.80	13.2	.72	11.9	.58	9.9
26	.77	13.2	.80	13.2	.72	11.9	.57	9.8
27	.34	4.3	.70	11.6	.75	12.4	.54	9.4
28	.40	5.4	.65	10.9	.75	12.4	.50	8.9
29	.41	5.6	.75	12.4	.75	12.4	.50	8.9
30	.78	13.4	.75	12.4	.75	12.4	.45	8.3
31	.80	13.8	.75	12.4	.75	12.4		
Mean		6.1		11.3		11.8		9.0

NOTE.—These discharges are believed to represent the total flow of the creek from August 3 to 20, 1906, and from about July 23 to September 8, and September 19 to 30, 1907.

SEEPAGE MEASUREMENTS ON MIOCENE DITCH.

Measurements were made at different times at several points along the main ditch and also on the Jett Creek branch to determine the loss by seepage from the different sections of the ditch. The discharge of the branches and principal feeders was found by measuring the flow in the ditch above and below them. The figures obtained for the section between points of measurement were therefore the resultant of the gain from creeks too small to measure and the loss by seepage and leakage. The measurements of July 3 to 4 and July 27 were made at periods of extreme low water, and show a much larger loss than those of September 11 to 12, when there was much more water entering. On the latter date the ditch was gaining along much of its course. These measurements are of value to ditch builders in showing the losses which may be expected in ditches in frozen countries.

Seepage measurements of Miocene ditch, 1906.

MAIN DITCH FROM NOME RIVER TO GLACIER CREEK.

Date.	Point of measurement.	Discharge.	Gain.	Loss.
		Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*
July 3	Nome River intake	21		
Do	Above Hobson	15.8		5.2
July 4	do	20.5		
Do	Below Hobson	31.0	10.5	
Do	Above flume	28.1		2.9
Do	Below flume	29.8	1.7	
Do	Above Ex	27.9		1.9
Do	Above tunnel	28.8	.9	
July 27	Nome River intake	28		
Do	Black Point	25.7		2.3
Do	Above Dorothy	26.2	.5	
Do	Below Dorothy	26.0		.2
Do	Above Hobson	23.7		2.3
Do	Below Hobson	38.0	14.3	
Do	Grouse Creek branch	1.7		
	Total above flume	39.7		
Do	Below flume	36.5		3.2
August 2	do	28.3		
Do	Glacier branch	13.0		
Do	Dexter branch	13.3		
	Total	26.3		2.0
September 11	Nome River at intake	29.8		
Do	Black Point	30.7	.9	
Do	Above Dorothy	30.3		.4
Do	Above Hobson	30		.3
Do	Below Hobson	44.4	14.4	
Do	Grouse Creek branch	2.4		
	Total above flume	46.8		
Do	Below flume	43.9		2.9
September 12	do	[a] 43		
Do	Glacier Fork at Ex	30.3		
Do	Dexter Fork at Ex	15.3		
	Total at Ex	45.6	2.6	
September 13	Glacier Fork at Ex	[a] 29.6		
Do	Above tunnel	29.4		.2
July 29	Intake, David Creek branch	6.9		
Do	Outlet, David Creek branch	6.4		.5

JETT CREEK BRANCH.

September 10	Copper Creek ditch, intake	2.5		
Do	Copper Creek ditch, outlet into Jett Creek ditch	1.8		0.7
Do	Jett Creek ditch, intake	4.2		
	Total	6.0		
Do	Jett Creek ditch, below junction with Copper Creek ditch	5.7		.3
Do	Outlet over Nugget divide	5.3		.4

[a] Estimated.

MISCELLANEOUS MEASUREMENTS.

The following measurements were made at the points stated during the two years:

Miscellaneous measurements of Miocene ditch, 1906-7.

Date.	Point of measurement.	Discharge.
1906.		*Sec.-ft.*
August 23	Above Dorothy Creek siphon	39.5
September 25	....do	41.4
1907.		
July 2	Grouse Creek branch	11.7
July 20	Above Snow Gulch	31.9
July 31	Copper Creek branch	3.5
August 20	Above Dorothy Creek siphon	40.9
September 28	Grouse Creek branch	5.8

CAMPION DITCH AT BLACK POINT.

The Campion ditch diverts water from Buffalo Creek at an elevation of 610 feet. Its lower end terminates in Dorothy Creek, into which it discharges. The ditch has a width of 6 feet on the bottom and 9 feet on top, is 2 feet deep, and has a mean velocity of 2 feet per second when running full. The water was turned in at 1 p. m., July 6, 1906. The ditch broke near its outlet at 7 a. m., July 8. It was repaired and water turned in again on the 19th. All water was turned out from 9.30 p. m. August 12 to 2.30 p. m. August 13.

It ran continuously from July 7 to September 29, 1907, except September 23, when the water was turned out on account of slush ice.

Measurements were taken on the ditch in order to determine the natural flow of Nome River below the junction of Buffalo and Deep Canyon creeks.

Discharge measurements of Campion ditch at Black Point, 1906-7.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
July 7	0.80	11.9	July 10	0.88	9.9
July 20	.60	8.9	July 12	.35	2.7
July 21	.70	10.2	July 17	.79	8.2
August 2	.67	9.7	August 4	1.04	13.9
August 11	1.36	27.5			
August 18	76	12.0			
August 23	1.10	19.6			
August 31	1.00	16.8			

Daily gage height and discharge of Campion ditch, 1906-7.

[Drainage area at point of diversion, 8.2 square miles.]

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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	......	......	0.69	10.1	0.98	16.5	......	......	1.00	12.8	1.10	15.7
2	......	......	.68	10.0	.90	14.5	......	......	1.00	12.8	1.12	16.3
3	......	......	.65	9.5	1.02	17.5	......	......	1.00	12.8	1.12	16.3
4	......	......	.62	9.0	1.04	18.0	......	......	.99	12.5	1.10	15.7
5	......	......	.56	8.2	1.00	17.0	......	......	.95	11.5	1.06	14.5
6	......	......	.61	8.9	1.02	17.5	......	......	.90	10.3	1.11	16.0
7	0.88	14.1	.69	10.1	.96	16.0	0.71	6.8	.92	10.8	1.08	15.1
8	......	......	.70	10.3	.96	16.0	.58	5.1	.96	11.8	1.06	14.5
9	......	......	.73	10.9	1.00	17.0	.80	8.3	.98	12.3	1.16	17.4
10	......	......	.77	11.7	1.08	19.0	.81	8.5	.90	10.3	.82	8.7
11	......	......	1.13	20.4	1.07	18.8	.66	6.0	.90	10.3	.65	5.9
12	......	......	1.05	18.2	1.02	17.5	.52	4.4	.94	11.3	.93	11.0
13	......	......	1.09	19.2	1.06	18.5	.77	7.8	.94	11.3	1.00	12.8
14	......	......	1.02	17.5	1.02	17.5	.69	6.5	.98	12.3	.91	10.5
15	......	......	.92	15.0	.98	16.5	.66	6.0	.89	10.1	.97	12.0
16	......	......	.80	12.3	.93	15.2	.73	7.1	1.08	15.1	.92	10.8
17	......	......	.80	12.3	.92	15.0	.70	6.7	.99	12.5	.97	12.0
18	......	......	.78	11.9	.90	14.5	.95	11.5	1.09	15.4	1.01	13.1
19	......	......	.75	11.3	1.10	19.5	.84	9.1	1.01	13.1	1.06	14.5
20	......	......	.80	12.3	.98	16.5	.90	10.3	.98	12.3	1.18	18.0
21	......	......	.76	11.5	.50	7.5	.94	11.3	1.03	13.6	.98	12.3
22	......	......	1.01	17.2	.60	8.7	.88	9.9	1.04	13.9	.99	12.5
23	......	......	1.16	21.3	.75	11.3	.93	11.0	1.02	13.4	......	0
24	......	......	.99	16.8	.72	10.7	.89	10.1	1.02	13.4	.98	12.2
25	.92	15.0	.93	15.2	.91	14.8	.88	9.9	1.00	12.8	.99	12.5
26	.78	11.9	1.15	21.0	.96	16.0	.89	10.1	1.09	15.4	1.06	14.5
27	.75	11.3	1.16	21.3	1.02	17.5	.83	8.9	1.08	15.1	1.04	13.9
28	.82	12.7	1.14	20.7	.98	16.5	.86	9.5	1.06	14.5	1.03	13.6
29	.78	11.9	1.09	19.2	.95	15.8	.91	10.5	1.05	14.2	.98	12.2
30	.76	11.5	1.00	17.0	.94	15.5	1.05	14.2	1.12	16.3	......	0
31	.72	10.7	.99	16.8	......	......	1.07	14.8	1.08	15.1	......	......
Mean	......	12.4	......	14.4	......	15.8	......	9.0	......	12.9	......	12.5

SEWARD DITCH.

The Seward ditch was built in 1905-6 to take water from Nome River just below Dorothy Creek, at an elevation of 407 feet, and convey it to Saturday Creek for use along the ancient beach line. Its total length is 38 miles. The water is conducted across Hobson and Clara creeks by 42-inch continuous stave-pipe siphons having lengths of 1,050 and 800 feet. A part of the flow of Hobson Creek is diverted by a branch ditch.[a] In 1907 a gage was established near the intake and read by the ditch walker.

Measurements to determine the flow and also the seepage of this ditch were made as follows:

Seepage measurements of Seward ditch, 1906.

Date.	Point of measurement.	Discharge.	Gain.	Loss.
		Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*
July 29	Intake	19.7	......	......
Do.	Above Clara Creek	20.6	0.9	......
Do.	Hobson branch	4.0	......	......
		24.6		
Do.	Above Trout Creek	22.0	......	2.6

[a] For measurements of the Hobson Creek branch, see page 24.

Other measurements were made at the intake as follows:

Discharge measurements of Seward ditch at intake, 1906–7.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
August 18		25	July 11	0.55	19.1
August 30		26	July 18	.72	23.2
September 13		[a] 32	July 24	.82	25.7

[a] Computed from gage reading.

Daily gage height and discharge of Seward ditch at intake, 1907.

Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.	Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.85	27.2	0.90	29.0	18	0.70	22.5	0.85	27.2	0.85	27.2
2			.85	27 2	89	28.6	19	.75	23.8	.84	26.9	.82	26.2
3			.85	27.2	.89	28.6	20	.75	23.8	.84	26.9	.82	26.2
4			.80	25.4	.89	28.6	21	.75	23.8	.90	29.0	.78	24.8
5			.74	23.6	.88	28.3	22	.75	23.8	.84	26.9	.78	24.8
6			.72	23.0	.88	28.3	23	.75	23.8	.87	27.9	.80	25.4
7			71	22.8	.89	28.6	24	.75	23.8	.87	27.9	.80	25.4
8			.72	23.0	.88	28.3	25	.80	25.4	.90	29.0	.80	25.4
9			.74	23.6	.85	27.2	26	.82	26.2	.90	29.0	.80	25.4
10			.72	23.0	.81	25.8	27	.82	26.2	.85	27.2	.80	25.4
11	0.60	20.1	.72	23.0		0	28	.88	28.3	.85	27.2	.75	23.8
12	.62	20.5	.71	22.8	.82	26.2	29	.82	26.2	.87	27.9	.74	23.6
13	.65	21.3	.78	24.8	.85	27.2	30	.85	27 2	.89	28.6	.75	23.8
14	.65	21.3	.77	24.5	.84	26.9	31	85	27.2	.89	28.6		
15	.70	22.5	.71	22.8	84	26.9							
16	.70	22.5	.88	28.3	.84	26.9	Mean		23.9		26.2		25.7
17	.70	22.5	.88	28.3	.85	27.2							

PIONEER DITCH.

The Pioneer ditch, begun in 1905 and completed in 1907, has its intake on Nome River just below the mouth of Christian Creek, about 3 miles below the Seward intake and at an elevation of about 330 feet. It has a total length of 38 miles and extends to Anvil Creek. There are three siphons, composed of two lines of 30-inch riveted steel pipes—one 545 feet long across Hobson Creek, one 1,050 feet long across Banner Creek, and one 755 feet long across Dexter Creek. Several narrow gulches and gullies eroded by waste water from the other ditches are crossed by flumes.

Daily gage heights and discharges of the Pioneer ditch at the intake and of Nome River are given on page 22.

GRAND CENTRAL RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

On account of its elevation and well-sustained flow, Grand Central River offers one of the most valuable unused water supplies of Seward Peninsula. The drainage area of this stream, which is about 12 miles long and 2 miles wide, is almost surrounded by ridges of the Sawtooth Range (Kigluaik Mountains), having elevations of 1,500 to 4,000 feet. (See Pl. VI, *A* and *B*.)

The river is formed near the foot of Mount Osborn, at an elevation of about 700 feet, by the junction of North and West forks, and flows in a southerly direction into Salmon Lake. From the forks to Salmon Lake the river has a fall of about 300 feet, and at high stages spreads over a wide gravelly bed. On either side there is a little bottom land, from which the mountains rise abruptly.

The principal tributaries of Grand Central River below the forks are Gold Run and Rainbow Creek from the east, and Thompson, Thumit, Nugget, Jett, and Morning Call creeks from the west. These tributary streams, with the exception of Nugget Creek, drain short, steep-sided gulches. They have considerable fall and are fed from melting snow.

In order to make the water from this drainage basin available for use at Nome it has to be diverted over the Nugget divide, which has an elevation of 785 feet. One such diversion has been made from Jett Creek and Copper Creek, from which water is taken by the Jett Creek ditch into the Miocene ditch.

The Miocene Ditch Company is building a ditch which will tap West Fork above the mouth of the Crater Lake outlet and North Fork at an elevation of about 850 feet. This ditch will extend down the west side of the valley, crossing and tapping Thompson and Thumit creeks, and will pass over the Nugget divide, where it will be taken up by the main Miocene ditch and carried to Glacier and Anvil creeks.

The Wild Goose Mining and Trading Company has started from Crater Lake a 42-inch continuous wood-pipe line, which will extend along the south side of the valley over the Nugget divide and down Nome Valley to Anvil Mountain. The company plans to dam and use Crater Lake as a storage resorvoir, into which the waters from North and West forks will be diverted by lateral pipes. Other laterals will carry the water of Gold Run and Thompson Creek into the main pipe line. Measurements made in this drainage are shown on the following pages.

NORTH FORK OF GRAND CENTRAL RIVER.

North Fork of Grand Central River rises in a cirque at the base of Mount Osborn, which is surrounded by almost perpendicular moun-

A. UPPER GRAND CENTRAL RIVER DRAINAGE.

B. MOUNT OSBORN, JULY, 1906.

tains rising from 1,000 to 3,000 feet above the bed of the stream. This cirque contains a small glacier, the melting of which maintains a very steady flow. The flow is increased by a large spring at an elevation of about 860 feet.

Discharge measurements on this stream in 1906 were made at elevations of about 750 feet and 1,030 feet, points which give the flow at the ditch and pipe intakes, respectively. The bed is very rough and it is difficult to obtain satisfactory measuring sections. Gage heights were read at the time of the measurements by measuring down from reference points on rocks.

In 1907 a gaging station was established about 100 yards above the junction of the forks to take the place of the one at the ditch intake. The increase in flow between the stations is small. The gage was read by Cornelius Edmunds.

Daily gage height and discharge of North Fork of Grand Central River near ditch intake, 1906.

[Elevation, 750 feet; drainage area, 5.4 square miles.]

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1		23		30		44
2		(23)		30	0.92	[b] 44
3		(23)		30		38
4		(25)		32		38
5				32		40
6				29		37
7			0.81	[b] 32		33
8				33		31
9				31	.76	[b] 27
10				33		28
11	1.10	[a] 67		32		27
12				27		(26)
13				27		26
14				28		27
15				28		26
16			.76	[a] 27		25
17			.74	[b] 25		25
18				27		27
19				25		
20		40		27		
21		(45)		(32)		
22	.85	[a] 38		(36)	1.5	[b] [c] 120
23		42		(60)		
24		61	.85	[b] 37		
25	.95	[a] 47		40		
26	.90	[b] 42		(40)		
27		45		(67)		
28		50		67		
29		38		71		
30		42		54		
31		28		48		
Mean		[d] 39.9		36.7		[e] 31.6
Run-off per square mile		7.39		6.80		5.85
Run-off depth in inches		4.67		7.84		3.92

[a] Measurements.
[b] Estimates based on gage readings.
[c] Not included in mean.
[d] 17 days.
[e] 18 days.

NOTE.—These values were obtained by subtracting the sum of the discharges at the West Fork and Crater Lake station from the flow below the forks. For the days for which this method does not give consistent results the discharges are based on the West Fork flow and are in parentheses. From July 5 to 19 the flow did not fall below 40 second-feet. The flow on June 26 was 43 second-feet.

Discharge measurements of North Fork of Grand Central River at the forks, 1907.

[Elevation 690 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 8	1.31	65	August 13	1.07	28
July 16	1.19	41	August 26	1 36	70
July 25	1.23	47	September 6	1.18	36
July 26	1.20	45	September 16	1.44	56
August 5	1.11	34			

Daily gage height and discharge of North Fork of Grand Central River at the forks, 1907.

[Drainage area, 6.9 square miles.]

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.16	37	1.32	64
2			1.20	42	1.22	45
3			1.15	36	1.14	35
4			1.15	36	1.22	45
5			1.12	33	1.25	50
6			1.10	31	1.16	37
7			1.10	31	1.10	31
8	1.31	62	1.10	31	1.07	29
9		46	1.10	31	1.50	102
10	1.25	50	1.08	29	2.15	238
11		70	1.10	31	2.10	194
12		60	1.10	31	1.68	106
13		65	1.08	29	1.52	72
14		50	1.11	32	1.50	68
15		41	1.05	27	1.49	66
16	1.19	41	1.34	68	1.44	57
17		38	1.40	81	1.40	49
18		42	1.35	70	1.37	45
19		50	1.28	56	1.32	39
20		60	1.34	68	1.30	36
21		80	1.44	89	1.29	35
22		51	1.44	89	1.10	21
23		50	1.41	83	1.18	25
24		46	1.32	64		
25	1.22	45	1.30	60		
26	1.20	42	1.37	75		
27	1.19	41	1.38	77		
28	1.14	35	1.31	62		
29	1.11	32	1.74	152		
30	1.14	35	1.66	136		
31	1.16	37	1.42	85		
Mean		48.7		58.1		64.7
Run-off per square mile		7.06		8.42		9.38
Run-off, depth in inches		6.30		9.71		8.02

NOTE.—Channel conditions were changed during the high water of September 10, and a new rating table was used after that date. Discharges for days between July 8 and 25, when the gage was not read were obtained by the aid of a hydrograph.

Daily discharge in second-feet of North Fork of Grand Central River at pipe intake, 1906-7.

[Elevation, 1,030 feet; drainage area, 2.3 square miles.]

Day.	1906.			1907.		
	July.	Aug.	Sept.	July.	Aug.	Sept.
1	21	22	31		30	46
2	21	22	a 31		34	32
3	21	22	27		29	25
4	22	24	27		29	32
5		24	28		a 27	36
6		21	26		25	27
7		a 23	23		25	22
8		25	22	a 42	25	21
9		23	a 19	37	25	74
10		25	20	40	23	171
11		24	19	56	23	140
12		20	17	48	23	76
13		20	18	52	22	52
14		21	19	40	24	49

a Measurements. Other discharges are obtained by taking about the same percentage of the flow at the lower station, as was found on the dates of measurements. This varied from 70 to 90 per cent. Gagings on June 20, 1906, gave 30 second-feet, and on June 26, 1906, 43 second-feet. The flow from July 5 to 19, 1906, probably exceeded 35 second-feet.

Daily discharge in second-feet of North Fork of Grand Central River at pipe intake, 1906-7—Continued.

Day.	1906. July.	1906. Aug.	1906. Sept.	1907. July.	1907. Aug.	1907. Sept.
15	....	21	18	33	20	47
16	....	20	18	33	51	*a* 41
17	....	*a* 19	17	30	61	35
18	....	20	19	34	52	32
19	....	19	....	40	42	28
20	31	20	....	48	51	26
21	35	24	....	64	67	25
22	30	27	....	41	67	15
23	33	45	....	40	62	18
24	48	*a* 28	....	37	48	....
25	37	30	....	37	*a* 43	....
26	*a* 33	30	....	*a* 38	54	....
27	34	50	....	33	55	....
28	38	50	....	28	44	....
29	28	53	....	26	110	....
30	32	40	....	28	98	....
31	21	36	....	30	61	....
Mean	30.3	27.4	22.2	39.0	43.5	46.5
Run-off per square mile	13.2	11.9	9.65	16.9	18.9	20.2
Run-off, depth in inches	7.86	13.7	6.46	15.1	21.8	17.3

a Measurements. Other discharges are obtained by taking about the same percentage of the flow at the lower station, as was found on the dates of measurements. This varied from 70 to 90 per cent. Gagings on June 20, 1906, gave 30 second-feet, and on June 26, 1906, 43 second-feet. The flow from July 5 to 19, 1906, probably exceeded 35 second-feet.

A limestone spring at an elevation of 850 feet discharges into North Fork near the proposed ditch intake, and is the largest of a considerable number of springs in the upper Grand Central Valley. The following measurements of the flow of this spring were made in 1907: July 10, 3.8 second-feet; September 5, 7.4 second-feet.

WEST FORK OF GRAND CENTRAL RIVER.

West Fork of Grand Central River has its source in Mount Osborn, and flows between Mount Osborn and the high ridges which separate the Grand Central drainage from the Sinuk drainage. It is fed from snow storage for a greater part of the season, by limestone springs, and by Crater Lake, which lies at an elevation of 973 feet and has an area of about 106 acres.

There is considerable glacial drift in the lower part of the basin containing several depressions, one having an area of nearly 5 acres. These depressions fill with water during a rain and gradually drain off through the gravel.

Two gaging stations were established on the fork in 1906 at elevations of 1,010 and 860 feet. The lower station is just above the outlet to Crater Lake and shows the flow at the proposed ditch intake. The other station was established to obtain the flow at the proposed pipe intake by comparison with the flow at the lower station. The flow was about 70 per cent of that at the lower station during the earlier part of the season of 1906. As the snow above the pipe intake melted away and the flow of the springs between the intakes increased, this percentage became about 35 for low water and 50 for higher stages. The cold weather in September checked the flow at high levels and reduced the percentage to 32. During 1907 the percentages were almost the same as for the corresponding dates of 1906. In 1907 an additional station was established just above the forks, where the flow from Crater Lake is included.

Discharge measurements of West Fork of Grand Central River at the forks, 1907.

[Elevation, 690 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 10	1.88	107	August 13	1.61	46
July 16	1.77	80	August 26	1.71	61
July 26	1.74	77	September 5	1.62	44
August 5	1.65	50	September 17	1.70	61

NOTE.—These measurements were made by subtracting the flow of North Fork from that of the river below the forks, taking both from the rating curves of the two stations, all three gages being read at the same time.

Daily gage height and discharge of West Fork of Grand Central River at the forks, 1907.

[Drainage area, 7.7 square miles.]

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.72	66	1.82	93
2			1.71	64	1.78	82
3			1.70	61	1.63	47
4			1.70	61	1.72	66
5			1.65	50	1.68	57
6			1.60	42	1.68	57
7			1.60	42	1.76	77
8	1.93	129	1.62	45	1.84	99
9		95	1.64	48	2.07	179
10	1.88	112	1.62	45	2.70	406
11		125	1.62	45	2.37	287
12		90	1.65	50	2.12	197
13		95	1.62	45	1.82	93
14		88	1.65	50	1.80	87
15		80	1.62	45	1.80	87
16	1.77	79	1.88	112	1.74	71
17		70	2.00	154	1.70	61
18		75	1.92	125	1.67	54
19		85	1.88	112	1.62	45
20		100	1.78	82	1.61	44
21		140	1.82	93	1.59	41
22		90	1.78	82	1.54	34
23		80	1.72	66	1.61	44
24		76	1.65	50		
25	1.75	74	1.64	48		
26	1.75	74	1.63	47		
27	1.70	61	1.64	48		
28	1.65	50	1.65	50		
29	1.60	42	2.32	276		
30	1.68	57	2.38	291		
31	1.70	61	1.88	115		
Mean		84.5		81.0		100
Run-off, per square mile		11.0		10.5		13.0
Run-off, depth in inches		9.82		12.1		11.1

Discharge measurements of West Fork of Grand Central River at ditch intake, 1906-7.

[Elevation, 860 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
June 19		40.4	July 8	1.30	69
June 26		38	July 16	1.18	51
July 1		28.6	July 26	1.13	44
July 10	1.65	115	August 6	1.01	32
July 11	1.53	86	August 25	1.18	35
July 22	1.20	38.1	September 5	1.18	39
July 24	1.41	58	September 16	1.37	48
July 25	1.34	50			
August 6	1.12	30.9			
August 16	1.01	23			

Daily gage height and discharge of West Fork of Grand Central River at ditch intake, 1906-7.

[Elevation, 860 feet; drainage area, 5.4 square miles.]

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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	......	29	1.12	30	1.27	44	......	......	......	45	1.20	41
2	1.10	28	......	30	1.24	40	......	......	......	44	1.25	47
3	1.00	22	......	30	1.20	36	......	......	......	43	1.10	31
4	1.10	28	......	34	1.12	30	......	......	......	43	1.15	36
5	1.80	162	......	34	1.08	27	......	......	1.08	39	1.15	36
6	......	......	1.12	30	1.05	25	......	......	1.06	37	1.15	36
7	......	......	1.15	32	1.05	25	......	......	1.08	39	1.12	33
8	......	......	1.11	29	1.02	23	1.30	69	1.15	47	1.10	31
9	......	......	......	26	1.01	23	......	65	1.15	47	1.35	61
10	1.65	116	1.02	23	1.00	22	1.51	107	1.09	40	1.85	149
11	1.53	86	1.05	25	1.00	22	......	110	1.10	41	1.75	109
12	1.75	144	1.10	28	1.00	22	......	65	1.10	41	1.60	84
13	1.60	103	1.08	27	.98	21	......	68	1.12	43	1.45	59
14	1.55	90	1.05	25	.95	20	......	60	1.12	43	1.40	52
15	1.45	70	......	24	.92	19	......	54	1.07	38	1.40	52
16	1.40	61	1.01	23	.92	19	1.18	51	1.49	103	1.37	48
17	1.45	70	1.00	22	.92	19	......	45	1.48	77	1.32	42
18	1.40	61	1.00	22	1.00	22	......	50	1.38	60	1.30	40
19	1.30	47	1.00	22	......	......	......	60	1.25	43	1.28	38
20	1.30	47	.98	21	......	......	......	70	1.35	56	1.28	38
21	1.35	54	1.12	30	......	......	......	100	1.40	63	1.27	37
22	1.20	36	1.20	36	1.60	a103	......	65	1.35	56	1.22	32
23	1.52	83	1.39	60	......	......	......	58	1.25	43	......	35
24	1.41	63	1.21	37	......	......	......	54	1.20	37	......	......
25	1.33	51	1.16	33	......	......	1.20	54	1.18	35	......	......
26	1.25	42	1.22	38	......	......	1.13	45	1.19	36	......	......
27	1.25	42	1.35	54	......	......	......	42	1.20	37	......	......
28	......	39	1.30	47	......	......	......	34	1.18	35	......	......
29	1.20	36	1.30	47	......	......	......	28	1.50	98	......	......
30	1.15	32	1.27	44	......	......	1.10	41	1,48	82	......	......
31	1.14	31	......	44	......	......	......	45	1.38	66	......	......
Mean	......	62.0	......	32.5	......	25.5	......	60.0	......	50.2	......	50.7
Run-off per square mile		11.5	......	6.02	......	4.72	......	11.1	......	9.30	......	9.39
Run-off. depth in inches		11.5	......	6.94	......	3.16	......	9.90	......	10.7	......	8.03

a Not included in mean.

NOTE.—Discharges for 1907 have been computed from four rating tables on account of the shifting channel conditions, and are somewhat uncertain. Discharges for days between July 8 and August 5, when the gage was not read, were obtained by the aid of a hydrograph.

Daily gage height and discharge of West Fork of Grand Central River at pipe intake, 1906-7.

[Elevation, 1,010 feet; drainage area, 2.8 square miles.]

Day.	1906 (discharge).			1907.					
	July.	August.	September.	July.		August.		September.	
				Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	a 19	12	22				14		13
2	18	12	19				14		15
3	15	12	16				14		15
4	18	14	12				14		11
5		14	9				12	.88	b 11.5
6		a 12	9			0.86	a 11.3		11
7		12	8				12		12
8		10	8		31		15		13
9		9	a 7.3		29		15		20
10		8	7	1.27	a 47		13		74
11	a 45	9	7		48		13		54
12	72	11	7		29		13		40
13	52	10	7		30	.91	b 13.7		28
14	45	9	6		26		14		25
15	32	8	6		24		12		25
16	27	8	6		22		52	1.02	b 23
17	32	a 7.6	6		20		35		17
18	27	8	7		22		19		13
19	20	8			26		14		12
20	20	7			31		18		12
21	23	12			44		20		12
22	a 15	16			29		18		10
23	44	30			26		14		11
24	32	a 18.5			24		12		
25	a 25	15			24	.90	a 12		
26	19	19		a .98	a 19.3		12		
27	19	27			18		12		
28	16	24			15		11		
29	14	24			12		39		
30	13	22			18		33		
31	12	22			20		26		
Mean	27.0	13.9	9.4		26.4		17.6		20.5
Run-off per square mile	9.64	4.96	3.36		9.43		6.29		7.32
Run-off, depth in inches	8.96	5.72	2.25		8.42		7.25		6.26

a Measurements.
b Estimates based on gage readings. Other discharges are obtained by taking about the same percentage of the flow at elevation 860 feet as was found on the dates of measurements. Gagings on June 19, 1906, gave 28 second-feet, and on June 26, 26 second-feet.

CRATER LAKE OUTLET.

Crater Lake discharges into West Fork of Grand Central River just below the ditch intake on that stream. The lake, which lies in a depression of glacial origin, has an elevation of 973 feet and an area of 106 acres. Its basin adjoins those of Sinuk River and Thompson Creek.

A gaging station was located on the outlet about midway between the lake and West Fork. The stream bed is composed of large angular rocks and has a fall of nearly 300 feet to the mile. It is hard to make measurements on account of the swiftness of the current, and the highest one of 1906 is only approximate. Gage heights were taken by employees of the Wild Goose Mining and Trading Company.

Discharge measurements of Crater Lake outlet, 1906–7.

[Elevation, 925 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
June 19		14.2	July 8	1.32	36.5
June 26		23.7	July 16	1.18	21.1
July 1		13.6	July 26	1.13	16.7
July 10	1.55	59.0	July 30	1.04	13.7
July 22	.96	12.0	August 6	1.00	10.0
July 24	1.10	21.5	August 13	.99	10.6
August 6	.90	7.1	August 25	.95	8.0
August 8	.98	13.0	September 5	.93	7.5
August 16	.80	5.6			
September 9	.73	4.3			

Daily gage height and discharge of Crater Lake outlet, 1906–7.

[Drainage area, 1.8 square miles.]

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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		14	0.85	7	0.98	13				20	1.03	11.8
2	1.00	14		7	.94	10				20	1.10	16.0
3	1.00	14		8	.90	9				17	1.08	14.7
4	1.15	25		8	.82	6				17	1.15	19.7
5	1.65	69		9	.78	5			1.04	12.3	.93	7.4
6			.90	9	.78	5			1.03	11.8	.90	6.4
7			.95	11	.78	5			95	8.0	.85	5.2
8			.96	12	.75	4.5	1.32	36	1.03	11.8	.83	4.8
9				10	.73	4.3		28	1.02	11.2	.80	4.2
10	1.55	59	.90	9	.71	4.1	1.27	31	1.02	11.2	1.05	12.8
11	1.25	33	.90	9	.69	3.9		36	1.03	11.8	1.90	106
12	1.45	50	1.00	14	.68	3.8		26	1.02	11.2	1.75	88
13	1.30	37	.95	11	.65	3.5		30	1.04	12.3	1.40	46
14	1.15	25	.90	9	.65	3.5		26	1.04	12.3	1.40	46
15	1.10	21		7	.61	3.1		22	1.01	10.7	1.35	40
16	1.15	25	.80	5.5	.61	3.1	1.18	22	1.41	47	1.00	10.2
17	1.10	21	.80	5.5	.61	3.1		20	1.40	46	.97	8.9
18	1.05	17	.79	5.5	.75	4.5		22	1.30	34	.95	8.0
19	1.00	14	.80	5.5				26	1.20	24	.94	7.7
20	1.00	14	.78	5				30	1.35	40	.92	7.0
21	1.05	17	1.01	15				40	1.40	46	.82	4.6
22	.96	12	1.01	15	1.40	*a* 46		30	1.35	40	.75	3.5
23	1.06	18	1.22	31				24	1.30	34	.75	3.5
24	1.10	21	1.02	15				22	1.35	40		
25	1.05	17	1.00	14			1.17	21	.95	80		
26	1.02	15	1.10	21			1.13	18.2	1.36	41		
27	1.00	14	1.12	23				18	1.37	42		
28		12	1.10	21				15	1.35	40		
29	.90	9	1.05	17				12	1.45	52		
30	.88	8	1.00	14			1.04	12.3	1.35	40		
31	.88	8		13				17	1.30	34		
Mean		22.3		11.8		5.2		24.4		26.0		21.0
Run-off per square mile		12.4		6.56		2.89		13.6		14.4		11.7
Run-off, depth in inches		12.4		7.56		1.93		12.1		16.6		10.0

a Not included in mean.

GRAND CENTRAL RIVER BELOW THE FORKS.

This station was established to obtain the total flow that can be diverted over the Nugget divide from the headwaters of Grand Central River. But little water enters the stream between this station and the proposed ditch intakes. Gage readings were taken during 1906 by employees of the Wild Goose Mining and Trading Company. Gage readings were discontinued in 1907, but measurements were made and the discharge of West Fork obtained by subtracting that of North Fork from the total below the junction. The two stations above the forks replaced the one below the forks in 1907.

Discharge measurements of Grand Central River below the forks, 1906-7.

[Elevation, 680 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-feet.*	1907.	*Feet.*	*Sec.-feet.*
July 1	0.95	63	July 10	1.33	145
July 11	1.40	180	July 16	1.20	121
July 24	1.29	140	July 26	1.19	119
Do	1.22	129	August 5	1.02	85
July 26	1.10	101	August 13	.97	72
August 7	.89	66	September 5	1.06	89
August 17	.79	54.4			

Daily gage height and discharge of Grand Central River below the forks, 1906.

[Drainage area, 14.6 square miles.]

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
1	0.95	63	0.90	67	1.10	100
2	.90	56	.90	67	1.05	91
3	.95	63	.90	67	1.00	82
4	1.05	80	.95	74	.95	74
5	1.87	370		74	.93	72
6			.90	67		67
7			.98	79		63
8			.94	73		59
9	1.75	325	.90	67	.80	55
10	1.70	300		65		54
11	1.45	198		66	.78	53
12		280		68	.75	50
13	1.45	198		65	.75	50
14	1.42	187		62	.75	50
15		168		59	.72	48
16		160	.81	56	.71	47
17	1.40	180	.79	54		47
18	1.10	100		54		54
19	1.05	91		53		
20	1.10	100	.78	53		
21	1.10	100		65		
22	1.00	82		59	1.72	a310
23	1.28	143		210		
24	1.29	145	1.08	96		
25	1.18	118	1.02	86		
26	1.10	100		140		
27		100		210		
28	1.10	100	1.25	135		
29	1.00	82	1.25	135		
30	1.00	82	1.15	111		
31	.90	67	1.12	104		
Mean		b144		85.2		c 62.0
Run-off per square mile		9.86		5.84		4.25
Run-off, depth in inches		10.27		6.73		2.84

a Not included in mean. b 28 days. c 18 days.

NOTE.—The interpolated discharges of Aug. 21-23 and 26-27 are 40 to 45 per cent of the flow at the station below Nugget Creek. This is about the proportion that holds for higher water. Other interpolations are made by comparison with the West Fork and Crater Lake outlet stations.

GRAND CENTRAL RIVER BELOW NUGGET CREEK.

This station was established June 30, 1906, but it was not possible to obtain regular gage readings until August 12, after which the gage was read once each day by A. W. Peterson. At low water the river at this point is about 50 feet wide and 1 to 2 feet deep, and has a mean velocity of about 2 feet per second. It is impossible to obtain measurements above gage height 1.2 feet by wading. The estimates at this station give practically the total flow of Grand Central River into Salmon Lake.

Discharge measurements of Grand Central River below Nugget Creek, 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
June 24	....	313	August 28	1.10	324
June 30	0.57	148	September 9	.46	121
July 7	.98	286	September 14	.36	101
August 4	.46	123			

Mean daily gage height and discharge of Grand Central River below Nugget Creek, 1906.

[Drainage area, 39 square miles.]

Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
1	0.5	132			0.8	220
2	.45	120			.75	204
3					.65	172
4					.6	157
5					.6	157
6					.55	144
7					.5	132
8					.5	132
9					.45	120
10	1.9	750			.42	114
11					.4	109
12	1.55	545	0.5	132	.4	109
13			.5	132	.38	105
14			.5	132	.35	100
15			.4	109	.35	100
16			.42	114	.3	90
17			.45	120	.3	90
18			.4	109	.4	109
19			.35	100	1.2	375
20			.5	132	2.6	1,230
21	.6	157	.55	144	2.2	950
22			.5	132	1.6	570
23			1.5	520	1.6	570
24			.8	220	1.35	445
25			.7	187	1.15	352
26	.5	132	1.05	310		
27			1.5	520		
28			1.1	330		
29			.95	272		
30			.9	255		
31			.8	220		
Mean				a 210		b 274
Run-off per square mile				5.38		7.03
Run-off, depth in inches				4.00		6.54

a 20 days. b 25 days.

GOLD RUN.

Gold Run enters Grand Central River from the east, about 2 miles below the forks. It drains a high cirque which lies between North Fork and Fox Creek, has a rapid fall, and terminates in a large gravel fan. A glacial lake near the head of its valley affords possibilities of storage to regulate the flow. On account of the large flow and the concentration of a considerable fall in a short distance, Gold Run has greater advantages for a high-head power development than any other stream on the south side of the Kigluaik Mountains.

In order to determine the quantity of water from this stream available for diversion across the Nugget divide, a station was established at an elevation of about 800 feet.

Daily gage height and discharge of Gold Run, 1906-7.

[Elevation, 800 feet.]

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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	......	14	......	18	......	30	......	......	......	24	......	22
2	......	[a] 13	......	18	0.95	[b] 26	......	......	......	24	......	25
3	......	13	......	18	......	23	......	......	......	22	......	25
4	......	20	......	20	......	20	......	......	......	22	......	30
5	......	......	......	24	......	17	......	......	1.24	[b] 22	1.22	[b] 20
6	......	......	......	30	......	16	......	......	......	19	......	16
7	......	......	1.03	[b] 34	......	15	......	......	......	16	......	14
8	......	......	.90	[b] 22	......	14	1.57	[a] 72	......	18	......	13
9	......	......	.89	[b] 21	......	13	......	60	......	18	......	13
10	......	......	......	20	.71	[a] 12	......	80	......	15	......	25
11	......	52	......	20	......	12	......	86	......	15	......	120
12	1.21	[a] 69	......	24	......	12	......	65	......	15	......	90
13	......	55	......	22	......	11	......	70	......	15	......	70
14	......	45	......	20	......	11	......	60	1.16	[a] 16	......	60
15	......	40	......	18	......	11	......	48	......	13	......	50
16	......	38	.81	[b] 17	......	10	1.40	[b] 42	......	50	1.38	[a] 26
17	......	42	.80	[b] 16.5	......	10	......	38	......	55	......	24
18	......	24	......	16	......	12	......	42	......	48	......	22
19	......	20	......	16	......	......	......	48	......	40	......	20
20	......	22	......	15	......	......	......	54	......	60	......	18
21	......	23	......	28	......	......	......	70	......	75	......	14
22	.84	[a] 18.5	......	34	......	......	......	45	......	75	......	11
23	1.00	[b] 30	......	50	......	......	......	40	......	70	......	10
24	......	30	......	34	......	......	......	35	......	60	......	......
25	1.00	[a] 30	.99	[b] 29	......	......	......	32	......	56	......	......
26	.93	[b] 24	......	44	......	......	......	32	1.58	[b] 74	......	......
27	......	24	......	68	......	......	......	24	......	76	......	......
28	......	21	1.13	[a] 51	......	......	......	20	......	60	......	......
29	......	20	......	40	......	......	1.20	[b] 18	......	90	......	......
30	......	19	......	36	......	......	1.25	[a] 23	......	70	......	......
31	......	18	......	32	......	......	......	24	......	40	......	......
Mean	......	29.0	......	27.6	......	15.3	......	47.0	......	41.1	......	32.1

[a] Measurements.

[b] Estimates based on gage heights. Other discharges were obtained by plotting a hydrograph passing through the known points and following the rise and fall of the other streams in the vicinity. Gagings made on June 20, 1906, gave 22 second-feet and on June 25, 24 second-feet.

THOMPSON CREEK.

Thompson Creek enters Grand Central River from the west about 2 miles below the forks. It drains a small glacial cirque almost wholly surrounded by very steep walls ranging from 1,000 to 2,000 feet in height. Measurements were made at a point with an elevation of 720 feet, which gives the amount of water available for diversion over the Nugget divide.

Daily gage height and discharge of Thompson Creek, 1906–7.

[Elevation, 720 feet; drainage area, 2.5 square miles.]

Day.	1906.						1907.					
	July.		August.		September.		July.		August.		September.	
	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		11		9		19				30		16
2		[a] 11		9		14				27		17
3		11		10		12				23		16
4		16		10		8				20		22
5				11		7				15		12
6				15		7			1.24	[b] 13	1.14	[a] 9.6
7			1.39	[b] 22.5		7				9		8
8			1.22	[b] 14		6	1.55	[a] 49		13		7
9			1.19	[a] 12.5	1.00	[b] 6.2		45		13		7
10				11	1.00	[a] 6.2	1.69	[b] 82		13		15
11		36		11		6		87		13		100
12		[a] 52		17		6		60		13		80
13		40		14		6		50	1.24	[b] 13		50
14		30		12		5		40	1.34	[a] 20		50
15		24		11		5		34		15		42
16		28	1.11	[b] 9.6		5	1.45	[b] 32		50		14
17		23	1.12	[b] 10		5		30		50	1.25	12.6
18		19		10		6		34		39		11
19		16		10				40		29		10
20		16		9				46		40		9
21		18		20				55		46		6
22	1.20	[b] 13		20				44		40		5
23		21		40				35		34	.99	[b] 5
24	1.42	[a] 25	1.40	[b] 23				30		40		
25	1.41	[a] 23		21			1.42	[b] 28	1.15	[b] 9		
26	1.29	[b] 17.5		28			1.47	[b] 35	1.47	[b] 35		
27		16		30				34		35		
28		14		28				31		35		
29		11	1.44	[b] 25.4				27		40		
30		11		22			1.44	[a] 32		34		
31		10		20				34		30		
Mean		20.5		16.6		7.6		42.2		27.0		22.8
Run-off per square mile		8.20		6.64		3.04		16.9		10.8		9.12
Run-off, depth in inches		7.62		7.66		2.10		15.1		12.4		7.80

[a] Measurements.
[b] Estimates based on gage heights. Other discharges were obtained by plotting a hydrograph passing through the known points and following the rise and fall of Crater Lake outlet, whose basin adjoins that of Thompson Creek and is of a similar character. A measurement on June 25 gave 42 second-feet.

NUGGET AND COPPER CREEKS.

Nugget Creek rises in the divide between Nome River and Grand Central River and empties its waters and those of its tributary, Copper Creek, into Grand Central River about 2 miles above Salmon Lake.

The headwaters of both Nugget and Copper creeks are precipitous and are fed by springs in limestone. Measurements were made on Nugget Creek at an elevation of 785 feet, at the point where its waters are diverted over the Nugget divide by the Grand Central branch of the Miocene ditch.

During 1907 the discharge of the creek was measured in the ditch about 200 feet below the intake. The results of measurements are given on page 31.

The flow of Copper Creek is also tapped by a branch of the Jett Creek ditch at an elevation of about 800 feet. The combined monthly discharge of Copper and Jett creeks for 1907 is given on page 51.

Discharge measurements of Nugget and Copper creeks, 1906-7.

NUGGET CREEK.

[Elevation, 785 feet.]

Date.	Elevation of point of measurement.	Discharge.	Date.	Elevation of point of measurement.	Discharge.
1906.	*Feet.*	*Sec.-feet.*	1906.	*Feet.*	*Sec.-feet.*
June 18		1.8	August 11		3.0
June 19		1.6	August 29		8.6
June 21		4.4	September 2		6.8
June 28		.96	September 7		6.1
July 12		6.8	September 14		4.4

COPPER CREEK.

Date.	Elevation of point of measurement.	Discharge.	Date.	Elevation of point of measurement.	Discharge.
1906.			1906.		
June 18	700	3.8	August 31	800	6.6
June 19	800	8.7	September 10	800	2.4
June 21	700	11.6			
July 12	700	11.3	1907.		
July 21	800	2.4	July 9	800	9.4
August 11	800	.8			

Monthly discharge of Nugget Creek at Miocene intake, 1907.

[Drainage area, 2.1 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
July 9-31	12.0	3.8	5.7	2.71	2.32
August	10.6	2.8	6.2	2.95	3.40
September	40	6.8	11.0	5.24	5.85
84 days	40	2.8	7.8	3.71	11.57

NOTE.—The maximum for September is estimated. For the daily discharge see page 32.

JETT CREEK.

Jett Creek enters Grand Central River from the south. It has a short drainage basin and is made up of a series of falls and rapids. Water is diverted over the Nugget divide into Nome River by the Jett Creek ditch. (See p. 31 for measurements on Jett Creek ditch.)

The discharge of this ditch at times of low water is equal to the combined discharge of Jett and Copper creeks at the intakes, less a small amount of loss by seepage. This has been compared with the natural flow of Nome River for four such periods, as follows:

Comparison of flow of Jett Creek ditch and Nome River at Miocene intake, 1907.

Dates.	Nome River.	Jett and Copper creeks.	Creeks in per cent of Nome River.
	Sec.-ft.	*Sec.-ft.*	
July 26-31	30	7.0	23
August 1-16	22	5.2	24
August 19-25	32	7.0	22
September 3-8	34	6.4	19

The above table shows that the discharge of Jett and Copper creeks was from 24 to 19 per cent of that of Nome River.

The combined discharges of the two creeks for other periods than those given have therefore been taken as 24 per cent of that of Nome River for July, 20 per cent for August, and 16 per cent for September, on the assumption that in September the flow was checked to a greater extent by cold weather than that of Nome River.

Measurements were made in 1906 to show the amount of water available at the diversion.

Discharge measurements of Jett Creek, 1906.

[Elevation, 800 feet.]

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
June 19	14.9	July 21	5.8
July 2	4.4	August 31	8.3
July 12	14.3	September 10	4.2

Combined monthly discharge of Jett and Copper creeks at Miocene intake, 1907.

[Drainage area, 2.25 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
July	40	5.9	17.3	7.69	8.87
August	15	3.9	7.1	3.16	3.64
September	49	2.9	9.6	4.27	4.76
92 days	49	2.9	11.3	5.04	17.27

MORNING CALL CREEK.

Morning Call Creek enters Grand Central River from the south near Salmon Lake. The hills to the south are lower and more exposed than those of Copper and Jett creeks, and the snow melts earlier in the spring. At low water all the flow disappears in the pervious limestone above the point where a ditch intended to cross the Nugget divide would have its intake. The water appears again near the contact with the schist, at an elevation of about 750 feet.

Discharge measurements of Morning Call Creek, 1906.

Date.	Elevation of point of measurement.	Discharge.	Date.	Elevation of point of measurement.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 20	700	36	July 2	700	10.0
June 20	900	24.6	July 12	700	20.8
June 24	500	27.3	August 9	900	0.0

STORAGE POSSIBILITIES.

There are several reservoir sites in the headwaters of Grand Central River. The most important of these is Crater Lake, which lies in a cirque at an elevation of 973 feet. This lake has an area of 106 acres, and a dam to raise the water 15 feet would increase the area to about 160 acres. The outlet could be arranged so as to draw the lake 5 feet below its present level, thus giving a storage capacity of about 2,500 acre-feet. There is also a small lake at the head of Gold Run. Its area has not been measured, but it would probably afford sufficient storage to reenforce the low-water flow of that stream considerably.

Computations have been made to ascertain the storage capacity that would be necessary to maintain a given discharge in a proposed ditch, taking water either from (1) Gold Run, both forks of Grand Central River, and Thompson Creek; (2) the forks of Grand Central River and Thompson Creek, without Gold Run; or, (3) Gold Run alone, with storage obtained on the lake on that stream. Both 1 and 2 have been studied for a discharge of 80, 100, and 120 second-feet with storage obtained on Crater Lake.

The amount of water that would have to be drawn from storage during any day is the difference between the discharge of the streams tapped and the assumed capacity of the ditch. The sum of these deficiencies for any week or month gives the total draft that would be made on the reservoirs for that period.

The days of deficient flow during 1906 occurred in four periods and those for 1907 in three periods, between which there were periods when the discharge of the streams exceeded the capacity of the ditch. During such periods of greater flow some of the water could be conserved in one of the lakes already mentioned. The amount thus retained would be equal to the excess of the discharge of the streams over the ditch capacity until this excess became greater than the discharge into the lake, or until the lake had refilled or contained enough water to meet any later demands on it. The amount thus conserved during periods of high water, deducted from the total drawn from storage, gives the net storage capacity that would be required. The unit used in the following statement is 1 second-foot for 1 day, which is equal to nearly 2 acre-feet.

Storage capacity required to maintain given discharges, 1906 and 1907.

GRAND CENTRAL RIVER, THOMPSON CREEK, AND GOLD RUN.

Discharge.	July 1 to September 30, 1906.			July 8 to September 23, 1907.		
	Total deficiency.	Storage capacity required.		Total deficiency.	Storage capacity required.	
Sec.-feet.	*Sec.-ft. for 1 day.*	*Sec.-ft. for 1 day.*	*Acre-feet.*	*Sec.-ft. for 1 day.*	*Sec.-ft. for 1 day.*	*Acre-feet.*
80	127	123	244	9	9	18
100	560	372	738	51	51	101
120	1,332	1,002	1,987	274	145	288
GRAND CENTRAL RIVER AND THOMPSON CREEK.						
80	413	268	532	26	26	51
100	1,227	925	1,834	212	107	213
120	2,206	1,811	3,590	607	320	635
GOLD RUN.						
20	165	104	206	91	40	79
25	395	181	359	225	117	232
30	679	444	880	410	217	430

NOTE.—Discharges for the latter part of September, 1906, were estimated.

SALMON LAKE.

Salmon Lake lies at the foot of the Kigluaik Mountains at an elevation of about 442 feet. It has a water surface area of 1,800 acres and a drainage area of 81 square miles. Its principal supply comes from Grand Central River, which enters it at its west end. A number of small streams also enter the lake from both the north and the south, but with the exception of Fox Creek and Jasper Creek these are of minor importance. The outlet of the lake is through Kruzgamepa River.

This lake offers an excellent opportunity for a storage reservoir for power purposes and mining along Kruzgamepa River. The use of its water in the vicinity of Nome is practically prohibited, owing to its low elevation and the long tunnel which would be necessary to bring the water through the Nugget divide into the Nome River basin. By raising the water of the lake to an elevation of 500 feet the shortest tunnel line would be between 5 and 6 miles long; and if any allowance be made for drawing on the storage, water could not be brought through to the Nome Valley at an elevation greater than about 450 feet. The mouth of the tunnel would be near Dorothy Creek, and the loss in grade between that point and Nome would bring the water so low that it could not be used to any extent for hydraulicking. Even if the water could be brought to the vicinity of Nome under a sufficient head for hydraulicking, the great cost and difficulty of building so long a tunnel would make the feasibility of the plan very doubtful.

Measurement of flow in and out of Salmon Lake, 1906.

Date.	Stream.	Discharge.
		Sec.-feet.
June 22	Rainbow Creek	3.4
Do.	Fox Creek	99
Do.	8 small streams from north	a 6
June 24	Jasper Creek	11.6
Do.	Morning Call Creek	27
Do.	Jett Creek	a 10
Do.	6 small streams from south	a 4
Do.	Grand Central River below Nugget Creek	313
	Total	474
June 23	Kruzgamepa River, at outlet of Salmon Lake	425

a Estimated.

NOTE.—The stage of Salmon Lake remained practically constant from June 22 to 24, inclusive.

A measurement on Fox Creek August 16, 1906, gave a discharge of 17.3 second-feet.

KRUZGAMEPA RIVER DRAINAGE BASIN BELOW SALMON LAKE.

GENERAL DESCRIPTION.

Kruzgamepa or Pilgrim River, the outlet of Salmon Lake, has a larger discharge than any other stream in this section on which records have been obtained. For about 12 miles it flows in a valley ranging from 6 to 12 miles in width, and then enters the lowlands north of the Kigluaik Range, finally discharging into Imuruk Basin. The principal tributaries are Crater, Grouse, and Homestake creeks from the north and Iron Creek from the south.

As it leaves Salmon Lake the river flows through a narrow outlet having a width of 150 feet at the bottom and 500 feet at the top, offering an excellent dam site and location for a hydro-electric power plant. Plans for the construction of such a plant have been perfected by the Salmon Lake Power Company, which intends to develop 3,000 horsepower, to be used on dredges at Nome and Council and on Solomon River.

Salmon Lake, at its present level, 442 feet, covers 1,800 acres; if raised to a level of 475 feet it would cover 3,600 acres; and at 500 feet, 4,600 acres. The reservoir thus formed could be used for the storage of the water of the floods caused by the melting snow in the spring and the occasional heavy rains in the summer. The water thus retained would give a large minimum flow not only in summer but also during the winter months, when the natural run-off becomes small.

Kruzgamepa River seldom freezes over before the first of January, and it is probable that with proper installation power could be developed throughout the year.

KRUZGAMEPA RIVER AT OUTLET OF SALMON LAKE.

A gaging station was established at Leland's camp, about 100 yards below Salmon Lake, June 23, 1906. A temporary gage had been set and float measurements made during the spring flood by J. P. Samuelson.

Discharge measurements were made by wading when the discharge was less than 600 second-feet. The high-water measurements were made by floats in 1906, and from a cable in 1907.

The gage was read twice daily by J. P. Samuelson and M. Donworth.

Discharge measurements of Kruzgamepa River at outlet of Salmon Lake, 1906–7.

	Area of section.	Mean velocity.	Gage height.	Discharge.		Area of section.	Mean velocity.	Gage height.	Discharge
1906.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*	1907.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 23	183	2.32	1.22	425	June 16	415	4.94	2.97	2,050
June 29	170	2.08	1.00	353	June 17	367	4.47	2.56	1,640
June 30	157	2.01	.93	315	June 28	282	3.62	1.88	1,020
July 9	431	5.43	3.18	2,340	Do	270	3.67	1.78	991
Do	412	5.09	3.02	2,094	July 2	248	3.03	1.56	751
July 10	372	4.73	2.68	1,760	July 4	220	2.58	1.30	567
August 4	117	1.81	.38	212	July 14	229	2.69	1.37	616
August 15	116	1.80	.37	209	August 2	149	2.04	.65	304
August 25	148	2.11	.70	312	August 14	125	1.86	.39	232
August 26	159	2.33	.80	371	August 23	174	2.52	.89	438
August 28	184	2.49	1.02	458	September 6	155	2.13	.68	330
September 1	164	2.27	.85	373	September 11	362	4.20	2.52	1,520
September 7	127	1.95	.52	248	September 12	327	4.01	2.19	1,310
September 17	108	1.62	.27	175	September 20	162	2.21	.76	358
September 21	336	4.61	2.38	1,546					
September 23	299	3.76	2.06	1,124					
September 24	269	3.44	1.80	925					

Daily gage height and discharge of Kruzgamepa River at Salmon Lake, 1906.

[Drainage area, 81 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			3.05	1,780	0.82	272	0.48	239	0.86	387
2			3.75	2,270	.72	241	.42	221	.81	364
3			3.90	2,350	.70	235	.38	209	.74	336
4			4.20	2,520	.70	235	.36	203	.69	316
5			3.75	2,270	.80	265	.38	209	.65	300
6			3.20	1,920	1.10	380	.38	209	.60	280
7			2.45	1,220	1.10	380	.40	215	.53	256
8					1.92	1,030	.40	215	49	242
9					3.05	2,130	.40	215	.46	233
10					2.60	1,640	.36	203	.41	218
11					2 20	1,275	.35	200	.39	212

Daily gage height and discharge of Kruzgamepa River at Salmon Lake, 1906—Continued.

[Drainage area, 81 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.*
12	....	....	....	....	1.95	1,065	0.35	200	0.37	206
13	....	....	....	....	1.85	985	.36	203	.34	197
14	....	....	....	....	1.55	768	.34	197	.31	188
15	....	....	....	....	1.45	702	.36	202	.30	185
16	....	....	....	....	1.25	582	.35	200	.28	180
17	....	....	....	....	1.12	511	.32	197	.26	175
18	....	....	....	....	1.08	490	.30	185	.27	178
19	....	....	....	....	.98	441	.26	175	.52	252
20	....	....	....	....	.90	405	.32	191	1.34	634
21	....	....	....	....	.82	369	.39	212	2.35	1,410
22	....	....	....	....	.85	382	.42	221	2.40	1,455
23	....	....	1.20	420	.82	369	.66	304	2.11	1,198
24	....	....	1.25	442	.85	382	.71	324	1.78	930
25	....	....	1.20	420	.82	369	.70	320	1.58	787
26	....	....	1.12	388	.80	360	.76	344	1.38	658
27	....	....	1.10	380	.72	328	.90	405	1.22	566
28	5.45	3,270	1.05	360	.70	320	1.02	460	1.08	490
29	5.00	3,000	1.02	348	.62	288	1.05	475	.98	441
30	4.05	2,430	.92	308	.55	262	.99	446	.88	396
31	3.60	2,180	....	....	.50	245	.94	423	....	....
Mean	....	2,720	....	a 2,050 b 383	....	571	....	259	....	456
Run-off per square mile	....	33.6	....	a 25.3 b 4.73	....	7.05	....	3.20	....	5.63
Run-off, depth in inches	....	5.00	....	a 6.59 b 1.41	....	8.13	....	3.69	....	6.28
Run-off, acre-feet	....	21,600	....	a 28,500 b 6,040	....	35,100	....	15,900	....	27,100

a June 1 to 7. b June 23 to 30.

NOTE.—The channel changed during the high water of July 9, and a new rating table was used after that date. The discharges of May 28 to June 7 are based on measurements which show a low velocity, probably caused by backwater.

Daily gage height and discharge of Kruzgamepa River at Salmon Lake, 1907.

[Drainage area, 81 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	....	....	1.70	875	0.69	326	1.14	522	0.30	205
2	....	....	1.58	791	.65	312	1.00	450	.23	188
3	....	....	1.44	696	.62	302	.90	405	.21	182
4	....	....	1.28	599	.61	298	.82	373	.20	180
5	....	....	1.20	555	.60	295	.77	354	19	178
6	....	....	1.20	555	.55	280	.73	340	....	....
7	....	....	a1.50	735	.48	259	62	302	....	....
8	....	....	a1.45	702	.45	250	.58	289	....	....
9	....	....	a1.40	670	.45	250	.71	334	....	....
10	....	....	a1.35	640	.44	247	1.25	582	....	....
11	....	....	a1.30	610	.44	247	2.50	1,560	....	....
12	....	....	a1.25	582	.42	241	2.26	1,330	....	....
13	....	....	a1.30	610	.40	235	1.98	1,090	....	....
14	....	....	1.35	640	.40	235	1.59	798	....	....
15	3.30	2,360	1.26	588	.38	229	1.40	670	....	....
16	2.99	2,040	1.15	528	.40	235	1.26	588	....	....
17	2.47	1,530	1.10	500	.69	326	1.10	500	....	....
18	2.72	1,770	1.02	460	.94	423	.98	441	....	....
19	3.02	2,070	1.00	450	.97	436	.86	389	....	....
20	2.80	1,850	1.00	450	.90	405	.74	344	....	....
21	2.32	1,390	1.18	544	.88	397	.72	337	....	....
22	2.08	1,180	1.18	544	.90	405	.62	302	....	....
23	2.00	1,110	1.12	511	.89	401	.54	277	....	....
24	2.08	1,180	1.08	490	.82	373	.54	277	....	....

a Estimated.

Daily gage height and discharge of Kruzgamepa River at Salmon Lake, 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.*
25	2.22	1,300	1.05	475	0.78	358	0.50	265		
26	2.30	1,370	1.02	460	.80	365	.48	259		
27	2.28	1,350	.98	441	.88	397	.46	253		
28	2.12	1,210	.80	365	.84	381	.42	241		
29	1.95	1,070	.72	337	.86	389	.38	229		
30	1.78	935	.62	302	1.18	544	.34	217		
31			.60	295	1.20	555				
Mean		1,480		548		335		477		187
Run-off per square mile		18.3		6.77		4.14		5.89		2.31
Run-off, depth in inches		10.9		7.80		4.77		6.57		.43
Run-off, acre-feet		47,000		33,700		20,600		28,400		1,850

NOTE.—The datum of the 1907 gage was 0.16 foot higher than that of the 1906 gage. The river began to break up May 22, 1907. The discharge increased up to June 15, which was the maximum of the season, and was probably as great during the first half of June as during the last half.

CRATER CREEK.

Crater Creek is the first large tributary entering Kruzgamepa River from the north. It rises in mountains that reach an elevation of nearly 4,000 feet. The topography and general character of its basin closely resemble those of Grand Central River. (See p. 38.) It drains many small lakes, but none of any considerable size. This stream has good possibilities for water-power development. Measurements were made at an elevation of about 550 feet.

Should developments in the vicinity of Nome ever demand it, the water of Crater Creek could be diverted over the divide into Eldorado River by about 8 miles of ditch and 1.2 miles of siphon across Kruzgamepa River, none of which would be under a pressure of more than 100 feet.

Discharge measurements of Crater Creek, 1906–7.

[Elevation, 550 feet.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-feet.*	1907.	*Feet.*	*Sec.-feet.*
August 5		67	June 29	1.80	217
August 15	0.45	57	July 3	1.55	131
August 27	1.30	290	July 15	1.56	141
September 1	.71	110	August 2	1.34	89
September 8	.45	55	August 23	1.66	185
September 16	.35	39	September 12	2.05	245

IRON CREEK.

Iron Creek rises in an area of limestone and schist hills of no great elevation lying between Salmon Lake and the headwaters of Casadepaga and Eldorado rivers. It is formed by the junction of Eldorado and Telegram creeks. Its principal tributaries are Discovery and Canyon creeks, both from the southwest. The portion of the stream above Discovery Creek is sometimes called Dome Creek. Iron Creek empties into Kruzgamepa River about 12 miles below Salmon Lake.

Several mines are being worked successfully on this stream and its tributaries. During 1906 the Gold Beach Development Company built a ditch 13 miles long, which diverts water from Eldorado, Discovery, and Canyon creeks, for use on Discovery, No. 1, and No. 2 claims on Iron Creek.

During 1907 gaging stations were established on Dome Creek below the junction of Eldorado and Telegram creeks, and on Iron Creek below the mouth of Canyon Creek. The gages were read during the low-water period in August by employees of the Gold Beach Development Company.

Measurements on Iron Creek and tributaries, 1906.

Date.	Stream.	Elevation.	Discharge.
		Feet.	*Sec.-feet.*
August 14	Iron Creek	450	a 17.1
September 15	do	425	a 26.1
August 14	Iron (Dome) Creek	630	6.0
September 15	do	630	5.0
August 13	Eldorado Creek	750	4.5
September 15	do	750	5.6
August 13	Discovery Creek	740	1.25
September 15	do	740	2.3
August 13	Canyon Creek	760	1.3
September 15	do	760	1.1

a Below Canyon Creek.

Discharge measurements of Dome and Iron creeks, 1907.

DOME CREEK.

[Elevation, 630 feet.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*
August 1	0.41	26
August 22	.48	37
September 18	.37	22

IRON CREEK BELOW CANYON CREEK.

[Elevation, 450 feet.]

August 1	2.09	51
August 22	a 1.50	99
September 19	a 1.38	80

a New gage.

Daily gage height and discharge of Dome and Iron creeks, August, 1907.

Day.	Dome Creek (drainage area, 20 square miles). Gage height.	Dome Creek Discharge.	Iron Creek below Canyon Creek (drainage area, 50 square miles). Gage height.	Iron Creek Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	0.40	25	2.10	52
2	.39	24	2.10	52
3	.38	23	2.10	52
4	.37	22	2.10	52
5	.34	20	2.08	50
6	.31	18	2.08	50
7	.30	17	2.08	50
8	.27	15	2.05	47
9	.24	14	2.02	43
10	.22	13	2.00	41
11	.20	12	1.90	33
12	0.22	13	1.90	33
13	.26	15	1.90	33
14	.26	15	1.90	33
15	.28	16	2.00	41
16	.55	54	2.18	62
17	.70	101	2.45	100
Mean	......	24.5	......	48.5
Run-off per square mile	......	1.22	......	.99
Run-off, in inches	......	.77	......	.61

NOTE.—These discharges are very uncertain, as no measurements were obtained covering the low stages.

MISCELLANEOUS MEASUREMENTS.

Slate and Willow creeks are tributaries of Kruzgamepa River from the south, 5 or 6 miles below Salmon Lake. Rock Creek is a branch of Slate Creek. These streams will be tapped at an elevation of about 900 feet by a ditch which is being built to work ground on the left bank of Iron Creek. Measurements were made at the proposed intakes.

Pass, Smith, and Grand Union creeks rise on the north side of the Kigluaik Mountains, north of Grand Central River and Gold Run. They are fed by the melting of large banks of snow and have a very steep slope. A project is contemplated for bringing their waters to Coffee and Dahl creeks by means of a pipe line about 18 miles long across the flats of Kruzgamepa and Kuzitrin rivers to Coffee Dome.

Miscellaneous measurements in Kruzgamepa River drainage basin, 1907.

Date.	Stream.	Elevation.	Discharge.
		Feet.	*Sec.-feet.*
July 29	Pass Creek	620	18.1
Do	Smith Creek	890	40
Do	Grand Union Creek	650	12.7
September 19	Willow Creek	900	3.3
Do	Slate Creek	900	11.3
Do	Rock Creek	900	9.0

IMURUK BASIN DRAINAGE.

The following measurements were made on streams tributary to Imuruk Basin to determine their availability and value for water-power development. They rise on the northerly slope of the northernmost ridge of the Kigluaik Range and are fed by large banks of perpetual snow.

Measurements on streams tributary to Imuruk Basin, 1906.

Date.	Stream.	Elevation.	Drainage area.	Discharge.
		Feet.	*Sq. miles.*	*Sec.-feet.*
September 5	Fall Creek	1,208	5	34
Do	Glacier Creek	1,212	3	10
Do	Snow Gulch	1,212	2	9.7

SINUK RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Sinuk River rises on the southern slope of the Kigluaik Range, adjacent to the headwaters of Grand Central River and Thompson and Buffalo creeks. It flows in a southwesterly direction, entering Bering Sea near Cape Rodney. The upper portion of its drainage basin is mountainous, the greater part of it having an elevation of over 1,000 feet. The upper valley contains a large amount of glacial débris and rock slide. Below the mouth of Stewart River, which is the principal tributary, the valley widens out and is almost flat. The principal tributaries to the upper stream are Windy Creek and the outlet of Glacial Lake from the north and Stewart River from the south.

During 1906 only a few measurements were made and no daily discharge has been computed. A fair estimate of the weekly flow is given on page 72. During 1907 more measurements were made and additional gage readings obtained.

Three plans by which the water from this drainage basin could be brought into the Nome River Valley are outlined in Water-Supply Paper No. 196, pages 38-40. The development of such projects would be very expensive on account of the rocky nature of the ground in the Sinuk drainage basin and the great length of ditch required. The Grand Central River and its tributaries, with their low-water flow reenforced by storage, will probably furnish as much additional water supply as the development of the Nome region will require, and at a smaller cost than that at which it could be obtained from Sinuk River and Windy Creek. If a large body of ground adapted to hydraulic mining should be discovered in the Sinuk Basin itself, the river will furnish a good supply of water at a high level.

UPPER SINUK RIVER.

The gagings on the upper Sinuk during 1906 and prior to August, 1907, were made at an elevation of 770 feet, and show the probable water supply which could be diverted into Nome River. During August and September, 1907, the gaging station was located about 1½ miles farther downstream, at an elevation of about 700 feet.

Discharge measurements of upper Sinuk River, 1906.

[Elevation, 770 feet; drainage area, 6.2 square miles.]

Date.	Discharge.	Date.	Discharge.
	Sec.-feet.		*Sec.-feet.*
June 27	33	August 3	20
July 6	37	August 10	23.5
July 20	36		

Daily gage height and discharge of upper Sinuk River, 1907.

[Elevation, 700 feet; drainage area, 8.2 square miles.[a]]

Day.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.
	Sec.-ft.	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	[b] 70		36		55
2	60		35	1.38	[d] 46
3	54		34		40
4	40		31		50
5	48		29		40
6	[b] 52		26	1.32	[d] 33
7	46		24		30
8	42	1.28	[c] 26		28
9	42		25		60
10	60		25		160
11	80		24		114
12	70	1.27	[d] 24		90
13	[b] 75		24		75
14	62		24	1.48	[c] 65
15	52		22		58
16	44		60		52
17	40		100		46
18	50		82	1.41	[b] 41
19	60	1.49	[c] 70		35
20	80		46		32
21	100		54		24
22	60		54	1.21	[e] 7
23	56	1.34	[d] 37		
24	48		34		
25	42		32		
26	38		50		
27	[b] 36		62		
28	29	1.40	[c] 55		
29	24		80		
30	28		100		
31	32		70		
Mean	52.3		45.0		53.7
Run-off per square mile	8.44		5.49		6.55
Run-off, depth in inches	9.73		6.33		5.36

[a] Elevation, 770 feet, and drainage area, 6.2 square miles during July.
[b] Measurement at elevation, 770 feet.
[c] Measurement at elevation, 700 feet.
[d] Computed from gage reading.
[e] Estimated; slush ice running.

NOTE.—Other discharges were obtained by plotting a hydrograph passing through the known points and following the rise and fall of Nome and Grand Central rivers.

WINDY CREEK.

Windy Creek, the first large tributary of Sinuk River, lies between the main ridge of the Kigluaik Mountains and the headwaters of the Sinuk. It adjoins West Fork of Grand Central River, from which it may be reached by crossing a high divide. The topography is very rough, the creek being entirely lost in some places in the large bowlders which form its bed.

Discharge measurements of Windy Creek, 1906.

Date.	Elevation at point of measurement.	Discharge.	Date.	Elevation at point of measurement.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 21	1,000	49	August 3	650	32
June 27	1,100	17	August 10	650	[b] 35
July 13	[a] 650	114	September 6	650	[b] 32
July 20	650	48			

[a] Drainage area, 12 square miles. [b] Estimated.

Daily gage height and discharge of Windy Creek. 1907.

[Elevation, 650 feet; drainage area, 12 square miles.]

Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	1.36	[a] 128		60		72
2		96		56	1.15	[a] 67
3		90		52		56
4		100		50		64
5		112		42		54
6		120		34	1.05	[a] 43
7		116		32		38
8		114	1.01	[b] 35		36
9		120		34		80
10		130		34		200
11		140		32		140
12		125	1.00	[a] 33		110
13	1.36	[b] 128		33		90
14		105		33	1.20	[a] 79
15		85		32		70
16		74		90		64
17		66		125		56
18		70		100	1.08	[a] 50
19		80	1.21	[b] 88		45
20		100		60		40
21		130		70		30
22		80		72		[c] 15
23		76	1.06	[a] 45		
24		72		42		
25		68		40		
26		60		68		
27	1.13	[b] 57		80		
28		48	1.14	[b] 70		
29		40		90		
30		50		120		
31		56		82		
Mean		91.5		59.2		68.1
Run-off per square mile		7.62		4.93		5.68
Run-off, depth in inches		8.78		5.68		4.65

[a] Computed from gage reading. [b] Measurements. [c] Estimated; slush ice running.

NOTE.—Other discharges were obtained in the same manner as those of Sinuk River.

NORTH STAR CREEK.

North Star Creek lies between Sinuk River and Windy Creek, and is a tributary to the latter near its mouth. It is a small stream with a steep slope.

Discharge measurements of North Star Creek, 1906.

[Elevation, 900 feet, drainage area, 2.3 square miles.]

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
June 27	9.8	July 20	3.9
July 6	18 1	August 3	3.0
July 13	16.4	August 10	2.9

Daily gage height and discharge of North Star Creek, 1907.

[Elevation, 900 feet; drainage area, 2.3 square miles.]

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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	1.36	[a]28	......	8	......	7	20	......	24	......	7	......	4
2	......	20	......	7	0.92	[b]4.5	21	......	30	......	8	......	3
3	......	16	......	7	......	4	22	......	20	......	8	.75	[c]2.0
4	......	13	......	6	......	7	23	......	16	97	[b]5.2	......	......
5	......	14	......	5	......	6	24	......	13	......	5	......	......
6	1.26	[a]16	......	5	.94	[b]4.8	25	......	10	......	4	......	......
7	......	14	......	4	......	4	26	......	8	......	8	......	......
8	......	13	0.94	[a]4.8	......	4	27	1.03	[a]5.5	......	12	......	......
9	......	14	......	5	......	4	28	......	5	1.13	[a]9.1	......	......
10	......	16	......	5	......	40	29	......	4	......	14	......	......
11	......	20	......	5	......	30	30	......	5	......	20	......	......
12	......	22	.97	[b]5.3	......	20	31	......	6	......	10	......	......
13	1.33	[a]23	......	5	......	14							
14	......	17	......	5	1.08	[b]7.8	Mean		14.8	......	8.3	......	8.9
15	......	14	......	5	......	7	Run-off per square mile		6.43	......	3.61	......	3.87
16	......	12	......	15	......	7							
17	......	10	......	25	......	6	Run-off, depth in inches		7.41	......	4.16	......	3.16
18	......	13	......	16	1.00	[b]5.7							
19	......	17	1.10	[a]8.3	......	5							

[a] Measurements. [b] Computed from gage reading. [c] Estimated; slush ice running.

NOTE.—Other discharges were obtained in the same manner as those of Sinuk River.

STEWART RIVER.

Stewart River lies south of upper Sinuk River, to which it is tributary. It drains an area of limestone and schist hills. The flow is small and the stream of minor importance.

Discharge measurements of Stewart River, 1906.

[Elevation, 400 feet.]

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
July 15	72	July 30	[a]26
July 17	49	August 19	11.4

[a] Estimated.

SLATE CREEK.

Slate Creek is the second tributary to Stewart River from the north. The following measurements give approximately the flow that can be diverted into Nome River over Divide Creek:

Discharge measurements of Slate Creek, 1906.

[Elevation, 700 feet; drainage area, 2.1 square miles.]

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
July 15	6.7	July 30	2.8
July 17	4.4	August 19	2.2

OTHER SINUK RIVER DRAINAGE.

For measurements on Josie, Irene, and Jessie creeks, which are small tributaries of Stewart River, see "Cedric ditch."

CRIPPLE RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Cripple River enters Bering Sea about 12 miles west of Nome, and drains an area of about 88 square miles. As yet but little mining has been done in this section, except in the vicinity of Oregon and Hungry creeks. Some small ditches have been constructed at the headwaters of Cripple River, the principal one being the Cedric, which diverts water from the Stewart River drainage area.

CEDRIC DITCH.

GENERAL DESCRIPTION.

The Cedric ditch was built in 1905 to divert water from Josie and Jessie creeks (tributary to Stewart River) over the divide to the Cripple River basin for use on Oregon, Hungry, Trilby, and Nugget creeks. After passing the divide it picks up water from upper Oregon (two forks), Slate, and Aurora creeks, which are its principal feeders, and from Daisy Swift Creek, Snowshoe Gulch, and three other small gulches. It has a total length of about 19 miles and a width of 4 to 8 feet. The elevation of the head is about 870 feet and of the outlet 790 feet. The capacity of the lower half is about 25 second-feet. Water is carried across Oregon Creek near the outlet by a syphon 2,970 feet long, of 30-inch riveted steel pipe. There are about 6 miles of distributing ditches at the lower end.

The following measurements were made to determine the amount of water available for the ditch:

Water available for Cedric ditch, 1906-7.

Stream.	1906.			1907.
	July 15-17.	July 30-31.	August 19.	August 31.
	Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
Josie Creek	3.0	1.5	1.1	[a]2.0
Irene Creek	1.0	[a].8	[a].4	[a]3.0
Jessie Creek	[b]3.2	2.6	.6	[a]3.0
Upper Oregon Creek	[b]6.8	2.6	....	[a]3.5
Slate Creek	4.0	2.0	....	3.1
Aurora Creek	4.8	2.1	....	2.4
Daisy Swift Creek	.5	....	....	....
Total available for ditch	18.3	11.6	....	17.0

[a]Estimated.
[b]Measured below ditch level; only about half this amount is available for the ditch.

Seepage measurements on Cedric ditch, 1906.

Date.	Point of measurement.	Discharge.	Loss.	Distance.	Loss per mile.
		Sec.-ft.	*Sec.-ft.*	*Miles.*	*Sec.-ft.*
July 30	Below upper Oregon Creek	2.6			
Do	Above Slate Creek	1.9	0.7	2.3	0.3
Do	Below Slate Creek	3.9			
July 31	Above Aurora Creek	3.1	.8	1.8	.4
Do	Below Aurora Creek	5.2			
Do	Above Daisy Swift Creek	4.7	.5	2.0	.25
Do	Below Daisy Swift Creek	4.5	.2	.6	.3
Do	At penstock	2.5	2.0	3.7	.5
			4.2	10.4	.4

CEDRIC DITCH ABOVE PENSTOCK.

This station was established to determine the total flow of the ditch. The gage was located just above the penstock of the siphon across Oregon Creek. Part of the water was used in a giant connected with the bottom of the siphon and part was used for hydraulicking about one-fourth mile above the siphon.

Discharge measurements of Cedric ditch above penstock, 1907.

Date.	Above penstock.		Discharge to upper giant.
	Gage height.	Discharge.	
	Feet.	*Sec.-ft.*	*Sec.-ft.*
July 22	0.80	10.3	3.0
August 30	.78	8.6	4.4
August 31	.76	7.9	5.0
September 19	.10	0	

Daily gage height and discharge of Cedric ditch above penstock, 1907.

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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			1.00	13.1	0.95	12.2	18			1.08	14.6	1.05	14.0
2			1.02	13.5	.85	10.2	19			1.15	16.0		0
3			1.02	13.5	.98	12.7	20			1.08	14.6		0
4			1.05	14.0	.88	10.8	21			1.10	15.0		0
5			.95	12.2	.95	12.2	22	0.80	9.3	1.10	15.0		0
6			.88	10.8	.95	12.2	23	.88	10.8	.95	12.2	.65	6.6
7			.80	9.3	.98	12.7	24	1.00	13.1	.95	12.2	.68	7.1
8			.92	11.6	.95	12.2	25	.98	12.7	1.05	14.0	.60	5.7
9			.90	11.2	1.05	14.0	26	1.00	13.1	1.20	16.9	.60	5.7
10			.90	11.2	1.20	16.9	27	.90	11.2	1.10	15.0	.62	6.1
11			.88	10.8	1.25	17.8	28	.88	10.8	1.05	14.0	.58	5.4
12			.90	11.2	1.15	16.0	29	1.00	13.1	1.00	13.1	.52	4.5
13			.95	12.2	1.05	14.0	30	1.10	15.0	.85	10.2	.50	4.2
14			.98	12.7	1.02	13.5	31	1.05	14.0	.80	9.3		
15			.98	12.7	1.10	15.0							
16			1.05	14.0	1.02	13.5	Mean.		12.3		12.9		9.6
17			1.05	14.0	1.05	14.0							

PENNY RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Penny River rises about 13 miles from the seacoast and enters Bering Sea about 10 miles west of Nome. Its basin lies between Snake and Cripple rivers and has a total area of 36 square miles. Two ditches have been built by the United Mining Company. The Sutton ditch has its intake one-half mile above the mouth of Willow Creek and extends about 6 miles to a point near the mouth of Jess Creek. The water is used for hydraulicking on the second beach line, which lies about 1,200 feet back of the present beach. The Highline ditch, uncompleted, has its intake 7 miles above the Sutton ditch and will extend to Sunset Creek, a distance of about 11 miles. The water is carried across Honey Creek in a pipe line 2,000 feet long.

PENNY RIVER AT SUTTON INTAKE AND SUTTON DITCH.

Gaging stations were established on Sutton ditch and Penny River just below the ditch intake, and the sum of the discharges gives the natural flow of the river at this point. The gages were read by employees of the United Mining Company.

Discharge measurements of Penny River and Sutton ditch at intake, 1906-7.

PENNY RIVER.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1907.	*Feet.*	*Sec.-ft.*
August 1		6.2	July 4	.82	12.6
			July 22	1.30	42
1907.			September 1	.99	16.3
July 4	1.11	31			

SUTTON DITCH.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.			1907.		
August 1		30	July 4	1.49	44
			July 22	1.11	25
1907.			September 1	1.32	38
July 4	1.20	28			

Daily gage height and discharge of Penny River and Sutton ditch at intake, 1907.

Day.	July.				August.				September.			
	River.		Ditch.		River.		Ditch.		River.		Ditch.	
	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	......	71	......	29	......	85	......	0	1.0	19	1.3	35
2	......	56	......	29	......	85	......	0	1.0	19	1.3	35
3	......	41	......	29	......	85	......	0	1.0	19	1.3	35
4	1.1	26	1.2	29	......	85	......	0	1.0	19	1.3	35
5	1.1	26	1.2	29	......	85	......	0	.9	14	1.3	35
6	1.3	44	1.25	32	1.6	79	0.8	9	.9	14	1.3	35
7	2.2	152	1.2	29	1.4	55	.8	9	.9	14	1.3	35
8	1.6	79	1.2	29	1.1	26	1.0	18	.9	14	1.3	35
9	1.3	44	1.25	32	1.1	26	1.0	18	1.0	19	1.3	35
10	1.3	44	1.2	29	.8	10	1.2	29	2.1	140	1.3	35
11	1.3	44	1.2	29	.8	10	1.2	29	1.8	103	1.3	35
12	1.2	34	1.2	29	.7	7	1.2	29	1.6	79	1.3	35
13	1.4	55	1.2	29	.7	7	1.2	29	1.0	19	1.3	35
14	1.5	67	1.2	29	.7	7	1.2	29	1.0	19	1.3	35
15	1.2	34	1.1	23	.6	4	1.2	29	1.8	103	.5	0
16	1.2	34	1.1	23	1.4	55	1.2	29	1.8	103	.5	0
17	1.2	34	1.1	23	1.2	34	1.2	29	1.7	91	.8	9
18	1.2	34	1.1	23	1.1	26	1.2	29	1.3	44	1.3	35
19	1.5	67	1.1	23	.9	14	1.25	32	1.3	44	1.3	35
20	1.3	44	1.1	23	.8	10	1.3	35	1.3	44	1.3	35
21	1.5	67	1.1	23	1.0	19	1.25	32	1.3	44	1.3	35
22	1.3	44	1.1	23	.9	14	1.25	32	1.2	34	1.3	35
23	1.2	34	1.1	23	.8	10	1.3	35	1.1	26	1.3	35
24	1.4	55	1.1	23	.8	10	1.3	35	1.1	26	1.3	35
25	1.4	55	1.0	18	1.0	19	1.5	47	1.1	26	1.3	35
26	1.6	79	1.0	18	1.3	44	1.2	29	1.1	26	1.3	35
27	1.5	67	1.0	18	1.3	44	1.2	29	1.0	19	1.3	35
28	1.5	67	1.0	18	1.3	44	1.2	29	.9	14	1.3	35
29	1.4	55	.9	13	1.2	34	1.2	29	.9	14	1.3	35
30	1.5	67	.8	9	1.2	34	1.2	29	.8	10	1.3	35
31	1.6	79	.7	6	1.1	26	1.2	29	......	......	......	......
Mean	......	54.8	......	23.9	......	35.3	......	23.8	......	33.9	......	31.8

Monthly discharge of Penny River at Sutton intake, 1907.

[Drainage area, 19 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
July	181	55	78.7	4.14	4.77
August	88	33	59.0	3.11	3.58
September	175	45	71.1	3.74	4.17
92 days	181	33	69.6	3.66	12.52

NOTE.—These values are the sum of the discharges of Sutton ditch and of Penny River below the ditch intake.

Discharge measurements of Penny River at Highline intake, 1906-7.

Date.	Discharge.	Per cent of Sutton intake.	Date.	Discharge.	Per cent of Sutton intake.
1906.	*Sec.-ft.*		1907.	*Sec.-ft.*	
August 1	7.8	22	July 22	15.9	24
			August 30	15.6	28

SNAKE RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Snake River empties into Bering Sea at Nome. It has a drainage area of 110 square miles, which contains some of the richest mining ground in Seward Peninsula, notably the claims on Glacier, Anvil, and Little creeks. Owing to its slight fall the use of the main stream for mining purposes is limited to ground sluicing. All the available water from its tributaries is being used, and water is diverted into this area by the Miocene ditch, the Seward ditch, and the Nome River ditch of the Pioneer Mining Company.

SNAKE RIVER ABOVE GLACIER CREEK.

A station was established June 25, 1907, just above the mouth of Glacier Creek, to determine the discharge of this stream and the relation of the run-off from its drainage basin to that from areas in and near the Kigluaik Mountains. The run-off per square mile during the period covered by the records was 56 per cent of that of Nome River and 38 per cent of that of Kruzgamepa River.

The gage was read by A. H. Clambey.

Discharge measurements of Snake River above Glacier Creek, 1907.

Date.	Gage height	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 25	1.88	527	August 10	.89	72
July 3	1.20	168	September 3	1.01	112
July 20	1.13	147			

Daily gage height and discharge of Snake River above Glacier Creek, 1907.

[Drainage area, 69 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			1.35	235	1.05	120	1.08	129
2			1.30	212	1.02	111	1.05	120
3			1.25	191	1.00	105	1.05	120
4			1.18	163	1.00	105	1.05	120
5			1.22	178	.96	94	1.04	117
6			1.32	221	.95	91	1.03	114
7			1.50	308	.96	94	1.02	111
8			1.35	235	.94	89	1.08	129
9			1.25	191	.92	83	1.08	129
10			1.25	191	.92	83	1.15	152
11			1.28	204	.91	80	1.90	540
12			1.25	191	.90	77	1.68	408
13			1.20	170	.98	99	1.52	319
14			1.20	170	.97	97	1.47	293
15			1.18	163	.90	77	1.50	308
16			1.10	135	1.04	117		
17			1.12	142	1.10	135		
18			1.10	135	1.10	135		
19			1.18	163	1.05	120		
20			1.18	163	1.00	105		
21			1.20	170	1.05	120		
22			1.18	163	1.01	108		
23			1.16	156	.99	102		
24			1.22	178	1.00	105		

Daily gage height and discharge of Snake River above Glacier Creek, 1907—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.*
25	1.90	540	1.30	212	1.02	111		
26	1.85	510	1.22	178	1.08	129		
27	1.80	480	1.18	163	1.10	135		
28	1.55	335	1.12	142	1.10	135		
29	1.45	283	1.08	129	1.10	135		
30	1.40	258	1.08	129	1.10	135		
31			1.05	120	1.08	129		
Mean		401		177		108		207
Run-off per square mile		5.81		2.56		1.56		3.00
Run-off, depth in inches		1.30		2 95		1.80		1.67

FLAMBEAU AND ELDORADO RIVER DRAINAGE BASINS.

Flambeau and Eldorado rivers rise near Salmon Lake and flow in a southerly direction to Bering Sea near Cape Nome.

The Flambeau Hastings ditch has its intake on the upper fork of Flambeau River and is to be built to Hastings Creek, near Cape Nome. Another ditch to Hastings Creek is projected, which will divert the water to Eldorado River below Venetia Creek, and will have a length of over 30 miles. The following measurements were made at the proposed intake of this ditch: August 14, 1906, 44 second feet; September 17, 1907, 225 second feet.

SOLOMON RIVER DRAINAGE BASIN.

Solomon River empties into Bering Sea at Solomon, 40 miles east of Nome. This stream has been a good producer of gold, and several ditches have been built to utilize its water and that of its tributaries, including the East Fork ditch of the Solomon River Hydraulic Company, the Midnight Sun ditch from Big Hurrah Creek, the Brogan ditch from the mouth of Johns Creek to East Fork, and a ditch about 7 miles long on Coal Creek.

A ditch has been started by the Three Friends Mining Company to furnish power for its dredge on Solomon River. It will take water from the river just below East Fork and extend to a point below the mouth of Shovel Creek, where a head of 75 feet will be available.

Discharge measurements in Solomon River drainage basin, 1907.

Date.	Stream and locality.	Drainage area.	Discharge.
		Sq. miles.	*Sec.-ft.*
October 1	Solomon River below Johns Creek	66	43
Do	Brogan ditch at intake		7.7
			50.7
October 2	Solomon River below East Fork	40	96
Do	East Fork ditch	10	17
			113

FLOW OF DITCHES IN NOME REGION.

The following table has been prepared to show in a concise manner the flow of the ditches which take their water supply from Nome River and its tributaries, and from near-by streams. It is also of value for comparison with the discharge of the streams from which the water is taken, to show the percentage of flow that can be delivered by a ditch at the point where it is to be used.

Monthly discharge of ditches in Nome region, 1907.

Ditch.	Point of measurement.	Yearly maximum.	July		August.	September.
		Sec.-ft.	*Days.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
Campion	Black Point	18.0	25	9.0	12.9	12.5
Miocene	do	42.6	29	28.0	34.4	38.7
Do	Clara Creek	37.0	29	25.4	28.7	33.7
Do	Above Hobson	34.9	29	23.6	27.4	31.8
Do	Below Hobson	54.7	31	43.8	45.3	47.9
Do	Flume	55.2	31	45.1	44.0	50.4
Do	David Creek branch	16.5	15	11.3	11.8	9.0
Do	Jett Creek branch	8.2	20	4.9	6.1	[a] 6.1
Do	Grand Central branch	13.4	23	5.7	6.2	9.0
Seward	Nome River intake	29.0	21	23.9	26.2	25.7
Do	Hobson Creek branch		26	5.2	4.3	4.5
Pioneer	Nome River intake [b]	26.8	16	20.4	22.2	21.8
Do	Hobson Creek branch					5.8
Sutton	Intake	35.0	31	23.9	23.8	31.8
Cedric	Penstock	17.8	10	12.3	12.9	9.6

[a] Mean for 14 days.
[b] Values for Pioneer ditch have been estimated at 85 per cent of those for Seward ditch; this was the proportion during the time for which records were obtained on both ditches.

AVAILABLE WATER SUPPLY DURING 1906 AND 1907.

In order to show the amount of water that was available during 1906 and 1907 for hydraulicking the placers near Nome, the mean flow of the streams in each drainage basin has been tabulated by weekly periods in the table on page 72. In using this table the following points should be noted :

The "Nome River high-level flow" represents the total amount of water in that river above the Miocene ditch, including the flow of the Campion ditch, David Creek, and Hobson Creek. The flow of the springs on Hobson creek has been taken as 14 second-feet during 1906 except for the first week in July, when it did not exceed 10 second-feet.

The "Nome River low-level flow" includes all additional water down to Pioneer ditch. The drainage area of Nome River below the Miocene and David Creek intakes and above the Pioneer intake is 18 square miles. The run-off from this area for the period in August, 1907, during which records were kept was at about the same rate per square mile as at the Miocene intake. The low-level flow has therefore been taken as 1.2 times the natural flow at the Miocene intake, where the drainage area is 15 square miles. To this has been added 60 per cent of the discharge of Hobson Creek at the Miocene intake, this being approximately the amount entering that stream between the Miocene and Pioneer intakes.

"Upper Grand Central River," etc., includes the station below the forks and those on Thompson Creek and Gold Run, and gives the amount that can be brought over the Nugget divide.

The mean flow of "Nugget, Copper, and Jett creeks" gives the amount that can be brought over the Nugget divide, and for 1906 was estimated from the few measurements obtained.

The flow of "Sinuk River, Windy and North Star creeks," has been estimated for an elevation of 800 feet, which is as low as the water can be taken over the divide into Nome River. The amount of this flow for 1906 was obtained by taking 70 per cent of the flow of Grand Central River below the forks, this precentage being determined as follows:

Comparison of flow of Grand Central River below forks with that of Sinuk River and its tributaries at elevation of 800 feet.

Date.	Sinuk River.	Windy Creek.	North Star Creek.	Total.	Grand Central below forks.	Sinuk, Windy, and North Star in per cent of Grand Central.
	Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	
June 26, 27	33	22	10	65	105	62
July 6	37	(35)	18	90	....	....
July 13	(75)	86	16	177	198	89
July 20	36	36	4	76	100	76
August 3	20	24	3	47	67	70
August 10	23.5	26	3	52.5	65	81
September 6	(20)	24	(3)	47	67	70

The drainage area of Grand Central River lies on the north side of a ridge of the Kigluaik Mountains, and the basins of Sinuk River and Windy and North Star creeks lie adjacent to it on the south side of the same ridge. On the days when measurements of flow were made of the streams on both sides of the mountains it was found, as shown in the preceding table, that the flow on the south side was from 62 to 89 per cent of the flow on the north side. It is, therefore, conservative to say that the average combined flow of Sinuk River and Windy and North Star creeks was 70 per cent of the flow of Grand Central River below the forks.

During the season of 1907 gaging stations were maintained on all the streams which are summarized below, and their daily discharge is given elsewhere.

The following table should not be taken as indicating the water that can be used. This will, of course, be limited by the capacity of ditches that can be built economically. In the economical construction of a ditch the size will depend largely upon the duration of the low-water flow. This will probably limit the size in most cases to twice the minimum, except for short ditches.

Mean weekly water supply, in second-feet, available for use back of Nome, 1906-1907.

Date.	Available for use at elevation 220 to 280 feet.	Available for use at elevation 400 to 450 feet.				Total.
	Nome River low-level flow.	Nome River high-level flow.	Upper Grand Central, Thompson, and Gold Run.	Nugget, Copper, and Jett creeks.	Sinuk River, Windy and North Star creeks.	
1906.						
July 1-7	43	45	153	7	88	324
July 8-14	155	144	[a] 343	26	173	796
July 15-21	52	58	179	15	90	378
July 22-28	43	49	156	12	79	325
July 29-August 4	36	42	101	8	50	223
August 5-11	39	45	108	8	49	236
August 12-18	49	53	91	8	42	228
August 19-25	81	84	138	10	62	352
August 26-September 1	130	128	202	22	94	540
September 2-8	68	73	101	14	51	287
September 9-18	48	53	68	9	36	199
September 19-30	120	118	250	20	125	599
Mean	72	74	158	13	78	375
Maximum	155	144	343	26	173	796
Minimum	36	42	68	7	36	199
1907.						
July 1-7	135	199	([b])	36	152	522
July 8-14	102	152	292	27	172	745
July 15-21	84	107	228	21	143	583
July 22-28	60	77	183	15	105	440
July 29-August 4	44	59	144	11	77	335
August 5-11	36	49	107	8	50	250
August 12-18	49	62	190	13	95	409
August 19-25	47	61	245	15	86	454
August 26-September 1	72	89	318	18	124	621
September 2-8	51	63	142	14	72	342
September 9-15	176	204	418	40	167	1,005
September 16-23	60	76	115	24	62	337
September 24-30	45	56	([b])	15	([b])	116
Mean	74	96	216	20	109	473
Maximum	176	204	418	40	172	1,005
Minimum	36	49	107	8	50	116

[a] Too small, no record of highest water.
[b] No record. No water could have been used from Grand Central River the first week in July, on account of snow; nor from either Grand Central or Sinuk rivers the last week in September, on account of ice.

DITCH AND PIPE LINES.

In order to bring the water to the gold-producing ground between Capes Nome and Rodney at sufficient elevation to be used for hydraulicking and sluicing, nearly 300 miles of ditch and pipe line have been constructed and several extensive additional systems are now under construction or consideration. The first ditch in this section was built in 1901, by Leland, Davidson, and Bliss, from upper Glacier Creek to Snow Gulch. This ditch demonstrated the practicability of ditch systems in this country and was the beginning of the Miocene system.

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 pick. 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 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 neces-

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

sary. 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 following table gives a list of the principal ditches in this region. Some of the data given are only approximate, as it was necessary to obtain them by inquiry.

Ditches between Cape Nome and Cape Rodney, Seward Peninsula.

Name.	From—	To—	Length.	Date completed.	Bottom width.	Fall per mile.	Capacity.	Elevation. Head.	Elevation. Outlet.
			Miles.		*Feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Feet.*
Miocene Ditch Co.:									
Main ditch	Nome River	Hobson Creek	13	1903	8	4.5	40	572	500
	Hobson Creek	The Ex	14	1902	10	3.37	55	500	445
	The Ex	Snow Gulch	4	1901	8	6.5	55	445	420
Feeding laterals.	Upper Glacier Creek.	The Ex	2	1901	......	......	6	......	445
	Grouse Creek	Flume	4	......	......	......	10	......	478
	Upper New Eldorado Creek.	Buster Creek	10	1907	......	......	6	742	......
	David Creek	Nome River above main intake.	1.8	1905	5	5.28	18	590	580
	Jett Creek	Nugget Divide.	3.5	1906	3.5	6	10	806	785
	Grand Central River.	....do	8	(a)	8-10	5	80	850	785
Distributing laterals.	The Ex	Grass Gulch	4	......	6	3.17	16	445	432
	New Year Gulch.	Cooper Gulch	4	1907	8	5.28	40	417	396
Tunnel	Kanoma Gulch, Glacier Creek	New Year Gulch, Anvil Creek.	[b] 1,800	1904	[c] 4x7	......	......	420	417
Wild Goose Mining and Trading Co.:									
Seward	Nome River below Dorothy Creek.	Anvil Creek	38	1906	10	3.17	32	408	274
Pipe line	Crater Lake	Nugget Divide.	8	(a)	[d] 42	15	60	963	......
	Nugget Divide.	Anvil Mountain.	35	(a)	[d] 48	10	70	......	......
	Pumping plant.	....do	7	......	[d] 18	......	6	......	......
	No. 3, below Little Creek.	Pumping plant.	3	1902	4	5.3	6	......	......
Pioneer Mining Co.:									
South bank	No. 2, above Anvil Creek.	No. 1, below Anvil Creek.	0.75	1902	5	7	4-6	......	......
North bank	No. 4, above Anvil Creek.	Moonlight Reservoir.	1.25	1903	6	......	10-12	......	......
	Nome River, above Clara Creek.	Little Creek	38	1907	8	3.17	30	320	200

[a] Under construction.
[b] Feet.
[c] Cross section.
[d] Diameter in inches.

Ditches between Cape Nome and Cape Rodney, Seward Peninsula—Continued.

Name.	From—	To—	Length.	Date completed.	Bottom width.	Fall per mile.	Capacity.	Elevation.	
								Head.	Outlet.
			Miles.		*Feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Feet.*
United Ditch Co.:									
Sutton	Penny River	Beach	6	1905	20-15	3.12	40	120	90
Highline	do	Sunset Creek	10.5	(a)	7	4.22	......	420	......
Miscellaneous:									
Cedric	Josie Creek	Hungry Creek.	19	1905	4-8	4	25	870	790
Campion	Buffalo	Dorothy Creek.	4	1903	6	7.5	28	610	580
Peninsula Hydraulic Co.	New Eldorado Creek.	Osborn Creek	9	1907	14	......	50	......	......
Northland Mining Co.	Goldbottom Creek.	Balto Creek	12	(a)	......	......	20	390	......
Hot Air	Divining	Glacier Creek, opposite Snow Gulch.	6	1902	......	......	10	......	......
Price and Tremper.	Glacier Creek	Opposite Snow Gulch.	2.5	......	......	......	5	175	......
Golden Dawn.	Twin Mountain Creek.	Alpha Creek	10	(a)	......	......	20	500	......
Corson Mining Co.	Last Chance Creek.	Pioneer Gulch	4	1903	......	......	18	460	......
Plein	No. 7, Otter Creek.	Mouth	1	1904	......	......	3	......	......
Flambeau Hastings.	Head of Flambeau River.	Hastings Creek	29	1906	......	......	20	......	......
Capt. Peterson.	No. 3, below Anvil Creek.	Little Creek	2.5	......	......	......	16	......	......
Cripple River Hydraulic Mining Co.	West bank Cripple River	Fox Gulch	11	(a)	8-10	4	50	......	......
Jourden-Cummings.	Buffalo Creek	Boer Creek	4	1906	4	6	10	1,000	......

a Under construction.

WATER-POWER POSSIBILITIES.

Owing to the great value of water in this region for use in working the auriferous gravels but little attention has been given to power development. In various portions of the peninsula there are, however, excellent power sites whose development is feasible from both an engineering and a financial standpoint. The scarcity of fuel makes steam power very expensive, and it is probable that much of the future mining, especially along the tundra back of Nome and along the larger streams, will be carried on by dredging or by some form of elevating in which power will play an important part. With this in view, the attention of capitalists should be directed to the consideration of power possibilities.

Work has been begun at Salmon Lake on the construction of a dam. (See p. 54.) The Three Friends Mining Company has started a ditch on Solomon River to develop power for its dredge.

Many streams in the Kigluaik Mountains, notably the glacier-fed torrents on their northern slope, are available for developments under a high head.

THE KOUGAROK REGION.

By Fred F. Henshaw.

INTRODUCTION.

In 1907 the investigation of streams begun the previous year in the Nome region was extended to the Kougarok region. Owing to the large area that had to be covered and the lack of railroad or other transportation facilities only a few regular stations were maintained, and on most of the streams only a few discharge measurements were made. The work was carried on by the writer, who was in this district from July 15 to September 18.

In the present report the name Kougarok region is used to include not only most of the Kougarok precinct, but parts of the adjoining Port Clarence and Goodhope precincts. The drainage basin of Kruzgamepa River, though included in the Kougarok precinct, has already been considered with the Nome region, with which it more naturally falls.

A summary of the records in this region is combined with one for the Nome region (see p. 95), in order to afford a comparison of conditions in the two districts.

DESCRIPTION OF AREA.

The Kougarok region lies northeast of the Kigluaik Mountains, in the central portion of Seward Peninsula. It is about 50 miles square, embracing the drainage basin of Kougarok River and parts of the adjoining basins of Noxapaga, Serpentine, and American rivers.

Most of this area is comprised in an upland which represents a former level of erosion. The flat-topped ridges of the hills lie at an elevation of 1,000 to 1,600 feet. Several mountain masses rise above the level of the plateau, notably Kougarok, Midnight, and Baldy mountains. Into this plateau the river channels are deeply cut. The streams flow in steep canyons, above which one or more levels of benches can usually be traced. The rivers drain southward into the Kuzitrin, which flows through the broad lowland basin separating this region from the Kigluaik Mountains.

The general slope of the rivers from source to mouth is more uniform than in the Nome region. The fall occurs mostly in riffles separated by pools of slack water. The stream beds are narrower and have shallower gravel deposits than most of the streams south of the mountains. (See Pl. VIII, *A*, p. 80.)

A large portion of the area, probably 40 to 60 per cent, is underlain with frozen muck and ground ice, which was observed in some places to have a thickness of 25 to 30 feet. This is covered with moss, and unless exposed by stripping never thaws deeper than a few inches.

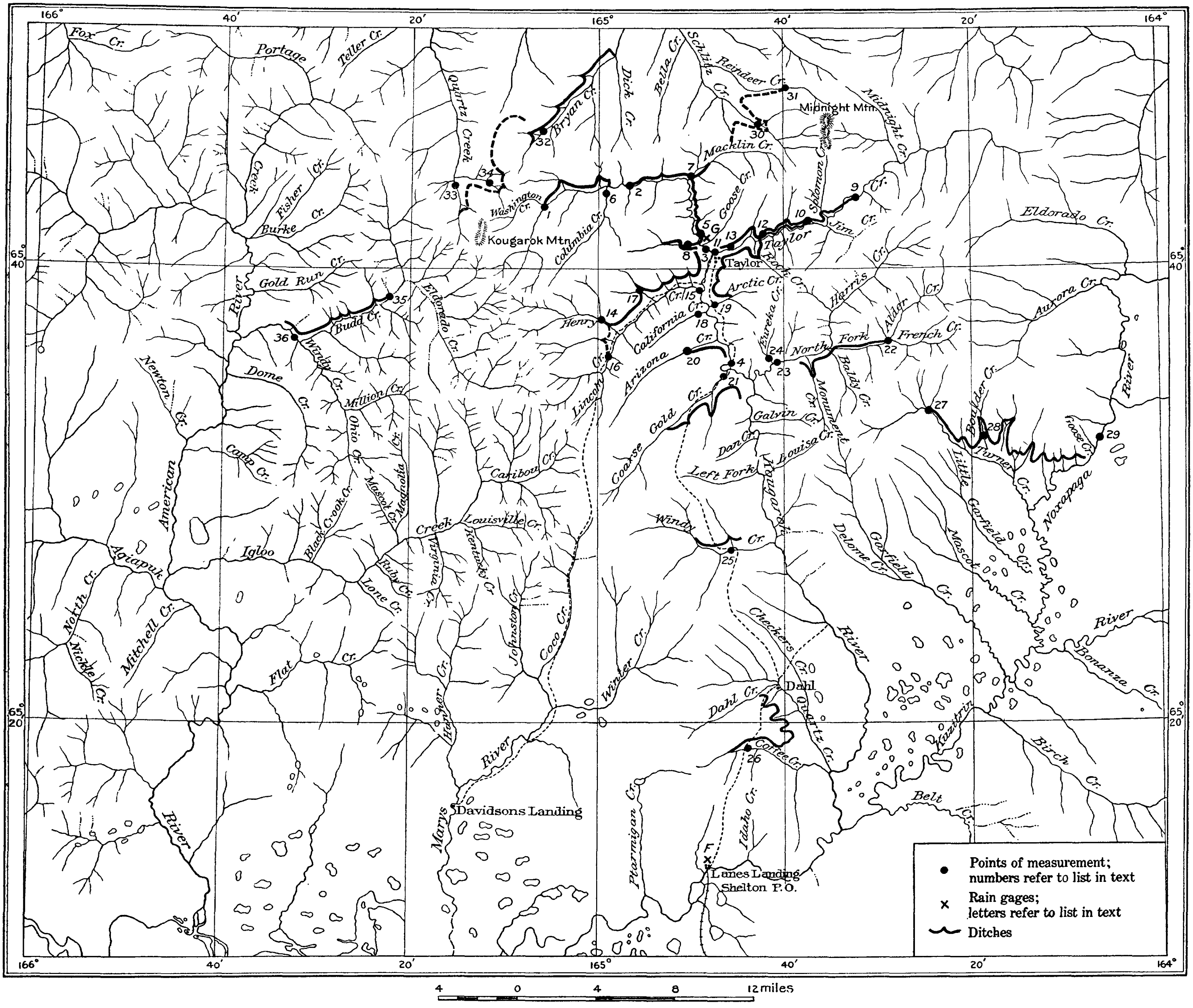
CONDITIONS AFFECTING WATER SUPPLY.

In general the water supply of the Kougarok region comes from the same sources as that of the Nome region, namely, summer rains, melting of snow, and melting of frozen ground.

The difference in rainfall between this area and that south of the mountains is striking. The totals of 2.51 and 2.79 inches for Shelton and Taylor, respectivly, are only about one-sixth of the total at Grand Central and only one-third to one-half of those of the other three rainfall stations. (See p. 137.) The Kougarok region is in a measure cut off from the comparatively abundant rainfall of the Nome region by the Kigluaik Mountains. This high and steep range causes most of the moisture from the southerly winds to be precipitated on its southern slope, leaving little to be carried into the region farther north. The northerly winds bring heavy clouds and fog banks from the Arctic Ocean, but they yield little rain.

In 1907 there was no rain in this region until the middle of July and very little until a month later, so that the run-off up to August 1 came mostly from melting snow. During the three weeks of extremely low water that followed the water must have been derived from the melting of the ground and the snow banks that still remained, partly from springs, and only to a slight degree from the rainfall. The ground is all frozen muck, and is so protected by moss that it never thaws more than a few inches. There can be no regulation of flow by ground storage, therefore, and the rain finds its way into the streams immediately after it falls. This effect is more marked here than in the Nome region. Thus, on July 24, 1907, the flow of Taylor Creek rose from 10 to 186 second-feet in two or three hours, and four days later had fallen again to about 13 second-feet.

But little definite information can be obtained in regard to climatic conditions in former years in the Kougarok region. The last season was one of drought in that region, whereas the water supply south of the mountains was plentiful. The most reliable information that could be obtained was to the effect that the low-water periods of 1900



MAP SHOWING LOCATION OF GAGING STATIONS AND DITCHES IN KOUGAROK REGION.

and 1906 were fully as long and as severe as that of 1907. During the week of August 10 to 16, 1907, the flow at all the gaging stations remained nearly constant, and was probably as low as it would have become had the weather continued dry, as practically all the water must have come from springs and from the melting snow. Whenever there occurs a period of two weeks or more in midsummer without rain, the flow is likely to become as small as in 1907.

GAGING STATIONS.

The following is a list of the points in the Kougarok region at which gages were established or discharge measurements made in 1907. The numbers refer to Pl. VII.

Gaging stations in Kougarok region.

1. Kougarok River below Washington Creek, Washington Creek, and Irving ditch.
2. Kougarok River at Homestake intake and Homestake ditch.
3. Kougarok River above Taylor Creek.
4. Kougarok River above Coarse Gold Creek.
5. Homestake ditch at penstock.
6. Columbia Creek.
7. Macklin Creek.
8. Homestake Creek.
9. Taylor Creek at North Star intake.
10. Taylor Creek at Cascade intake.
11. Taylor Creek at mouth.
12. North Star ditch above siphon.
13. Cascade ditch.
14. Henry Creek at ditch intake.
15. Henry Creek at mouth.
16. Lincoln Creek at ditch level.
17. Lillian Creek.
18. California Creek.
19. Arctic Creek.
20. Arizona Creek.
21. Coarse Gold Creek.
22. North Fork at Northwestern intake.
23. North Fork above Eureka Creek.
24. Eureka Creek.
25. Windy Creek and ditch.
26. Coffee Creek and ditch.
27. Turner Creek at McKays intake.
28. Boulder Creek.
29. Noxapaga River above Goose Creek.
30. Schlitz Creek.
31. Reindeer Creek.
32. Bryan Creek.
33. Quartz Creek.
34. Bismark Creek.
35. Budd Creek spring.
36. Budd Creek below Windy Creek.

KOUGAROK RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kougarok River drains a large area lying in the central portion of Seward Peninsula and empties into the Kuzitrin about 8 miles above Lanes Landing. It rises southeast of Kougarok Mountain and flows northward, then eastward, and after making a sharp bend to the right flows a little east of south to its mouth. The largest tributaries are Taylor Creek and North Fork from the east, and Henry, Coarse Gold, and Windy creeks from the west. Of less importance are Washington, Columbia, Macklin, Homestake, Goose, California, Arctic, Arizona, Louisa, Galvin, and Dan creeks, and Left Fork. Quartz Creek, which empties into the river below those named above, and its tributaries, Coffee, Dahl, Checkers, Carrie, and Independence creeks, have been the most important gold producers of the region, but have a very small run-off except at times of heavy rain.

KOUGAROK RIVER BELOW WASHINGTON CREEK.

The following measurements were made to determine the water supply available for the ditch of the Irving Mining Company, which is about 200 feet higher than the Homestake ditch: July 27, 4.5 second-feet; August 12, 2.2 second-feet; September 9, 122 second-feet.

KOUGAROK RIVER AT HOMESTAKE INTAKE AND HOMESTAKE DITCH.

These stations are located about 100 yards below the intake of Homestake ditch (see Pl. VIII, *A*), and the sum of their discharges gives the total flow of the river at this point. The gage was read by employees of the Kugarok Mining and Ditch Company.

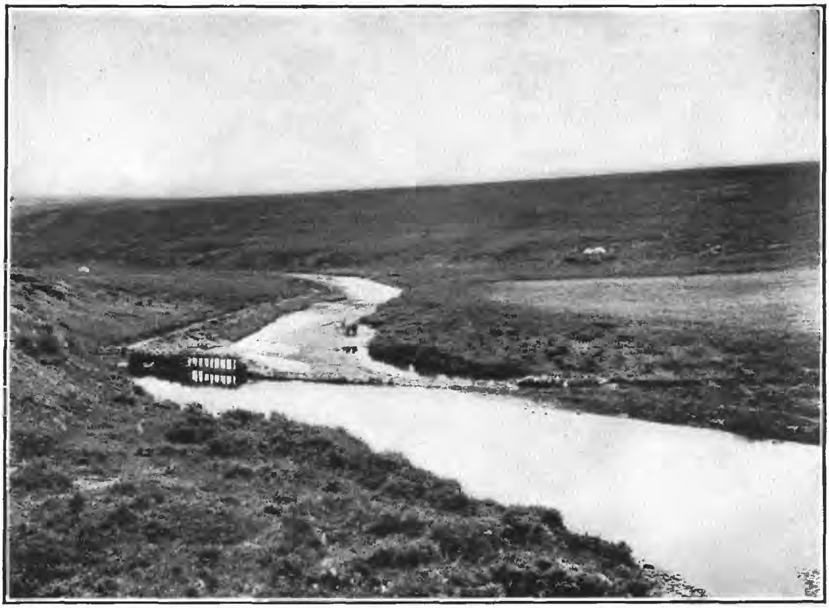
Discharge measurements of Kougarok River at Homestake intake and Homestake ditch, 1907.

KOUGAROK RIVER.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 15	1.24	18.0	August 22	1.64	82
Do	1.13	6.6	September 1	.89	.5
July 20	1.08	2.0	September 4	1.34	42
August 9	.92	3.1	September 10	2.47	303
August 12	.90	2.2	September 11	1.98	153
August 19	.92	3.3			

HOMESTAKE DITCH.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
July 15	0.51	11.6	August 19	0.28	7.4
Do	.45	10.2	Do	.27	7.3
Do	-.05	.4	August 22	.62	17.6
July 20	.36	8.1	Do	.75	23.0
July 29	.20	5.7	September 10	.44	12.0
August 12	-.04	1.5			



A. INTAKE OF HOMESTAKE DITCH ON KOUGAROK RIVER.

B. HOMESTAKE DITCH, SHOWING SOD WORK.

Daily gage height and discharge of Kougarok River at Homestake intake and Homestake ditch, 1907.

Day.	July.				August.				September.			
	River.		Ditch.		River.		Ditch.		River.		Ditch.	
	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						0.4	0.25	6.8	1.01	10.8	0.62	17.8
2						.4	.15	4.8	1.15	22	.66	19.4
3						.4	.18	5.3	1.12	20	.68	20.2
4						.4	.32	8.5	1.35	42	.64	18.6
5						.4	.28	7.5	1.57	71	.58	16.3
6						.4	.20	5.7	1.44	53	.64	18.6
7						.4	.16	4.9	1.28	35	.64	18.6
8						.4	.10	3.8	1.16	23	.65	19.0
9					0.92	3.2	.06	3.2	1.78	110	.69	20.6
10					.90	2.2	−.02	2.0	2.56	336	.55	15.2
11					.90	2.2	−.03	1.8	1.86	124	.62	17.8
12					.90	2.2	−.04	1.7	1.54	67	.65	19.0
13					.89	1.7	−.06	1.5	1.33	40	.66	19.4
14					.90	2.2	−.06	1.5	1.17	24	.66	19.4
15	1.24	18		0	.91	2.7	−.08	1.2	1.74	99	.66	19.4
16		3.0		13.0	.91	2.7	−.08	1.2	1.50	61	.68	20.2
17		3.0		12.0	.91	2.7	+.04	2.8	1.22	29	.69	20.6
18		3.0		10.0	.92	3.2	.12	4.2	1.11	18.9	.70	21.0
19		3.0		9.0	.92	3.2	.28	7.5	1.04	13.2	.62	17.8
20	1.08	2.9	0.36	8.0	.91	2.7	.18	5.3	1.10	18.0	.30	8.0
21	1.05	2.0	.40	9.0	1.40	48	.60	17.0				
22	1.04	1.6	.31	6.7	1.71	93	.61	17.4				
23	1.00	.4	.34	7.4	1.58	72	.61	17.4				
24	1.20	14.0	.62	15.4	1.17	24	.63	18.2				
25	1.03	1.3	.55	15.2	1.54	67	.58	16.3				
26	1.00	.4	.49	13.2	1.28	35	.59	16.6				
27	.88	.4	.42	11.1	1.22	29	.66	19.4				
28	.89	4	.26	7.1	1.09	17	.62	17.8				
29		.4	.22	6.2	.96	5.8	.61	17.4				
30		.4	.21	5.9	.95	5.0	.69	20.6				
31		.4		6.4	.89	.5	.57	16.0				
Mean		3.2		9.2		13.9		8.9		60.8		18.3

NOTE.—Discharges for July 16 to 19 are estimated. All water was carried in the ditch from July 26 to August 8, inclusive, except the seepage through the diversion dam, which was estimated. During this time about 2 second-feet was turned out of the first waste gate to furnish a sluice head for operators who were working in the river bed below.

Monthly discharge of Kougarok River at Homestake intake, 1907.

[Drainage area, 44 square miles.]

Month.	Discharge in second feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft per sq. mile.	Depth in inches.
July 15-31	29	6.3	12.4	0.28	0.18
August	110	3.2	22.8	.52	.60
September 1-20	351	26	79.1	1.80	1.34
68 days	351	3.2	36.8	.84	2.12

NOTE.—These values include the discharge of both the river and Homestake ditch, as given in the previous table.

KOUGAROK RIVER ABOVE TAYLOR CREEK.

The following measurements were made just above the mouth of Taylor Creek, to compare the flow of the two forks at their junction, and to determine the discharge available for a ditch at this level: July 26, 18.5 second-feet; July 29, 8 second-feet; August 10, 5.1 second-feet.

KOUGAROK RIVER ABOVE COARSE GOLD CREEK.

Between the mouths of Taylor Creek and North Fork, Kougarok River has a meandering course, with well-marked benches along most of the distance. At the mouth of Coarse Gold Creek it makes a bend which brings two points more than 2 miles apart by river within 560 feet of each other in a straight line. A tunnel through this neck would drain the gravels in this stretch of river bed and make them accessible for working, and would also render available a considerable water power. The difference in level of the water surface at the two ends of the tunnel is about 17 feet. An outcrop of rock which crosses the river just below the proposed tunnel intake would make a fairly good dam site. A gaging station was established at this point July 15, 1907. The gage was located just above the rock outcrop mentioned above, where the channel is permanent, and was read by William Ellis. The bench mark is a cross on the highest point of a rock near the left bank, about 200 feet above the tunnel entrance; elevation, 2.18 feet above the datum of the 1907 gage.

The discharge at this station also gives the water supply that would be available for a low-line ditch to Dahl Creek. Such a ditch is proposed. It will have its intake on Kougarok River below Dreamy Gulch and on Henry Creek near the mouth, and will extend to Dahl and Coffee creeks, a distance of over 30 miles. Only a small percentage of the water enters the river between these proposed intakes and the gaging station.

Discharge measurements of Kougarok River above Coarse Gold Creek, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 14	1.11	89	August 8	0.44	19
July 21	.86	51	August 14	.40	17
July 23	.74	36	August 23	2.22	460
July 30	.64	33	August 26	1.95	323

Daily gage height and discharge of Kougarok River above Coarse Gold Creek, 1907.

[Drainage area, 250 square miles.]

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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			0.70	35		210	19	0.90	54	1.12	92		160
2			.63	31		230	20	.84	47	1.08	84		130
3			.60	29		205	21	.82	45	1.68	229		
4			.63	31		280	22	.82	45	2.25	490		
5			.60	29		500	23	.75	39	2.22	472		
6			.57	27	2.15	430	24	1.14	96	2.19	454		
7			.50	23	2.10	400	25	1.58	200	2.22	472		
8			.46	21	1.80	270	26	1.20	109	1.99	341		
9			.38	16		600	27	1.06	81		280		
10			.38	16	3.50	1,240	28	.83	46		240		
11			.38	16		550	29	.70	35		210		
12			.37	16		350	30	.66	33		360		
13			.39	17	1.80	270	31	.72	37		190		
14	1.09	86	.40	17	2.23	478	Mean		67.2		141		388
15	1.03	75	.40	17		600	Run-off per square mile		.27		.56		1.55
16	.98	67	.43	19		380	Run-off, depth in inches		.18		.65		1.15
17	.90	54	.50	23		270							
18	.94	60	1.03	75		200							

NOTE.—Discharges for days when gage was not read were estimated with the aid of a hydrograph.

IRVING DITCH.

The Irving ditch was built in 1906, and has its intake on Kougarok River at the mouth of Washington Creek. It extends for 4½ miles along the north bank of the river to a point opposite the mouth of Columbia Creek, where a head of 160 feet is obtained.

The following measurements were made of the discharge of the ditch: August 12, 1.8 second-feet; September 9, 12.4 second-feet.

HOMESTAKE DITCH.

The Homestake ditch of the Kugarok Mining and Ditch Company was begun in 1905 and completed in 1907. It diverts the water from the upper Kougarok, near Mascot Gulch, and extends along the left bank of the river to a point opposite the mouth of Homestake Creek, having a total length of 7½ miles. The water is carried across Macklin Creek in a siphon 843 feet long, of 36 and 34 inch pipe.

Above Macklin Creek the ditch is built into the rocky bluffs of close-grained schists and slates for about 1 mile. Below the siphon some ground ice was encountered, and also a large amount of loose rock mixed with ice and frozen muck, which gave much trouble. Nearly half of the length of the ditch had to be lined with sod, some parts requiring both sides and bottom of this material. (See Pl. VIII, *B*.) In 1907 a lateral ditch was built to Macklin Creek. It is 6,300 feet long and 4 feet wide on the bottom.

The water was used during the latter part of 1906 in the bed of the river just above Taylor Creek. A waste ditch was formed by a retaining wall built on one side of the channel; but at times this was overtopped and the workings flooded. The discharge at such times was estimated at 600 to 800 second-feet.

During the season of 1907 the water was used on the John L. bench claim, on the right bank of the river below Homestake Creek. A head of about 150 feet is available on this claim.

Two stations were maintained on the ditch, at the intake and just above the penstock. The discharge at the intake is given on page 81.

The station above the penstock was maintained during the high-water period of 1907, to determine the amount of water used at the mine. The gage was read by employees of the Kugarok Mining and Ditch Company.

Discharge measurements of Homestake ditch above penstock, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
August 21	1.19	9.1	August 26	1.60	18.0
Do	1.49	15.6	September 11	1.74	21.0
August 22	1.47	15.0			

Daily gage height and discharge of Homestake ditch above penstock, 1907.

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			1.76	21.5	18			1.76	21.5
2			1.70	20.2	19			1.68	17.8
3			1.62	18.4	20			1.15	8.4
4			1.75	21.3	21	1.34	12.3		
5			1.54	16.7	22	1.48	15.4		
6			1.70	20.2	23	1 54	16.7		
7			1.70	20.2	24	1.54	16.7		
8			1.70	20.2	25	1.60	18.0		
9			1.72	20.6	26	1.60	18.0		
10			1.52	16.2	27	1.56	17.1		
11			1.74	21.1	28	1.58	17.6		
12			1.75	21.3	29	1.58	17.6		
13			1.76	21.5	30	1.68	19.8		
14			1.76	21.5	31	1.70	20.2		
15			1.76	21.5					
16			1.74	21.1	Mean		17.2		19.6
17			1.76	21.5					

TAYLOR CREEK AT NORTH STAR INTAKE.

Taylor Creek is the longest tributary of Kougarok River and is larger than the main stream at their junction. It rises near the headwaters of Noxapaga and Goodhope rivers and flows in a southwesterly direction. Its principal tributaries are Midnight, Solomon, Jim, Brown, Rock, and Arizona creeks. Two ditches have been built on Taylor Creek—the North Star, with its intake about 3 miles above Solomon Creek, and the Cascade, which takes out water about 5 miles farther downstream.

The following measurements were made at North Star intake to determine the water supply available for the ditch: July 17, 12 second-feet; July 24, 174 second-feet; August 10, 3.8 second-feet; September 13, 94 second-feet. They indicate a discharge of 75 to 90 per cent of that at the Cascade intake; the drainage area is 58 square miles, or 78 per cent of that at the lower point.

TAYLOR CREEK AT CASCADE INTAKE.

This station was established to determine the total water supply of the two ditches on Taylor Creek. It is located about 100 yards above the diversion dam of the ditch. During August and September a part of the discharge of the creek was diverted past the station in the North Star ditch; the amount of this diversion is given on page 87. The gage was read by employees of the Cascade Mining and Ditch Company.

Discharge measurements of Taylor Creek at Cascade intake, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 17	0.67	16	August 10	0.49	4.6
July 24	1.65	186	August 21	1.95	268
July 26	.93	43	August 24	1.30	91

Daily gage height and discharge of Taylor Creek at Cascade intake, 1907.

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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				7	1.12	67	18		20	0.84	32	1.00	50
2				7	1.24	87	19		15	1.15	72		45
3				7	1.15	72	20		13	.95	44		35
4				6	1.25	89	21		13	1.60	164		
5				6	1.55	152	22		12	1.48	136		
6				6	1.36	110	23		10	1.38	114		
7				5	1.25	89	24	1.65	186	1.25	89		
8				5	1.00	50	25		80	1.65	178		
9				4.6	1.24	87	26	.93	43		147		
10			0.49	4.6	2.40	430	27		25	1.39	116		
11				4	1.80	220	28		13		98		
12				4	1.45	129	29		8	1.20	80		
13			.31	2.5	1.30	98	30		8	1.65	178		
14			.42	3.9	1.15	72	31		8	1.20	80		
15		20	.47	4.6	1.60	164							
16		18	.50	5.0	1.30	98	Mean		29.9		52.2		111
17	0.67	16	.57	9.2	1.15	72							

NOTE.—Discharges for days on which gage was not read were obtained by the aid of a hydrograph.

Monthly discharge of Taylor Creek at Cascade intake, 1907.

[Drainage area, 74 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
July 15-31	186	8	29.9	0.40	0.25
August	186	3.9	54.2	.73	.84
September 1-20	441	35	119	1.61	1.20
68 days	441	3.9	67.1	.91	2.29

NOTE.—These values include the discharge of both the creek and North Star ditch; for daily discharge of the ditch see page 87.

TAYLOR CREEK AT MOUTH.

The following measurements of Taylor Creek were made near the mouth, to compare its discharge with that of Kougarok River above the mouth of Taylor Creek and to determine the discharge available for a ditch at this level: July 17, 18 second-feet; July 26, 46 second-feet; July 29, 9.6 second-feet; August 10, 7.2 second-feet.

NORTH STAR DITCH ABOVE SIPHON.

The North Star ditch of the Taylor Creek Ditch Company was begun in 1905 and completed in 1907. It diverts water from Taylor Creek about 12 miles above its mouth and about 3 miles above the mouth of Solomon Creek. The ditch lies on the left bank for the first mile, then crosses the creek in a flume and continues on the right bank to a point 7 miles below the intake. Here it crosses Taylor Creek in a siphon 2,600 feet long, composed of 40-inch steel pipe, riveted throughout, there being no slip joints. The pipe is carried across the creek on a suspension bridge about 100 feet long. The difference in elevation between the ends of the siphon is 19 feet, and the depression at the bottom 150 feet. Below the siphon the ditch receives the flow of Rock Creek and continues to Arctic Creek, having a total length of 15.2 miles.

Water was turned into the ditch at the intake about August 5, but was not run through the siphon until about the 20th. The water was used on the Thorson bench, on the left bank of Kougarok River, and for stripping on Dreamy Gulch, a small tributary from the east.

The station above the siphon was established to determine the amount of water diverted past the gage at the Cascade intake. The quantity used at the mines includes in addition the discharge of Rock Creek. The gage was read by employees of the Taylor Creek Ditch Company.

Discharge measurements of North Star ditch above siphon, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
August 10		a 2.9	September 5	1.14	7.0
August 21	1.05	5.0	September 13	1.24	9.7
August 24	.50	0.0	Do		a 8.0

a Measured at intake.

Daily gage height and discharge of North Star ditch above siphon, 1907.

Day.	August Gage height.	August Discharge.	September Gage height.	September Discharge.	Day.	August Gage height.	August Discharge.	September Gage height.	September Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec-ft.*
1			1.21	8.8	18			1.22	9.2
2			1.16	7.5	19				
3			1.11	6.2	20				
4			1.16	7.5	21				
5			1.18	8.0	22	1.04	5.0		
6			1.17	7.8	23	1.09	5.8		
7			1.18	8.0	24				
8			1.14	7.0	25	1.18	8.0		
9			1.14	7.0	26	1.14	7.0		
10			1.28	11.3	27	1.05	5.2		
11			1.30	12.0	28	1.15	7.2		
12			1.22	9.2	29	1.18	8.0		
13		a 1.5	1.25	10.2	30	1.14	7.0		
14			1.24	9.9	31	1.16	7.5		
15			1.30	12.0					
16			1.28	11.3	Mean		b 6.2		9.0
17			1.22	9.2					

a Estimated. b Ten days.

CASCADE DITCH.

The Cascade ditch was built in 1906. It diverts water from Taylor Creek about 7 miles above its mouth and 110 feet lower than the North Star ditch. For the first quarter of a mile the ditch lies on the left bank of the creek; it then crosses to the right bank in a flume about 60 feet long, and extends within a half a mile of the mouth of Taylor Creek, having a total length of 6¼ miles. The flow of the ditch was very irregular during 1907, on account of breaks, repairs, and interruption of work at the mine. The water was used to run a hydraulic elevator in the bed of Taylor Creek. The water supply of the ditch was insufficient for this purpose during the first two weeks of August, and the pit was flooded on account of insufficient waste-way capacity most of the time after August 20.

The following measurements were made of the discharge of the ditch:

Discharge measurements of Cascade ditch, 1907.

Date.	Place.	Discharge.
		Sec.-ft.
August 10	Flume near intake	4 4
August 18	Near penstock	5.8
August 21	do	4.5
September 5	do	7.1

HENRY CREEK.

Henry Creek, which enters Kougarok River about 2 miles below the mouth of Taylor Creek, is the largest tributary from the west, and in dry weather furnishes the steadiest high-level water supply in the Kougarok drainage area. Its headwaters lie south of the upper Kougarok River and adjoin those of Budd Creek on the west. Lincoln Creek, which rises between Henry and Coarse Gold creeks, is the most important tributary. Lillian Creek enters from the north, about 4 miles from the mouth.

The Henry Creek ditch, which was built by the T. T. Lane Company in 1905 and 1906, extends from Henry Creek about 2 miles above the mouth of Lincoln Creek to a point near the mouth of Homestake Creek, and has a total length of 10¼ miles. An additional 3¼ miles would divert Lincoln Creek. No water was running in the ditch in 1907. It is now the property of the Taylor Creek Ditch Company.

Measurements were made at the ditch intakes and also at the mouth. The total flow at ditch level on the dates when it was measured was about 70 per cent of that at the mouth, and has been estimated as the same proportion for days when measurements were made only at the mouth.

Discharge measurements of Henry and Lincoln creeks, 1907.

Date.	Henry Creek at mouth.	At ditch level.		
		Henry Creek.	Lincoln Creek.	Total.
	Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
July 16		10.0	8.2	18.2
July 25	22.0	7.4	8.0	15.4
July 30	9.6			6.8
August 9	8.2			5.7
August 13	6.8	2.7	2.3	5.0
August 20	12.0	5.0	3.3	8.3
August 23	60			42
August 26	34			24
August 29	27			19
September 6	55			38
September 12	99	41	42	83

The following measurements of Lillian Creek show the amount of water it would contribute to the Henry Creek ditch: July 16, 1.0 second-feet; August 20, 0.6 second-feet; September 12, 6 second-feet.

COARSE GOLD CREEK.

Coarse Gold Creek is one of the larger tributaries of Kougarok River. It has a total length of about 16 miles, and flows in a northeasterly direction, entering the river about 25 miles above the mouth. The creek is relatively flat in its upper portion, and has a fall of 40 to 80 feet per mile in the lower 6 miles.

The Coarse Gold ditch, constructed in 1907, has its intake about 5 miles above the mouth, and is built along the south slope of the valley, picking up the flow of Jones Gulch and Nugget Gulch. It extends about 5 miles to Two-bit Gulch, a small tributary of Kougarok River, where a head of nearly 300 feet is obtained. Measurements were made near the mouth of the creek. They show the water supply available for the ditch, as practically the whole flow is diverted.

Discharge measurements of Coarse Gold Creek near mouth, 1907.

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
July 21	7.8	August 26	29
July 30	3.5	August 28	30
August 8	3.4	September 6	29
August 12	3.0	September 8	22
August 23	44	September 15	156

NORTH FORK.

North Fork is formed by the junction of French and Alder creeks and enters Kougarok River from the east, about a mile below the mouth of Coarse Gold Creek. Its principal tributaries are Harris, Baldy, Monument, Queen, Magnet, and Eureka creeks. Harris Creek is dry during low water for the lower 4 miles, the water flowing underground through the limestone which forms its bed. The flow of North Fork also is underground for over a mile, and appears again as a spring about a mile above Harris Creek.

In 1906 the Northwestern Development Company began a ditch which has its intake just below the junction of French and Alder creeks, extends along the north bank about 3 miles, and then crosses in a siphon to the south bank. Six miles of ditch are completed.

A lower ditch is proposed which will take its water above Eureka Creek and will extend to Dahl Creek. Measurements were made to show the water available for both ditches.

Discharge measurements of North Fork, 1907.

Date.	At Northwestern intake (drainage area, 20 squaremiles).	Above Eureka Creek (drainage area, 66 squaremiles).
	Sec.-ft.	*Sec.-ft.*
July 22	2.5	13.0
August 15	.7	9.6
August 27	31	103
September 7	17	70
September 15	[a] 36	122

[a] Estimated.

MISCELLANEOUS MEASUREMENTS.

Measurements of a number of the smaller streams and ditches in the Kougarok drainage are given in the following table. Their location is indicated on the map (Pl. VII, p. 78). Macklin Creek is tapped about 1 mile from the mouth by a branch of the Homestake ditch. The Okdurok ditch diverts the flow of Homestake Creek.

The Arizona Creek ditch is 2 miles long and is built to the benches of the Kougarok, having an elevation of 185 feet above the river. The Windy Creek ditch is 4 miles long and gives a head of 150 feet above the creek at Anderson Gulch, where the water is used for ground sluicing. The McMonagle, Dolan & McFadden, and Blocker & Sayle ditches divert water from Kougarok River between the Homestake intake and Macklin Creek, and are used to furnish a sluice head for shoveling into boxes.

Miscellaneous measurements in Kougarok River drainage basin, 1907.

CREEKS.

Date.	Stream and locality.	Discharge.
		Sec.-feet.
July 21	Arctic, near mouth	0.6
August 26	do	1.5
September 6	do	3.0
August 29	Arizona, including ditch	5.1
September 8	do	6.2
August 29	California, near mouth	1.1
July 12	Coffee, near Wonder Gulch	.5
July 27	Columbia, near mouth	1.5
September 9	do	19
September 7	Eureka, near mouth	5.8
July 22	Harris, claim 15	1.0
August 22	Homestake, including ditch	4.0
September 6	do	8.7
August 19	Macklin, including ditch	5.5
August 22	do	19
September 11	do	20
August 12	Washington, near mouth	.13
September 9	do	40
July 13	Windy, including ditch	9.0
July 31	do	4.8
August 8	do	3.0

DITCHES.

August 29	Arizona Creek ditch	1.8
September 8	do	1.8
August 19	Blocker & Sayle ditch	3.0
September 11	do	4.1
August 19	Dolan & McFadden ditch	2.5
Do	Macklin branch	4.0
Do	McMonagle ditch	3.0
August 22	Okdurok ditch	3.0
September 6	do	2.3
July 31	Windy Creek ditch	1.8
August 8	do	1.0

TOTAL WATER SUPPLY IN 1907.

The amount of water that would have been available in 1907 for the use of the principal ditches of the Kougarok drainage basin, built and proposed, is summarized by weekly periods in the accompanying table. The following points should be noted:

The flow available "for Dahl Creek at elevation 300 to 350 feet" is the quantity that could have been diverted by proposed low-line ditches, one taking water from Kougarok River near Dreamy Gulch and from Henry Creek near the mouth, the other from North Fork above Eureka Creek. These ditches could be combined into one below the mouth of North Fork. The water in the North Star and Henry Creek ditches could be carried past the intakes and used below them, so that the flow available for the low-line ditch as given in the table would be reduced by the amount so diverted. Practically none of the discharge of Coarse Gold Creek would be available for this ditch, as it would be used in the high-level ditch.

The flow available for "upper Kougarok at elevation 600 to 700 feet" is the sum of the discharges of the five principal forks of the river at the ditch intakes. At least 75 per cent of the discharge of Taylor Creek is available for the North Star ditch and the remainder for the Cascade ditch. The values for Henry and Coarse Gold creeks and North Fork were estimated with the aid of hydrographs and are only approximate.

Several other streams would furnish some water at high and low level, notably Homestake and Rock creeks. At low water this would be less than 1 second-foot for any single stream and may be disregarded; at high water it would not be needed.

Mean weekly water supply, in second-feet, of Kougarok River drainage basin, 1907.

Date.	For Dahl Creek at elevation 300 to 350 feet.			For upper Kougarok at elevation 600 to 700 feet.					
	Kougarok River.	North Fork.	Total.	Kougarok River.	Taylor Creek.	Henry Creek.	Coarse Gold Creek.	North Fork.	Total.
July 15-21	57	22	79	14	16	19	12	5.2	66
July 22-28	88	22	110	13	53	14	9.6	3.0	93
July 29-August 4	33	12	45	6.7	7.3	7.3	3.8	1.2	26
August 5-11	21	10	31	5.4	5.0	6.3	3.3	1.0	21
August 12-18	26	13	39	4.5	9.0	5.4	3.9	1.0	24
August 19-25	328	73	401	60	117	28	29	30	264
August 26-September 1	262	83	345	33	117	21	26	27	224
September 2-8	331	76	407	57	100	33	27	21	238
September 9-15	584	117	701	133	181	94	100	44	552
September 16-20	228	45	273	46	68	33	39	17	203
Mean	196	47	243	37.3	67.3	26.1	25.4	15.0	171
Maximum	584	117	701	133	181	94	100	44	552
Minimum	21	10	31	4.5	5.0	5.4	3.3	1.0	21

NOXAPAGA RIVER DRAINAGE BASIN.

Noxapaga River is the largest tributary of the Kuzitrin, and enters that stream from the north about 15 miles above the mouth of the Kougarok. The northwestern portion of its basin resembles that of Kougarok River, which it adjoins. An extensive lava flow covers the eastern portion, and the southern or lower end lies in the lowland area known as the Kuzitrin Flats.

Above the mouth of Goose Creek the river has been crossed by a recent lava flow, forming rapids in which there is a descent of 96 feet in 2.3 miles. Above the rapids the river has hardly any fall for several miles.

During 1907 a ditch was built by the McKay Hydraulic Mining Company from Turner Creek, a tributary to the Noxapaga from the northwest, to benches on the river above Goose Creek. It has a total length of 16 miles, and diverts water from Turner, Boulder, Miller, Winona, and several smaller creeks.

Measurements were made in this drainage basin at extreme low water and in no wise represent the average flow. The seasonal variation of the smaller streams was probably as great as in the Kougarok River basin, and the high-water discharge of the Noxapaga can probably be safely estimated as the same per square mile as that of the Kougarok.

Discharge measurements in Noxapaga River drainage basin, 1907.

Date.	Stream and locality.	Drainage area	Discharge.
		Sq. miles.	*Sec.-feet.*
August 15	Turner Creek at McKay intake	13	0.7
Do	Boulder Creek at claim 5		.8
August 16	Noxapaga River above Goose Creek	340	62

SERPENTINE RIVER DRAINAGE BASIN.

Serpentine River drains a large area lying north of the Kougarok. Measurements were made of only a few streams in the headwaters.

SCHLITZ AND REINDEER CREEKS.

These creeks rise on the slope of Midnight Mountain, and flow northwestward into Serpentine River. A ditch has been started by the Kugarok Mining and Ditch Company which will be about 8 miles long and will divert the flow of these creeks over a low divide into Macklin Creek, where it will be picked up by a branch of the Homestake ditch. Measurements were made near the proposed diversions, as follows: Schlitz Creek, August 11, 0.7 second-feet; September 4, 13 second-feet. Reindeer Creek, August 11, 1.9 second-feet; September 3, 13 second-feet.

BRYAN AND DICK CREEKS.

Bryan Creek rises to the east of Kougarok Mountain and flows northeastward into Serpentine River. Dick Creek is its principal tributary and has shown the best values of all the streams in this drainage basin. A ditch built by the Pittsburg-Dick Creek Mining Company in 1906 and 1907 diverts the water of Bryan Creek and extends along the left or north bank of the creek for 6½ miles to the mouth of Dick Creek, where a head of about 170 feet is available. The following measurements were made of Bryan Creek near the intake: July 19, 4.2 second-feet; July 27, 6.0 second-feet; July 28, 6.5 second-feet; September 2, 15.5 second-feet.

QUARTZ AND BISMARCK CREEKS.

Quartz Creek is the name applied to the headwaters of South Fork of Serpentine River. It rises west of Kougarok Mountain and flows in a northerly direction. Bismarck Creek is a small tributary of Quartz Creek. In 1907 the Pittsburg-Dick Creek Mining Company began a ditch which will take water from these creeks and carry it over the divide to a small tributary of Bryan Creek, where it will be picked up by the Bryan Creek ditch. The Quartz Creek ditch is about 350 feet higher than the Bryan Creek ditch and is about 8 miles long. Plans are made to extend it to upper Dick Creek, giving it a total length of 22 miles. Measurements were made about 200 feet lower than the intakes, and not over 75 per cent of the discharge at these points would be available for the ditch.

The gage on Quartz Creek was read during the low water of August by S. G. Revelas.

The following measurements were made of Bismarck Creek: July 19, 1.7 second-feet; July 28, 2.0 second feet.

Gage heights and discharges of Quartz Creek, 1907.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
MEASUREMENTS.	*Feet.*	*Sec.-feet.*	GAGE READINGS—cont'd.	*Feet.*	*Sec.-feet.*
July 19	....	8.2	August 5	0.60	9.0
July 28	0.60	9.0	August 7	.61	9.6
September 2	.80	25.0	August 9	.62	10.2
			August 11	.60	9.0
GAGE READINGS.			August 13	.62	10.2
			August 15	62	10.2
August 1	.61	9.6	August 17	.64	11.4
August 3	.60	9.0	August 19	.64	11.4

AMERICAN RIVER DRAINAGE BASIN.

American River, the north fork of the Agiapuk, drains a large area west of the Kougarok basin. Measurements were made only on Budd Creek, the tributary on which the most extensive development work has been done.

Budd Creek rises northwest of Kougarok Mountain and flows southeastward to the mouth of Eldorado Creek, thence southwestward to American River above the forks. The waters of Budd and

Eldorado creeks sink into the limestone which forms their beds, and after flowing from 2 to 4 miles underground appear as springs. Windy Creek is a large tributary from the south, on which some mining has been done.

In 1907 a ditch was built on the north bank of Budd Creek by the Ottumwa Gold Mining Company. It takes its water just below the spring and extends to a point below the mouth of Windy Creek, a distance of 8 miles. A head of about 160 feet is obtained. A second ditch was built by the same company on Million and Ohio creeks, tributaries of Windy Creek.

The following measurements were made August 31, when the water was at about as low a stage as it reached during the season, the rains beginning later here than in the Kougarok basin: Budd Creek Spring, drainage area 58 square miles; discharge, 25 second-feet. Budd Creek below Windy Creek, drainage area, 108 square miles; discharge, 39 second-feet.

HYDRAULIC DEVELOPMENT.

The first discovery of gold on any tributary of Kougarok River was made on Harris Creek in 1900. The river and creek claims were nearly all staked during the following summer, and values were found at many points. The district has continued as a producer since that time, but the total output of precious metal has been small compared with that of other districts in Seward Peninsula. In the lower part of the Kougarok region Dahl Creek has been the largest producer. Work on this stream is greatly handicapped by the scarcity of water. Dahl Creek has a small area and lies in a region of small run-off, so that it is only during the melting of the snow in the spring and for a few days after a heavy rain that enough water for sluicing can be obtained from the creek.

During 1903 and 1904 the first ditch in the region was built by the T. T. Lane Company. It extends from Coffee to Dahl Creek, diverting Carrie and Independence creeks along its course. In 1904 capital began to turn its attention to the upper Kougarok. Three large ditches were begun late that year or early in 1905—the Homestake, North Star, and Henry Creek ditches. In 1906, the Cascade, Irving, and North Fork ditches were built, and work was continued on the other three. In 1907 only one ditch, that on Coarse Gold Creek, was built in the Kougarok basin. Several developments were carried out on streams in adjacent drainage areas, including the McKay ditch from Turner Creek to Noxapaga River, the Bryan and Quartz creek ditches, and the Ottumwa ditch on Budd Creek. Most of these ditches have been described in the foregoing pages. The following tables summarize their principal features. The capacities are approximate in most cases.

Ditches in Kougarok region, Seward Peninsula.

Name.	Diverts from—	Extends to—	Date completed.	Length.	Bottom width.	Fall per mile.	Capacity.	Pressure obtained.
Kugarok Mining and Ditch Co.:				*Miles.*	*Feet.*	*Feet.*	*Sec.-ft.*	*Feet.*
Homestake	Kougarok River	Homestake Creek.	1907	7.5	8	3.17-4.22	25	160
Macklin Branch	Macklin Creek	Main ditch	1907	1.2	4	4.22	5	......
Arctic	Reindeer and Schlitz creeks.	Macklin divide	(a)	8	5	4.22	10	......
Irving Mining Co	Kougarok River	Columbia Creek	1907	4.4	6	4.22	15	160
Taylor Creek Ditch Co.:								
North Star	Taylor Creek	Arctic Creek	1907	b 7	8	3.70	40	......
			1907	c 8	10	4.22	40	200
Cascade Mining and Ditch Co.	.....do	Claim 3	1907	6.25	5.5	4.22	12	110
T. T. Lane Co.:								
Henry Creek	Henry Creek	Homestake Creek.	(a)	10.25	6	3.17	15	210
	Lincoln Creek	Henry Creek intake.	(d)	3.25	......	......	......	......
Coffee Creek	Coffee Creek	Dahl Creek	1904	12.25	3-5	3.17	......	......
C. F. Merritt and others.	Arizona Creek	Benches on river	1905	2	4	3.17	2	185
Galvin & Buell	Coarse Gold Creek.	Two-bit Gulch	1907	5	8	4.22	25	300
Northwestern Development Co.	North Fork	....	(a)	6	7	3.17	20	......
Anderson Bros	Windy Creek	Anderson Gulch	1906	4	4	4.22	8	150
McKay Hydraulic Mining Co.	Turner Creek	Goose Creek	1907	16	4-5	4.22	8-10	......
Pittsburg-Dick Creek Mining Co.	Bryan Creek	Dick Creek	1907	6.5	6	4.22	15	170
	Quartz Creek	Bryan Creek divide.	(a)	8	8	4.22	20	e 350
Ottumwa Gold Mining Co.	Budd Creek	Below Windy Creek.	1907	8	9	3.70	30	160
	Million Creek	Windy Creek	1907	....	4	4.22	8	......

a Under construction.
b Intake to siphon.
c Siphon to Arctic Creek.
d Proposed.
e Above Bryan Creek ditch.

RELATIVE RUN-OFF OF DIFFERENT AREAS.

In order to afford a comparison of the run-off conditions in different areas, especially between those north and south of the Kigluaik Mountains, tables have been prepared showing the daily minima and monthly means for 1906 and 1907 in second-feet per square mile for the drainage areas investigated. The streams have been grouped into three classes—(1) those running in the foothills, having southern exposures and but few gulches in which snow is retained into the summer months; (2) streams rising in the mountains, having deep valleys and cirques with northern exposures, where snow is stored and held during the whole summer, and having a much heavier rainfall than streams at lower elevations; (3) streams of the Kougarok region. A study of the following tables shows several interesting points. In general, the nearer the stream lies to the central mountain mass of the Kigluaik Range, the greater is its run-off. The most notable exception to this rule is Hobson Creek. The flow of this stream comes from limestone springs, which are believed to draw some of their water from areas lying outside the surface drainage basin of the creek. North Star Creek, Fox Creek, and Nome River have a smaller minimum than adjoining streams whose basins have a similar character and elevation. This is probably due to their more direct southern exposure.

There is a striking difference, both in minimum and mean, between streams south of the mountains and those in the Kougarok region. This is due mostly to the small rainfall north of the mountains. Budd Creek draws all of its flow at low water from springs and so has a much larger minimum than other streams in the vicinity.

These tables may be used to estimate the run-off from other streams in Seward Peninsula, but such estimates must be made with extreme caution on account of the great difference in run-off in areas apparently similar.

The streams are not given in the order in which the descriptions appear in the text, but are arranged in general from east to west and from higher elevations to lower.

Minimum daily flow of streams in Seward Peninsula, 1906-7.

STREAMS RISING IN FOOTHILLS.

Stream.	Elevation.	Drainage area.	1906. Date.	1906. Minimum flow.	1906. Minimum run-off per square mile.	1907. Date.	1907. Minimum flow.	1907. Minimum run-off per square mile.
	Feet.	*Sq. miles.*		*Sec.-ft.*	*Sec.-ft.*		*Sec.-ft.*	*Sec.-ft.*
Iron Creek below mouth of Canyon Creek.	450	50	Aug. 14	17.1	0.34	Aug. 11-14	33	0.66
Eldorado River below mouth of Venetia Creek.	400	51	Aug. 14	44	.86			
Jett Creek	800	1.4	Sept. 10	[a] 4.2	3	Sept. 23	2.9	1.3
Copper Creek	800	.85	Aug. 11	.8	.94			
Nugget Creek	785	2.1	June 28	[b] .96	.46	Aug. 10-11	2.8	1.3
David Creek	590	4.3	Aug. 19	3.3	.77	Sept. 30	8.3	1.9
Dorothy Creek	500	2.7	Aug. 18	2.9	1.1			
Hobson Creek	500	2.6	July 4	10.5	[c] 4	Aug. 19	14.3	5.5
Slate Creek (tributary to Stewart River).	700	2.1	Aug. 19	2.2	1.05			
Stewart River	400	36	Aug. 19	11.4	.32			
Snake River	40	69				Aug. 12	77	1.1
Penny River	120	19	Aug. 1	[a] 36	1.9	Aug. 15	33	1.7

[a] Lowest measurements obtained; the flow was less on certain dates.
[b] The lowest flow later in 1906 was 3 second-feet, or 1.4 second-feet per square mile, on August 11.
[c] The flow of Hobson Creek is from large limestone springs whose catchment area may not coincide with the surface watershed.

Minimum daily flow of streams in Seward Peninsula, 1906–7—Continued.

STREAMS RISING IN KIGLUAIK MOUNTAINS.

Stream.	Elevation.	Drainage area.	1906. Date.	1906. Minimum flow.	1906. Minimum run-off per square mile.	1907. Date.	1907. Minimum flow.	1907. Minimum run-off per square mile.
	Feet.	*Sq. miles.*		*Sec. ft.*	*Sec. ft.*		*Sec. ft.*	*Sec. ft.*
North Fork Grand Central River near ditch intake.	750	5.4	July 1......	23	4.3	....	....	....
West Fork Grand Central River at ditch intake.	850	5.4	Sept. 15–17..	19	3.5	July 29.....	28	5.2
Crater Lake outlet..	925	1.8	Sept. 15–17..	3.1	1.7	Sept. 22–23..	3.5	1.9
Thompson Creek....	720	2.5	Sept. 16–17..	5	2	Sept. 22–23..	5	2
Grand Central River below forks.	690	14.6	Sept. 16–17..	47	3.1	Aug. 15.....	72	4.9
Grand Central River below Nugget Creek.	455	39	Sept. 16–17..	90	2.3	....	....	....
Grand Central River between station below forks and station at Nugget Creek.	....	24.4	Sept. 16–17..	43	1.76	....	....	....
Kruzgamepa River..	442	81	Aug. 19 and Sept. 17.	175	2.16	Oct. 5.......	178	2.2
Crater Creek.........	550	11	Sept. 16–17..	39	3.5	....	....	....
Fox Creek...........	550	11	Aug. 16.....	17.3	1.6	....	....	....
Nome River.........	575	15	Aug. 5......	20	1.3	Aug. 15.....	16	1.1
Buffalo Creek........	800	4.4	Aug. 3......	9.1	2.1	....	....	....
Sinuk River.........	770	*b* 6.2	Aug. 3......	20	3.2	Aug. 15.....	*a* 22	2.7
North Star Creek....	900	2.3	Aug. 10.....	2.9	1.26	Aug. 7......	*a* 4	1.7
Windy Creek........	650	12	Aug. 3......	32	2.7	Aug. 15.....	*a* 32	2.7

a Minimum in midseason. *b* 8.2 after August 1, 1907.

STREAMS IN THE KOUGAROK REGION.

Stream.	Elevation.	Drainage area.	1906. Date.	1906. Minimum flow.	1906. Minimum run-off per square mile.	1907. Date.	1907. Minimum flow.	1907. Minimum run-off per square mile.
Kougarok River at Homestake intake.	....	44	....	....	....	Aug. 13.....	3.2	0.07
Kougarok River above Coarse Gold Creek.	....	250	....	....	....	Aug. 9–12...	16	.06
Taylor Creek at Cascade intake.	....	74	....	....	....	Aug. 14.....	3.9	.05
Henry Creek at mouth.	....	50	....	....	....	Aug. 13.....	6.8	.14
North Fork above Eureka Creek.	....	66	....	....	....	Aug. 15.....	9.6	.15
Noxapaga River.....	....	340	....	....	....	Aug. 16.....	62	.18
Turner Creek........	....	13	....	....	....	Aug. 15.....	.7	.05
Budd Creek.........	....	58	....	....	....	Aug. 21.....	25	.43

Mean run-off, in second-feet per square mile, at gaging stations, 1906.

Station.	Drainage area.	July 1-31.	July 1-4 and 11-31.	Aug. 1-31.	Sept. 1-30.	Sept. 1-18.
	Sq. mi.					
North Fork of Grand Central River:						
Near ditch intake	5.4	....	[a] 7.53	6.80	....	5.85
At pipe intake	2.3	....	....	11.9	....	9.65
West Fork of Grand Central River:						
At ditch intake	5.4	....	10.3	6.02	....	4.72
At pipe intake	2.8	....	9.64	4.96	....	3.36
Crater Lake outlet	1.8	....	10.8	6.56	....	2.89
Thompson Creek	2.5	....	8.20	6.64	....	3.04
Grand Central River below forks	14.6	....	8.36	5.84	....	4.25
Grand Central River below Nugget Creek	39	....	....	[a] 4.42	....	3.36
Kruzgamepa River at outlet of Salmon Lake	81	7.05	....	3.20	5.63	3.05
Between Grand Central River below the forks and Kruzgamepa River stations	66	....	....	2.62	....	2.79
Nome River at Miocene intake	15	3.43	2.71	3.36	4.29	....

[a] Approximate.

Mean run-off, in second-feet per square mile, at gaging stations, 1907.

STREAMS RISING IN FOOTHILLS.

Station.	Drainage area.	July 1-31.	July 8-31.	August.	Sept. 1-30.	Sept. 1-23.
	Sq. miles.					
Jett and Copper creeks	2.25	7.69	....	3.16	4.27	....
Nugget Creek	2.1	2.71	....	2.95	5.24	....
David Creek	4.3	7.49	....	3.30	4.81	....
Hobson Creek	2.6	8.69	....	6.58	7.35	....
Snake River	69	2.56	....	1.56	....	....
Penny River	19	4.14	....	3.11	3.74	....

STREAMS RISING IN KIGLUAIK MOUNTAINS.

Station.	Drainage area.	July 1-31.	July 8-31.	August.	Sept. 1-30.	Sept. 1-23.
North Fork Grand Central River:						
At the forks	6.9	....	7.06	8.42	....	9.38
At pipe intake	2.3	....	16.9	18.9	....	20.2
West Fork Grand Central River:						
At the forks	7.7	....	11.0	10.5	....	13.0
At ditch intake	5.4	....	11.1	9.30	....	9.38
At pipe intake	2.8	....	9.43	6.29	....	7.32
Crater Lake outlet	1.8	....	13.6	14.4	....	11.7
Thompson Creek	2.5	....	16.9	10.8	....	9.12
Kruzgamepa River at outlet Salmon Lake	81	6.77	....	4.14	5.89	....
Nome River at Miocene intake	15	4.81	....	2.19	3.89	....
Sinuk River	[a] 6.2	8.44	....	5.49	....	6.55
North Star Creek	2.3	6.43	....	3.61	....	3.87
Windy Creek	12	7.62	....	4.93	....	5.68

[a] 8.2 after August 1.

STREAMS IN THE KOUGAROK REGION.

Station.	Drainage area.	July 15-31.	August.	Sept. 1-20.
Kougarok River:	*Sq. miles.*			
At Homestake intake	44	0.28	0.52	1.80
Above Coarse Gold Creek	250	.27	.56	1.55
Taylor Creek at Cascade intake	74	.40	.73	1.61

THE FAIRHAVEN PRECINCT.

By Fred F. Henshaw.

INTRODUCTION.

The Fairhaven precinct, comprising a large area in northeastern Seward Peninsula, has been a producer of placer gold since 1901 and promises to be more important in the future. No stream-gaging work has been done in this district, and it has not been visited by any member of the Geological Survey since 1903. The following notes concerning the water supply and the hydraulic developments that have been carried on during the last two seasons have been compiled from reliable sources.

FAIRHAVEN DITCH.

The Fairhaven ditch was built during 1906 by the Fairhaven Water Company. It takes its water supply from Imuruk Lake, the source of Kugruk River. A dam about 500 feet long has been constructed across the outlet of the lake to conserve the run-off.

The upper section of the ditch is 17 miles long, the first 8 miles of which is through a lava formation. The water is dropped into upper Pinnell River, and flows down this stream for about 4 miles. The lower section takes the water from Pinnell River on its right bank and extends for 23 miles to Arizona Creek, where a head of 500 feet is obtained. The ditch is 11 feet wide on the bottom and has a grade of 5 feet to the mile.

The dam across Imuruk Lake was closed August 16, 1906, and remained so until August, 1907, no water being carried in the ditch in the meantime. The water surface of the lake rose 26 inches during this period. The area of the lake is 30 square miles and that of the drainage basin 99 square miles. The run-off was therefore 41,600 acre-feet, equivalent to 7.9 inches in depth over the entire drainage area. This would furnish 58 second-feet for one year, 210 second-feet for one hundred days, or 263 second-feet for eighty days. The snowfall during the winter of 1906–7 was heavier than usual, so that the water supply for other years may be less than this.

The above information was furnished by W. R. Hoffman, who had charge of the construction of the Fairhaven ditch.

CANDLE DITCH.

The Candle ditch was built during 1907 by the Candle-Alaska Hydraulic Gold Mining Company to furnish water for mining on Candle Creek. It has a total length of 33.6 miles, a bottom width of 9 feet, and a grade of 3.69 feet per mile. The estimated capacity is 35 second-feet. It takes its supply from the western tributaries of Kiwalik River. The present intake of the ditch is on Glacier Creek. The water is carried across Dome Creek in a siphon 2,250 feet long, composed of 28-inch pipe; across Bonanza Creek in 900 feet of 32-inch pipe; and across Eldorado Creek in a siphon 12,100 feet long, composed of equal lengths of 35½, 37½, and 39½ inch pipe. Eldorado Creek will be tapped with a lateral ditch about 6 miles long. An extension 8.1 miles long of 6-foot ditch will be built to Gold Run. It will also be possible to divert the flow from the headwaters of First Chance Creek, a tributary of Koyuk River, over a low divide into Gold Run.

The fall obtained is 250 feet at the mouth of Candle Creek and 132 feet at the mouth of Patterson Creek. The surveyed line crosses Candle Creek about 1 mile above the mouth of Willow Creek. Candle Creek was nearly dry during 1907, the flow some of the time being less than half a second-foot.

The above information was furnished by W. L. Leland.

BEAR CREEK DITCH.

A ditch was built in 1907 on Bear Creek, a tributary of the West Fork of Buckland River. It has its intake below the mouth of May Creek, and extends along the right bank to Split Creek, diverting Eagle, Polar, and other small creeks. The ditch has a length of about 6 miles, a bottom width of 6 feet, and a grade of 4 feet to the mile. The head obtained at the lower end is about 200 feet.

THE FAIRBANKS DISTRICT.

By C. C. Covert.

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 in width. The greater part of the region lies in the lower Tanana basin, but a portion to the northwest is directly tributary to the Yukon. Generally speaking, it 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 slough-like 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 plateau to the north, and it receives Chena River about 7 miles above Fairbanks. The plain is swampy in character 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 to the north of this plateau forms what might be termed the apex of the divide between the Tanana and the Yukon drainage basins. It rises to an altitude of 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. Wide, gravelly beds of a shifting nature and tortuous courses keeping to one side of the valley are marked characteristics. The channels usually have rather steep banks that form approaches to broad, level bottom lands which extend from 1,000 to 4,000 feet or more before they meet the abrupt slopes of the dividing ridges. The drainage basins are from 4 to 15 miles wide and are well cut up by small tributary streams flowing 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. Underneath this tundra ground ice is found in many places, particularly on the northern slopes, where the soil is scanty and there is 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, the sun rapidly thaws it so that the plow and scraper can be used to advantage.

Above an altitude 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 as the river bottoms are approached. There the prevailing growth is spruce, much of which attains diameters of 18 to 24 inches.

The Fairbanks mining district lies between Little Chena and Chatanika rivers. It embraces an area of some 500 square miles and extends about 30 miles to the north of Fairbanks, which is situated on Chena Slough nearly 12 miles above its confluence with the Tanana. The producing creeks in general 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 over 1,000 feet, above sea level.

The field work during 1907 in the Fairbanks district was carried on from June 20 to September 15. Owing to the lack of adequate funds the work was largely that of reconnaissance. However, the keeping of systematic records on some of the more important streams was made possible through the hearty cooperation of people who were interested.

After making a careful study of the general topographic conditions of the mining district and surrounding country, it was decided to establish a few regular stations, at the most convenient points in the larger drainage areas, and study the daily run-off, during the open season from records thus obtained.[a] This plan afforded greater opportunity for procuring comparative data than that of covering a larger territory in a less definite way. In this country without storage, daily records are an important factor, and such records could not have been obtained over an extended area. Outside of the producing creeks the country is practically a wilderness, and it is almost impossible to get observations, other than those made on the occasional visits of the engineer. No daily or even weekly records in such areas could have been assured and the results obtained from the occasional measurements would have furnished no comprehensive idea as to the actual daily run-off of the streams throughout the open season.

CONDITIONS AFFECTING WATER SUPPLY.

Stream flow in the Fairbanks district is affected by melting of accumulated snow and ice, summer rains, and melting of ground ice. In this district the break-up begins about the middle of April and the rise in the streams commences about the middle of May and continues intermittently until May 30, or thereabouts, when the maximum discharge occurs. The table on page 109 shows the daily gage height of Chena Slough at Fairbanks during the open season of 1907. 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 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.

The precipitation records kept at Fairbanks since 1905 (see table p. 143) show that snowfall in this section amounts to about 40 inches. On account of the frozen ground and the steady cold weather, very little of this snow runs off before the spring break-up. What run-off there is during the winter season, especially in the upper basins, is accumulated in the glacial ice formed in the stream beds. This ice does not entirely disappear before the middle or last of July.

There are few data regarding rainfall in this section. Records have been kept at Fairbanks since 1905 and in connection with the investigations of stream flow the Geological Survey established four stations in 1907. The daily and monthly rainfall at these points is given in the tables on pages 140 to 141. A comparison of the 1907 rainfall records throughout Alaska, especially those of the interior, with records previously obtained will show that the season was a comparatively normal one.

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[a] For explanation of data and methods of work see p. 9.

The melting of frozen ground affords a slight additional supply of water to the streams. The frozen muck and ground ice, which carry a large percentage of water, are well protected by a thick coat of moss, through which it is difficult for the heat of the summer sun to penetrate. As the season advances the imprisoned moisture is liberated through the combined influence of abundant sunshine and frequent warm rains. This gradual thawing of frozen ground is made noticeable not only by the increase of the daily flow of the streams, but also by the condition of the trail and the increased depth to which one sinks when traveling over the tundra. On the northern slope and in the deep canyons, which are protected from the rays of the sun, the frozen ground never thaws more than a few inches, even during July and August, when the sun shines nearly twenty-four hours a day.

Owing to the shallow depth to which the ground thaws, the prevailing mossy covering affords the only ground storage for rainfall in this country. This covering is filled with seepage from ground thaw and consequently any increase in the water supply, through rainfall, finds its way to the streams in a very short time over the underground ice and steep slopes of the drainage basins, causing streams to rise and fall very 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. May, June, and July are invariably months of slight rainfall in the interior (see p. 140) 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.

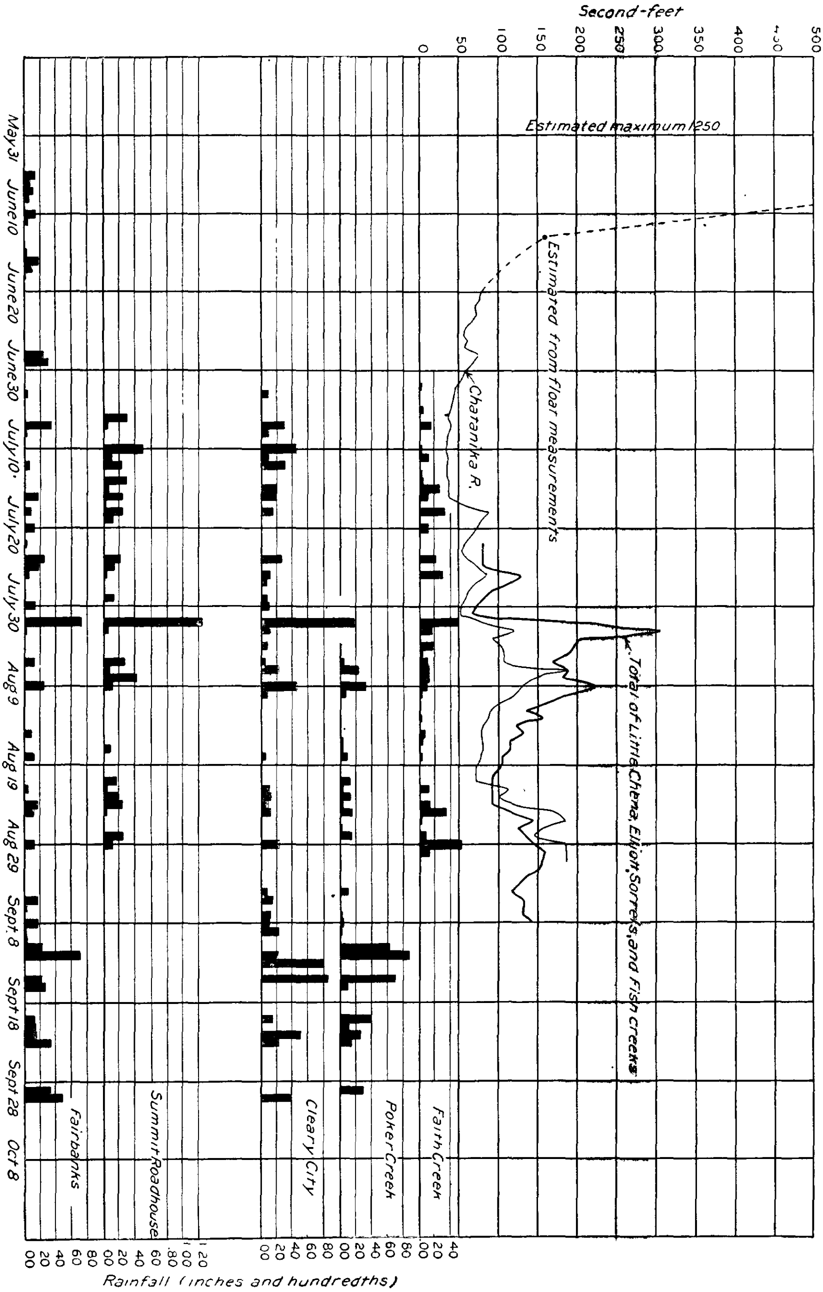


FIG. 2.—Diagram showing flow of Chatanika River and total flow of Little Chena River and its tributaries in 1907.

GAGING STATIONS.

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

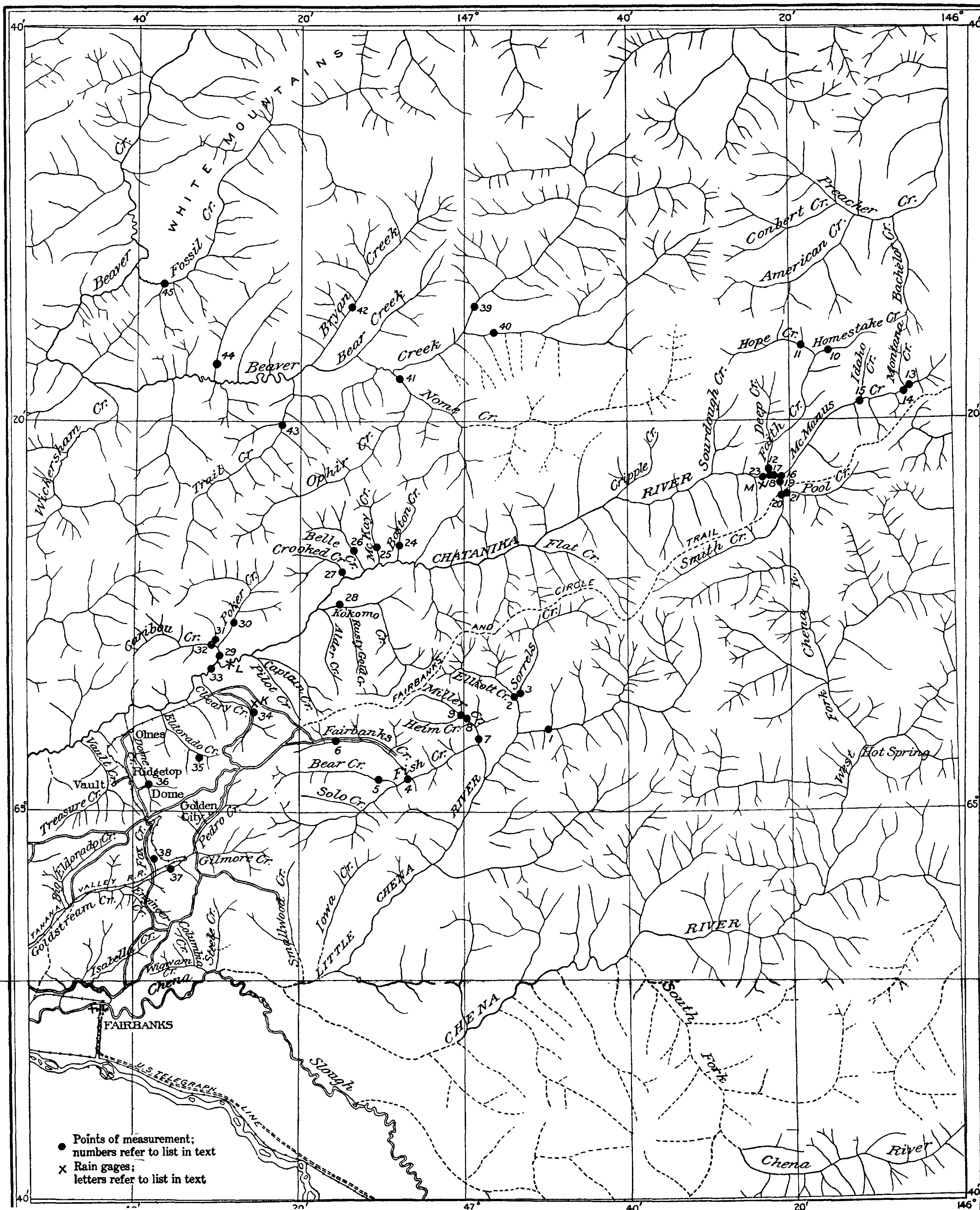
Gaging stations in Fairbanks district.

1. Little Chena River about 2 miles above Elliott Creek.
2. Elliott Creek above mouth of Sorrels Creek.
3. Sorrels Creek above mouth.
4. Fish Creek above Fairbanks Creek.
5. Bear Creek near mouth of Tecumseh Creek.
6. Fairbanks Creek.
7. Miller Creek near mouth.
8. Miller Creek below Heim Creek.
9. Miller Creek above Heim Creek.
10. Charity Creek 1 mile above mouth of Hope Creek.
11. Hope Creek near mouth of Zephyr Creek.
12. Faith Creek at weir near mouth.
13. McManus Creek above Montana Creek.
14. McManus Creek below Montana Creek.
15. McManus Creek 1 mile below Idaho.
16. McManus Creek 500 feet above mouth of Smith Creek.
17. McManus Creek below mouth of Smith Creek.
18. McManus Creek at mouth.
19. Smith Creek below mouth of Pool Creek.
20. Smith Creek above mouth of Pool Creek.
21. Pool Creek above mouth.
22. McManus Creek at weir near mouth.
23. Chatanika River below Faith and McManus creeks.
24. Boston Creek, elevation 800 feet.
25. McKay Creek, elevation 800 feet.
26. Belle Creek, elevation 800 feet.
27. Crooked Creek near mouth.
28. Kokomo Creek near mouth.
29. Poker Creek near mouth.
30. Poker Creek near elevation 800 feet.
31. Little Poker Creek above mouth.
32. Caribou Creek above mouth of Little Poker Creek.
33. Chatanika River below mouth of Poker Creek.
34. Cleary Creek near Cleary.
35. Little Eldorado Creek above trail to Dome.
36. Dome Creek near Dome.
37. Goldstream Creek at claim 6 below.
38. Fox Creek near elevation 900 feet.
39. Beaver Creek above mouth of East Branch.
40. East Branch Beaver Creek above mouth.
41. Nome Creek 1 mile above mouth.
42. Bryan Creek, elevation 1,800 feet.
43. Trail Creek about 4 miles above mouth.
44. Brigham Creek 1 mile above mouth.
45. 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 has a network of small, ramifying streams with steep, precipitous slopes in their upper drainage. The upper portion of the main stream is also steep, having a fall of 100 to 150


WHITE MOUNTAINS
CHATANIKA RIVER
CHENA RIVER
LITTLE CHENA RIVER
FAIRBANKS
Olnes
Ridgetop
Vault
Dome
Golden City
Fairbanks Cr.
Beaver Cr.
Bear Creek
Bryan Creek
Nome Cr.
Ophir Cr.
Wickersham Cr.
Trail Cr.
Fossil Cr.
Conbert Cr.
Preacher Cr.
American Cr.
Bachelor Cr.
Homestake Cr.
Hope Cr.
Idaho Cr.
Montana Cr.
Sourdough Cr.
Deep Cr.
Faith Cr.
McManus Cr.
Pool Cr.
Cripple Cr.
Smith Cr.
Flat Cr.
Kokomo Cr.
Alder Cr.
Rusty Gold Cr.
Belle Cr.
Crooked Cr.
McKay Cr.
Boston Cr.
Poker Cr.
Caribou Cr.
Captain Cr.
Pilot Cr.
Cleary Cr.
Eldorado Cr.
Elliott Cr.
Sorrels Cr.
Miller Cr.
Heim Cr.
Fish Cr.
Bear Cr.
Solo Cr.
Treasure Cr.
Vault Cr.
Pedro Cr.
Fox Cr.
Gilmore Cr.
Engineer Cr.
Goldstream Cr.
Isabella Cr.
Columbia Cr.
Wigwam Cr.
Steele Cr.
Smallwood Cr.
Iowa Cr.
Hot Spring
West Fork
South Fork
Slough
FAIRBANKS AND CIRCLE TRAIL
TANANA VALLEY R.R.
U.S. TELEGRAPH LINE
147°
146°
65°
Points of measurement; numbers refer to list in text
Rain gages; letters refer to list in text

feet to the mile. This slope decreases rather abruptly to about 18 feet to the mile in the vicinity of Elliott and Fish creeks.

The general course of the stream above the confluence of Fish Creek is through a rather broad, unsymmetrical valley. Below Fish Creek the river takes the center of a deep, narrow channel for about 8 miles to the point where Anaconda Creek, an important tributary from the left, enters. Below this point the valley gradually widens until the stream enters the lowlands tributary to Chena River, into which it empties 6 or 8 miles above the confluence of Chena Slough. Through this slough it discharges its waters into the Tanana near the town of Chena.

In the low-water period the stream has a channel width of 30 to 75 feet and flows from side to side of a broad, gravelly bed ranging from 100 to 300 feet in width. The channel is defined by steep, alluvial banks forming the approach to the heavily timbered bottom lands of the river valley which prevail above the confluence of Fish Creek. In the high-water stages the broad river bed is filled to its banks and often overflows them. During this stage the river seeks 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 invariably covered with the conventional moss, but here and there outcroppings of limestone, mica schist, and gravel are found on the slopes. In the creek valleys the mossy covering is usually underlain with frozen muck and glacial ice. Numerous swamp areas occur near the river banks, and these, together with the heavy growth of timber, make travel very difficult.

Gaging stations were established on Fish Creek above the mouth of Fairbanks Creek, on Elliott Creek above the mouth of Sorrels Creek, on Sorrels Creek above its mouth, and on the Little Chena about 2 miles above the mouth of Elliott Creek. Much credit is due Sherman White, the observer, for his faithful work in making approximately daily observations at each of these stations.

A project is under way to collect the waters from the different tributaries, at an elevation of about 900 feet, and to convey the supply by ditch line to a point in the lower drainage area, on the right bank of the Little Chena, 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 used for mining purposes.

The following 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."

Discharge and horsepower table for Little Chena River and tributaries, 1907.

Discharge.[a]	Horsepower (80 per cent efficiency) per foot fall.	Days of deficient discharge, July 22 to Sept. 10.	Discharge.[a]	Horsepower (80 per cent efficiency) per foot fall.	Days of deficient discharge, July 22 to Sept. 10.
Sec.-ft.			*Sec.-ft.*		
66	6	0	154	14	35
88	8	7	176	16	42
110	10	15	198	18	45
132	12	23	220	20	48

[a] This includes the flow of Little Chena, Elliott, Sorrels, and Fish creeks.

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	16.5	
Fish Creek from Miller Creek to mouth	1.0	
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.

CHENA SLOUGH AT FAIRBANKS.

Near the mouth of Salcha River a portion of the Tanana waters are diverted through a sloughlike channel about 50 miles in length, that separates the broad flat lands to the right into two parts. The channel receives the drainage of the plateau to the north and about midway in its course Chena River enters. Below this point the channel is known as Chena Slough. It affords a passageway for the Tanana steamers from its mouth near Chena to Fairbanks, 12 miles above, except in times of low water, when the cargoes are transferred at Chena to the Tanana Mines Railroad.

A gage fastened to the highway bridge in Fairbanks is read twice each day during the open season by employees of the Northern Navigation Company.

Daily gage height, in feet, of Chena Slough near Fairbanks, Alaska, 1907.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1		5.3	2.4	3.2	1.9	17	......	3.6	3.0	3.4	6.1
2		5.2	2.6	3.4	1.8	18	......	3.8	2.9	3.3	6.0
3		5.1	2.8	3.9	1.6	19	......	3.1	2.7	3.1	4.8
4	......	4.6	2.8	3.8	1.5	20	......	2.6	2.6	3.1	4.0
5	......	4.0	2.6	3.8	1.4	21	......	2.1	2.8	3.1	3.8
6	......	4.8	2.1	3.9	1.4	22	......	2.0	3.1	3.3	3.9
7	......	5.6	2.2	4.0	1.4	23	......	2.8	3.4	3.1	4.0
8	......	4.8	2.3	4.0	1.4	24	5.6	1.5	3.5	3.0	......
9	......	4.4	2.2	4.1	1.5	25	5.8	1.4	3.6	2.5	......
10	......	4.0	2.0	4.1	1.8	26	5.6	1.5	3.6	2.2	......
11	......	3.9	2.1	4.1	2.0	27	5.2	1.2	3.3	2.1	......
12	......	4.1	2.1	3.9	2.0	28	4.6	1.3	3.1	2.0	......
13	......	4.1	2.3	3.6	3.3	29	4.1	1.5	3.0	1.8	......
14	......	3.9	2.6	3.6	5.3	30	5.5	2.0	3.0	1.8	......
15	......	3.8	2.9	3.6	4.6	31	5.9	......	3.0	1.8	......
16	......	3.5	3.1	3.5	4.3						

LITTLE CHENA RIVER ABOVE MOUTH OF ELLIOTT CREEK.

A gaging station was established on Little Chena River about 2 miles above the mouth of Elliott Creek July 22, 1907. At this point the channel is from 30 to 50 feet in width 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 mouth of Elliott Creek, 1907.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
July 22	23.5	26.6	0.60	44.2
July 24	23.5	26.7	.565	39.7
August 4	40.0	42.2	1.10	113
August 5	33	37.2	1.05	103
August 20	25	28.0	.73	56.7

Daily gage height and discharge of Little Chena River above mouth of Elliott Creek, 1907.

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

Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	......	......	0.7	53	1.0	95
2	......	......	1.3	157	.9	80
3	......	......	1.1	113	.9	80
4	......	......	1.1	113	.8	66
5	......	......	1.1	113	.9	80
6	......	......	1.0	95	.95	88
7	......	......	1.05	104	.95	88
8	......	......	1.1	113	1.0	95
9	......	......	1.2	134	......	95
10	......	......	1.1	113	1.0	95
11	......	......	1.0	95	......	......
12	......	......	.9	80	......	......
13	......	......	1.0	95	......	......
14	......	......	.8	66	......	......
15	......	......	.9	80	......	......
16	......	......	.8	66	......	......
17	......	......	......	66	......	......
18	......	......	......	60	......	......
19	......	......	......	60	......	......
20	......	......	.7	53	......	......
21	......	......	.7	53	......	......
22	0.60	42	.7	53	......	......
23	......	42	.7	53	......	......
24	.60	42	.7	53	......	......
25	.60	42	......	73	......	......
26	.90	80	1.0	95	......	......
27	.80	66	.9	80	......	......
28	.70	53	.9	80	......	......
29	.60	42	......	88	......	......
30	.60	42	1.0	95	......	......
31	.60	42	1.0	95	......	......
Mean		[a]49.3	......	85.4	......	[b]86.2
Run-off per square mile		.625	......	1.68	......	1.09
Run-off, depth in inches		.23	......	1.24	......	.40

[a] July 22–31.

[b] September 1 to 10.

ELLIOTT CREEK ABOVE MOUTH OF SORRELS CREEK.

Elliott Creek takes the drainage from the southern slope of Twin Butte Hills, in the Chatanika divide, and flows in a southerly direction, discharging its waters and those of Sorrels Creek, its tributary, into the Little Chena about 4 miles above the mouth of 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 mouth of Sorrels Creek, 1907.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 23	9.5	6.4	1.6	5.1
August 5	12.0	9.6	1.85	13.8
August 20	10.1	6.98	1.615	7.1

Daily gage height and discharge of Elliott Creek above mouth of Sorrels Creek, 1907.

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

Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.7	9.0	1.8	12.3
2			2.1	23	1.8	12.3
3			2.1	23	1.7	9.0
4				17.2	1.7	9.0
5			1.8	12.3	1.7	9.0
6			1.8	12.3		9.0
7				12.3		9.0
8			1.8	12.3	1.7	9.0
9			1.9	15.6		10.0
10			1.8	12.3		12.0
11			1.8	12.3		
12			1.7	9.0		
13			1.8	12.3		
14			1.8	12.3		
15			1.7	9.0		
16			1.7	9.0		
17				9.0		
18				7.4		
19			16.5	7.4		
20			1.6	5.8		
21			1.6	5.8		
22	1.6	5.8	1.6	5.8		
23	1.6	5.8	1.6	5.8		
24	1.6	5.8	1.6	5.8		
25	1.6	5.8		7.4		
26	1.7	9.0	1.7	9.0		
27	1.7	9.0	1.7	9.0		
28	1.6	5.8	1.8	12.3		
29	1.6	5.8		12.3		
30		4.1		12.3		
31	1.5	2.5	1.8	12.3		
Mean		[a] 5.9		11.0		[b] 10.0
Run-off per square mile		0.43		0.797		0.724
Run-off, depth in inches		.16		.92		.27

[a] July 22 to 31.

[b] September 1 to 10.

SORRELS CREEK.

Sorrels Creek, a tributary to Elliott Creek about 3 miles above its mouth, rises in the Chatanika divide, to the 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. 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.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 23	11.0	9.95	1.00	10.3
August 5	17.0	16.8	1.40	28.2
August 20	12.0	10.7	1.02	12.0

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

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

Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	September. Gage height.	September. Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.1	14.7	1.2	19.0
2			1.4	27.8	1.2	19.0
3			1.4	27.8	1.1	14.7
4			1.5	32.1	1.1	14.7
5			1.35	25.6	1.1	14.7
6			1.3	23.4		14.7
7				23.4		14.7
8			1.3	23.4	1.1	14.7
9			1.4	27.8		14.7
10			1.3	23.4		19.0
11			1.3	23.4		
12			1.2	19.0		
13			1.2	19.0		
14			1.2	19.0		
15			1.1	14.7		
16			1.1	14.7		
17				14.7		
18				12.5		
19				10.3		
20			1.0	10.3		
21			1.0	10.3		
22	1.0	10.3	1.0	10.3		
23	1.0	10.3	1.0	10.3		
24	1.0	10.3	1.0	10.3		
25	1.0	10.3		12.5		
26	1.1	14.7	1.1	14.7		
27	1.1	14.7	1.1	14.7		
28	1.0	10.3	1.2	19.0		
29	1.0	10.3		19.0		
30		8.2		19.0		
31	.9	6.0	1.2	19.0		
Mean		[a]10.5		18.2		[b]16
Run-off per square mile		0.500		0.867		.762
Run-off depth in inches		.19		1.00		.28

[a] July 22-31.

[b] Sept. 1-10.

FISH CREEK ABOVE MOUTH OF FAIRBANKS CREEK.

Fish Creek rises in the high ridge at the head of Goldstream Creek and flows in a northeasterly direction through an irregularly formed valley. About 14 miles below its source it makes an abrupt bend to the right, flowing around 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 principal tributaries are Solo, Bear, Fairbanks, and Miller creeks, all from the left. These streams are rather steep in their upper courses but rapidly lessen in slope as Fish Creek Valley is approached. Fish Creek has a tortuous course and closely follows the right side of the valley, having a rather broad, marshy bottom land on the left.

A gaging station was established a short distance above Fairbanks Creek July 22, 1907 (see Pls. IX; XI, *B*), and regular readings were taken.

Discharge measurements of Fish Creek above mouth of Fairbanks Creek, 1907.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 21	9.5	10.4	1.00	23.7
July 25	10.0	12.2	1.00	24.3
August 3	14.5	17.5	1.55	47.8
August 4	12.7	14.0	1.35	37.6
August 19	9.2	9.95	1.00	20.8

Daily gage height and discharge of Fish Creek above mouth of Fairbanks Creek, 1907.

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

Day.	July.		August.		September.		Day.	July.		August.		September.	
	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			3.2	155	1.0	24	20				24		
2			2.4	100	1.0	24	21			1.0	24		
3			1.4	39	1.0	24	22	1.0	24	1.0	24		
4			1.3	35	1.0	24	23		24		24		
5				37	1.1	27	24		24	1.0	24		
6			1.4	39		27	25	1.0	24	1.1	27		
7			1.55	47		27	26	1.1	27	1.1	27		
8			1.3	35	1.1	27	27	1.0	24	1.0	24		
9			1.6	50	1.1	27	28	.9	21	1.0	24		
10			1.6	50	1.3	35	29	.9	21		27		
11				39			30	.8	18	1.2	31		
12			1.2	31			31	.8	18	1.1	27		
13			1.1	27									
14			1.1	27	2.6	[a] 115	Mean		[b] 22.5		36.8		[c] 26.6
15			1.1	27			Run-off per square mile		.577		.944		.682
16			1.0	24			Run-off, depth in inches		.21		1.09		.25
17			1.0	24									
18				24									
19			1.0	24									

[a] Not included in mean. [b] July 22 to 31. [c] Sept. 1 to 10.

BEAR CREEK.

Bear Creek rises in the high divide at the head of Goldstream Creek, flows eastward through a deep, narrow valley, and empties into Fish Creek about one-half mile above the gaging station. Measurements were made on this creek below the mouth of Tecumseh Creek as follows: July 20, 8.4 second-feet; August 22, 7 second-feet; drainage area, 12 square miles; run-off per square mile, 0.70 and 0.584 second-foot, respectively.

FAIRBANKS CREEK.

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

Discovery claim is located near Alder Creek. Mining operations are carried on from claim 9 above to claim 13 below. The pay streak follows closely to the stream channel 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.
	Feet.	*Sec.-ft.*
June 24	1,300	1.4
Do	1,250	2.2
July 5	1,375	.72
July 20	1,400	1.3

MILLER CREEK.

Miller Creek rises in the southeasterly slope of Coffee Dome, and flows in a southerly direction, emptying into Fish Creek about 2 miles 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. The following discharge measurements were made in 1907:

Discharge measurements of Miller Creek, 1907.

Date.	Point of measurement.	Elevation.	Drainage area.	Discharge.	Run-off per square mile.
		Feet.	*Sq. miles.*	*Sec.-ft.*	*Sec.-ft.*
July 6	Near mouth	750	15	7.0	0.47
July 24	.....do	750	15	7.6	51
August 20	.....do	750	15	8.0	.53
August 6	Below mouth of Heim Creek	790	10	8.0	80
August 7	.....do	790	10	8.0	.80
Do	Above mouth of Heim Creek	800	6	4.9	.82

CHATANIKA RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Chatanika River is formed by the junction of Faith and McManus creeks, which drain the high ridge forming the divide between the lower Tanana and Yukon basins. The river flows through a long and rather narrow valley in a southwesterly direction and is tributary to 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 in width. The valley is about 80 miles in length and heavily covered with timber below an altitude of 1,800 to 2,000 feet. The river has a drainage area of approximately 1,300 square miles above its mouth.

From the junction of Faith and McManus creeks the stream flows in a winding course and has a shifting, gravelly bottom. In low and medium stages it flows in a series of pools and rapids and has a width of 75 to 200 feet, and during the high-water period it often seeks several channels and covers 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. Here, from the left, the Chatanika receives the drainage from Cleary, Eldorado, Dome, Vault, and other less important streams from the mining district proper. Below these tributaries the valley narrows to a gorgelike channel which it follows for about 10 miles. Below this gorge 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.

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 which prevail on that side.

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 promoter 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 on page 117 in this report.

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 has a rather narrow, irregular valley, very steep in its upper course, and drains an area of 51 square miles.

The following measurements were made in its upper drainage basin July 11, 1907.

Hope Creek near the mouth of Zephyr Creek: Discharge, 7.7 second-feet; run-off, 0.42 second-foot per square mile.

Charity Creek about 1 mile above the mouth of Hope Creek: Discharge, 5.7 second-feet; run-off, 0.76 second-foot per square mile.

In the upper portion of the valley considerable glacial 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 moderate-sized dam 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 discharge, in second-feet, of Faith Creek at weir 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	[a]40.5	29.2	47.5	....
15	....	20.9	33.6	....					
16	....	21.7	34.4	....	Run-off per square mile	.795	.572	.932	....
17	....	35.3	30.8	....					
18	....	35.0	30.6	....	Run-off, depth in inches	.32	.66	1.07	....
19	....	62.5	28.5	....					

[a] June 20 to 30.

NOTE. These data were furnished by the Chatanika Ditch Company.

MCMANUS CREEK.

McManus Creek, the left fork of Chatanika River, rises in a somewhat lower divide than Faith Creek, though Idaho and Montana forks reach well up toward the headwaters of Homestake and Charity creeks, of the Faith Creek drainage basin. The main fork and Pool and Smith creeks, which are tributary to McManus Creek near its mouth, interlock with the headwaters of Birch Creek, a tributary to the Yukon and with the West Fork of the Chena, a tributary to the Tanana. The streams in the McManus Creek basin are not so precipitous as the tributaries of Faith Creek, and the run-off per square mile is less. There are one or two possible reservoir sites in this basin, but they are not as favorable as those on Faith Creek. The drainage area above the mouth of McManus Creek is 80 square miles.

A gaging weir was established near the mouth of McManus Creek about June 22, 1907, by the Chatanika Ditch Company and regular readings were taken subsequent to that date. The following measurements were made in this drainage basin in 1907:

Discharge measurements in drainage basin of McManus Creek, 1907.

Date.	Point of measurement.	Elevation.[a]	Drainage area.	Discharge.	Run-off per square mile.
		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	,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	

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

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

[Elevation, 1,375. 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	32.2	....
3	....	19	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	21.4	67.1	....
6	....	16.1	60.6	....	25	21.7	19.1	81.2	....
7	....	17.5	98.6	....	26	25	38.6	102	....
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	21.8	114	....
11	....	16.1	62.2	....	30	23.2	18.8	112	....
12	....	15	49.8	....	31	....	16.7	94.1	....
13	....	15.4	45.5	....					
14	....	17.8	40.0	....	Mean	*a* 28.5	21.4	66.4	....
15	....	18.5	37.2	....	Run-off per square mile	.356	.268	.830	....
16	....	19	42.4	....					
17	....	21.6	39.0	....	Run-off, depth in inches	.15	.31	.96	....
18	....	34.7	37.4	....					
19	....	40	34.7	....					

a June 20 to 30.

NOTE.—These data were furnished by the Chatanika Ditch Company.

CHATANIKA RIVER NEAR JUNCTION OF FAITH AND MCMANUS CREEKS.

A gaging station was established July 16, 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 drainage area above this point is 132 square miles.

Discharge measurements of Chatanika River near junction of Faith and McManus creeks, 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 16	C. C. Covert	47	58	1.58	51.9
July 26	E. B. Brigham	56	68	1.80	80.5
August 3	do	57	72	1.89	96.5
August 7	do	62	98	2.26	188

Daily gage height and discharge of Chatanika River near junction of Faith and McManus creeks, 1907.

[Elevation 1,350 feet; drainage area 132 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			1.80	80	19	1.80	80	1.75	73
2			2.02	122	20	1.75	73	1.75	73
3			1.86	92	21	1.70	66	1.75	73
4			1.93	101	22	1.62	57	1.98	111
5			1.95	106	23	1.60	54	1.92	101
6			1.95	106	24	1.64	60	2.04	122
7			2.25	186	25	1.75	73	2.22	177
8			2.12	147	26	1.85	88	2.25	186
9			2.05	128	27	1.75	73	2.15	154
10			2.02	122	28	1.67	63	2.13	147
11			1.92	101	29	1.65	60	2.25	186
12			1.85	88	30	1.60	54	2.25	186
13			1.85	88	31	1.60	54		186
14			1.80	80					
15			1.80	80	Mean		a 67		117
16			1.80	80	Run-off, per square mile.		.508		.887
17	1.65	60	1.80	80	Run-off, depth in inches.		.29		1.02
18	1.86	90	1.78	78					

a July 17 to 31.

NOTE.—For September: Maximum, 1,770 second-feet; minimum, 110 second-feet; mean, 297 second-feet.

The following 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."

Discharge and horsepower table for Chatanika River near junction of Faith and McManus creeks, 1907.

Discharge.	Horsepower (80 per cent efficiency) per foot fall.	Days of deficient discharge, June 16 to August 31.	Discharge.	Horsepower (80 per cent efficiency) per foot fall.	Days of deficient discharge, June 16 to August 31.
Sec.-ft.			*Sec.-ft.*		
33	3		99	9	56
44	4	13	110	10	62
55	5	19	125	11.3	63
66	6	30	143	13	67
77	7	40	165	15	72
88	8	48	220	20	

NOTE.—The discharge from June 16 to 25 is estimated from float measurements; from June 25 to July 17 from discharge over weirs at the mouth of Faith and McManus creeks.

BOSTON CREEK.

Boston Creek rises in the high ridge to the north of the Chatanika, to which it is tributary, about 24 miles below Faith Creek. It is about 5 miles long and has a total fall of about 2,000 feet. The following measurement was made on this creek August 15, 1907, at an elevation of about 800 feet: Discharge, 3.9 second-feet; drainage area, 6.5 square miles; run-off, 0.60 second-foot per square mile.

McKAY CREEK.

McKay Creek is the first stream to the west of Boston Creek, rises in the same divide, and empties into the Chatanika about 1 mile farther downstream. It is about 4 miles long and flows through a narrow, V-shaped valley. It has a drainage area of 6.7 square miles. The following measurement was made on this stream August 15, 1907, at an elevation of about 800 feet: Discharge, 3.7 second-feet; drainage area, 6.2 square miles; run-off, 0.602 second-foot per square mile.

BELLE CREEK.

Belle Creek rises in the high divide at the head of Ophir and Poker creeks and flows in a southeasterly direction to the Chatanika. The stream is about 6 miles long and flows through a deep, narrow valley. It drains an area of 11.9 square miles. A measurement was made on this stream August 15, 1907, at an elevation of about 800 feet, as follows: Discharge, 10 second-feet; drainage area, 11 square miles; run-off, 0.91 second-foot per square mile.

CROOKED CREEK.

Crooked Creek rises in the divide at the head of Poker Creek and flows in a southeasterly direction nearly parallel to Belle Creek. It drains an area of 7.2 square miles. A measurement was made near its mouth August 15, 1907, as follows: Discharge, 6.3 second-feet; drainage area, 7.2 square miles; run-off, 0.875 second-foot per square mile.

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 in a northwesterly direction, draining an area of 33 square miles above its mouth. Daily readings were taken from a reference point in a large stump on the river bank about 1 mile above the mouth of the stream.

Discharge measurements of Kokomo Creek near mouth, 1907.

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

[a] Measured down from nail in stump.

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

[Elevation, 750 feet; drainage, area 26 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			+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	10.9		
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		*a* 14.2		*b* 41.6
16	2.9	16.8			Run-off per square mile		.546		1.60
17	3.0	13.9			Run-off, depth in inches		.47		.83
18	2.8	19.8							

a July 9 to 31. *b* August 1 to 14.

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 is constructing a ditch line along the left bank of Poker Creek, following approximately the 800-foot contour. This ditch line will divert water from Poker, Little Poker, and Caribou creeks to a point on the Chatanika where about 80 feet head can be obtained. It is proposed to install a power plant at this point, to be run by water when available, and by steam at other times.

Discharge measurements in Poker Creek drainage basin, 1907.

Date.	Point of measurement.	Drainage area.	Gage height.	Discharge.	Run-off per square mile.
		Sq. miles.	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
July 27	Poker Creek ½ mile above 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 1 mile above Caribou Creek			21.1	

CHATANIKA RIVER BELOW MOUTH OF POKER CREEK.

A gaging station was established on Chatanika River below Poker Creek June 23, 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 mouth of Poker Creek, 1907.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 22	88.5	213	1.08	246
July 4	86.8	192	.83	178
August 9	98	302	1.98	669

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

[Elevation 700 feet; drainage area 456 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			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			.80	167	1.85	590	1.3	321	1.05	232
11			.90	192	1.6	455	1.35	342	1.45	384
12			.90	192	1.5	405	3.6	[a] 2,160	1.85	590
13			.95	204	1.35	342	4.45	[a] 3,160	1.80	560
14			.9	192	1.4	363	3.25	[a] 1,780	1.75	530
15			1.0	216	1.25	300	2.85	[a] 1,390		
16			1.05	232	1.2	283	4.0	[a] 2,620		
17			1.10	250	1.1	250	4.3	[a] 2,980		
18			1.1	250	1.1	250	2.35	942		
19			1.2	283	1.0	216	2.5	1,060		
20	1.10	250	1.15	266	1.1	250	2.3	901		
21	1.10	250	1.1	250	1.1	250	2.35	942		
22	1.10	250	1.1	250	1.0	216	2.3	901		
23	1.10	250	.95	204	1.15	266	2.25	860		
24	1.05	232	.9	192	1.20	283	2.15	788		
25	1.00	216	.9	192	1.35	342	2.0	680		
26	.90	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		[b] 228		211		428		954		[c] 506
Second-feet per square mile		.500		.463		.939		2.09		1.11
Depth in inches		.20		.53		1.08		2.33		.68

[a] Estimated by extending rating curve. [b] June 20 to 30. [c] October 1 to 14.

NOTE.—The river was frozen over after October 14.

CLEARY CREEK.

Cleary Creek heads to the north of Pedro Dome in a rather low saddle which separates its waters from those of Little Eldorado Creek and which has an elevation of about 1,800 feet. It 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. X.) 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. (See Pl. XI, *A*.)

Cleary Creek has a drainage area of 10.5 square miles above its mouth. A measurement made July 4 near Cleary gave a discharge of 2.9 second-feet.

LITTLE ELDORADO CREEK.

Little Eldorado Creek rises on the western slope of Pedro Dome and drains a rather narrow valley between Dome and Vault 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 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; run-off, 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 to more than 200 feet below in the Chatanika Flats, near the mouth. Very little water flows in the main channel during the low-water period, a large part of the flow being diverted by numer-

MINING OPERATIONS ON CLEARY CREEK.

ous small ditches. A measurement, made June 27, 1907, in a ditch near claim 2 below, gave an approximate discharge of 0.84 second-foot.

GOLDSTREAM CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

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

On either side of the stream is a narrow lowland having a gradual slope toward the dividing ridges. This is covered with the conventional moss, and in the lower portion of the valley, where it widens, has numerous lakes and swamps. The bottom land has been well covered with timber, but this has disappeared to make way for railroad and mining enterprises, which make the upper portion of the valley a scene of activity. The dividing ridges on either side are well timbered with spruce and birch and rise about 1,000 feet above the stream bed. About 12 miles below the source, the southern ridge has a low saddle over which the Tanana Mines Railroad from Fairbanks enters the mining district.

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

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 grows less as it approaches Goldstream Creek. 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 about to claim 10 below and then swings to the left bank, which it follows about to 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.

There are numerous small tributaries to Goldstream Creek from either side. Those from the right are Fox, Gold Run, Big Eldorado, O'Connor, and Cache creeks. Those from the left are Engineer, Butter, Spear, Nugget, Straight, and Allen creeks. Prospecting and more or less mining is done on nearly all these creeks. They average from 4 to 12 miles in length and drain small areas.

On the upper portion of Goldstream Creek and along Pedro Creek several small ditches have been built to divert the water for sluicing. The largest one is that owned by the Goldstream Ditch Company. The cost of construction was about $6,500. It is about 2 miles in length 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, supplying several mines at the rate of $2 per hour per sluice head, which ranges from 60 to 80 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.

GOLDSTREAM CREEK AT CLAIM 6 BELOW.

On account of the unfavorable condition of the channel of Goldstream Creek and the numerous small ditches that divert the flow, it was impossible to secure a good location for a gaging station. However, a gage was established near the lower line of claim 6 below, a short distance above the intake to the Goldstream ditch, June 20, 1907, and a reading was taken 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

A. LOWER CLEARY CREEK.

B. GAGING STATION ON FISH CREEK.

Daily gage height and 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		
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		[a]13.4		13.1		20.		24.		[b]20.7
Run-off per square mile		.469		.458		.699		.839		.724
Run-off, depth in inches		.192		.53		.81		.94		.19

[a] June 20 to 30. [b] October 1 to 7.

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.

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. The following measurement was made July 6, 1907: Discharge, 2.0 second-feet; elevation, 900 feet.

BEAVER CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION

A high limestone ridge—the White Mountains—50 miles to the 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 takes a westerly course 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 to 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 valley of rather high elevation, 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 in a northerly direction 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.

Date.	Stream.	Approximate elevation.	Drainage area.	Discharge.	Run-off per square mile.
		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

COMPARATIVE RUN-OFF OF DIFFERENT AREAS.

In order to afford a comparison of the run-off of different drainage areas in 1907, the following tables have been prepared, showing the minimum daily flow, the monthly means in second-feet per square mile, and the mean weekly flow of the drainage areas investigated. These tables can be used in estimating the run-off of other streams in this section having similar areas. Considerable care should be used in making such estimates, on account of local conditions affecting the run-off.

Minimum daily flow of streams in Fairbanks district, 1907.

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

Mean run-off in second-feet per square mile at gaging stations in Fairbanks district, 1907.

Stream.	Elevation.	Drainage area.	June 20-30.	July 1-31.	July 22-31.	Aug. 1-31.	Sept. 1-31.	Sept. 1-10.	Oct.
	Feet.	*Sq. miles.*							
Little Chena	800	79			0.62	1.08		1.09	
Elliott	800	13.8			.43	.80		.72	
Sorrels	800	21			.50	.87		.76	
Fish Creek	925	39			.58	.94		.68	
Faith Creek	1,400	51	0.80	0.57		.93			
McManus	1,400	80	.36	.27		.83			
Chatanika River below Faith Creek	1,350	132			[a] .51	.89	2.18		
Chatanika River below Poker Creek	700	456	.50	.46		.94	2.09		[b] 1.11
Goldstream Creek	870	28.6	.47	.46		.70	.84		[c] .72

[a] July 17-31. [b] October 1-10. [c] October 1-7.

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

Date.	Available for use by diversion at elevation 1,350 feet.	Available for use by pumping at elevation 700 feet.	Available for use by diversion at elevation 800 to 925 feet.				
	Chatanika River near Faith Creek.	Chatanika River below mouth of Poker Creek.	Little Chena River above Elliott Creek.	Elliott Creek above Sorrels Creek.	Sorrels Creek above mouth.	Fish Creek above Fairbanks.	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	70	224	52	7	12	24	95
July 29-August 4	80	540	80	12	18	55	165
August 5-11	128	516	110	12	24	42	188
August 12-18	82	313	73	10	16	26	125
August 19-25	104	260	56	6	10	24	96
August 26-September 1	169	413	90	11	18	26	145
September 2-8	120	324	82	9	15	26	132
September 9-15	513	1,360					
September 16-22	376	1,480					
September 23-29	216	737					
September 30-October 6		655					
October 7-13		415					
Mean	143	504	78	10	16	32	136
Maximum	513	1,480	110	12	24	55	188
Minimum	36	190	52	6	10	24	95

DEVELOPMENT OF WATER SUPPLY IN THE FAIRBANKS DISTRICT.

GENERAL CONDITIONS.

Since the discovery of gold on Pedro Creek in the Fairbanks district in 1902, considerable attention has been given to this section of Alaska, and, with nearly a $9,000,000 output in 1906, renewed interest has centered in this region.

The camp lies at the southern edge of the plateau country, almost where it breaks to the alluvial plain. At the present time a large part of the area may be spoken of as in a prospective stage of development. Little attention has been given to the development of water supply for mining purposes. The work 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 below the surface. In the lower reaches, where the pay streak is from 50 to 250 feet underground, with 25 to 200 feet of overburden, "drifting" seems 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. X, p. 122.)

The future development of this region, as of other mining districts in Alaska, depends largely on the economical development of its water resources. During July and part of August, 1907, the miners were obliged to resort to various schemes to secure sufficient water for sluicing. In some instances the water was returned for the second and third time to the sluice box by means of the steam pump, entailing extra expense both in fuel and equipment, and on a number of the creeks only about half of the mines were in operation.

DITCH LINES.

In general the relation of the mining camp to the surrounding country is not favorable for obtaining an outside water supply by gravity. The topography of the country is such that ditch lines from the larger drainage areas are not altogether practical. The camp lies in three drainage basins or valleys, separated by high dividing ridges, and, in order to supply the producing creeks in one valley with water by ditch line from another, the ditch must have a high elevation, which throws its source so far into the headwaters that there is only a small drainage area from which to draw the supply and consequently but little water.

On account of its elevation, the upper Chatanika drainage basin has received more attention concerning the water supply by 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 have to be conveyed for over 100 miles through a ditch line, difficult to construct and maintain, and on account of its low head only a small number of producing creeks would be benefited.

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 season of 1907. 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.

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 table on page 129 shows the weekly supply that would have been available for such a ditch, and the table on page 132 shows 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.

WATER-POWER DEVELOPMENT.

Water-power development for electric transmission in the Fairbanks district seems worthy of consideration. The table on page 118 shows the horsepower (80 per cent efficiency) that could have been developed in 1907 from the water supply of the Chatanika at the junction of Faith and McManus creeks. This table shows also the duration in days for different rates of flow. The table on page 132 shows the storage that would have been necessary for the maintenance of a daily flow of 100 second-feet, which would furnish 9.1 horsepower per foot of fall.

By constructing a ditch for 12 or 15 miles along the Chatanika, which would divert 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. This could easily be transmitted to the mining camps, where, by the use of pumps, water from the Chatanika could be furnished to the producing creeks along this river. This would require less than 50 miles of distributing ditch.

A similar enterprise, mentioned in the description of the Little Chena drainage basin (p. 107), would develop sufficient power for pumping water to Fairbanks Creek.

This method of utilizing the water supply would dispense with many miles of ditch construction and would not only supply the camp with water, but also with power for running the hoist, elevating the tailings, pumping water from mines, lighting the underground work, and, in some localities, running the dredger.

STORAGE.

In this country, where for six months in the year the ground is frozen from surface to bed rock—10, 20, 30, and in many places more than 200 feet below—and the streams are closed by ice, it is perhaps more practical to use the daily flow of a stream during the open season than to attempt to conserve any excessive run-off; but continuous records may develop the fact that storage reservoirs are necessary from a commercial standpoint, notwithstanding the obvious difficulties connected with their construction and maintenance.

Computations have been made of 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. These are given in the following table, together with the number of days of deficient flow for the different capacities:

Storage table for Chatanika River near Faith Creek, 1907.

Capacity of ditch.	Days of deficient flow.	Net storage required.	
		Sec.-ft. for 1 day.	*Acre-ft.*
Sec.-ft.			
75	40	795	1,570
100	56	2,100	4,158
125	63	3,100	6,138

This table covers the period from June 16 to September 1. During this time there were days when the discharge of the streams exceeded the capacity of the proposed ditches. This excess would have been stored in the reservoirs. The periods of deficient flow for the different ditches occurred as follows: For a capacity of 75 second-feet, from June 20 to July 17 and from August 11 to 12; for a capacity of 100 second-feet, June 18 to August 1 and August 12 to 21; for a capacity of 125 second-feet, from June 15 to August 6 and August 9 to 24.

It would have been necessary to conserve the entire amount of flow for the larger ditch previous to June 15 and 90 per cent of the storage for the 100-second-feet ditch previous to June 15. After July 30 the daily discharge of the streams would have taken care of the smaller ditch.

For the satisfactory development of water supply for either ditch lines or power purposes it is necessary to have a thorough knowledge of the flow of the streams from which the projects are to receive their supply and an understanding of the conditions affecting that flow. The success of any such project is measured largely by the information which enables the engineer to design his work in accordance with the maximum efficiency of the available water supply, and this can be determined with greater accuracy by the aid of long-continued records.

In some of the older mining camps of Alaska the results of failure to investigate the water supply and the necessity for its use before constructing a ditch line can be seen in the almost dry ditch bottoms at times of greatest demand for water and the lack of productive ground on which to use the supply when it is obtainable.

If the work set forth in the foregoing pages aids in developing the water supply in the Fairbanks district and points out to the prospector and engineer the value of first investigating the water supply and its use before building a ditch, this report, in a measure, will have served its purpose.

METEOROLOGICAL RECORDS.

By Fred F. Henshaw and C. C. Covert.

INTRODUCTION.

The United States is divided by the Appalachian and Rocky Mountain systems into three distinct geographic provinces. Rainfall records show that the precipitation is greatest on the slopes toward the coast lines, and also that it is heaviest on the higher slope. Brooks [a] shows that similar geographic divisions are present in Alaska, except that the general direction is east and west, instead of north and south as in the States, the highest range lying to the south.

Abbe [b] in his report on climatic conditions in Alaska shows clearly that the heaviest precipitation occurs on the southern coastal slope. Abbe's tables also show a marked difference between the rainfall of the coast and that of the interior. The southern portion of Alaska is characterized by its dense forests, steeply graded but small drainage areas, and heavy precipitation. In contrast to these conditions the interior has larger drainage basins, more numerous flat and broad areas, less timber, and less precipitation. In Seward Peninsula the country is characterized by barren conditions, gradual slope to one minor mountain range, and a comparatively medium rainfall, with considerable local variation.

One of the important facts brought out by the stream-gaging work in Alaska during the last two years is the direct relation existing between rainfall and run-off during the open season. This is graphically illustrated by figs. 1 and 2 in this report.

It will be seen from a study of the foregoing pages that the maximum discharge of streams usually occurs in May and June, that the minimum flow comes in July and the early part of August, and that during the latter part of August and September the discharge fluctuates, but in the aggregate increases up to the freeze-up, which occurs in October. A study of the available rainfall records shows that this distribution of flow is the direct result of climatic conditions. The winter is a season of slight precipitation. This comes in the form of snow, which accumulates up to about the middle of April, when the increasing sunshine has its effect and the general break-up begins.

[a] Brooks, A. H., Geography and geology of Alaska; Prof. Paper U. S. Geol. Survey No. 45, 1906, Pl. II.
[b] Abbe, Cleveland, jr., Prof. Paper U. S. Geol. Survey No. 45, 1906, pp. 189-200.

The discharge resulting from the break-up reaches its maximum in May. April, June, and July are usually the months of least precipitation. After the high water caused by the spring break-up has disappeared, there is little additional supply to the streams, owing to the frozen condition of the ground and the slight rainfall. Consequently the streams rapidly reach a point of low discharge. The rainfall records also show that during August and September there is a gradual increase in the amount of precipitation. This, together with the effect of temperature on the frozen ground, is the primary cause of the increased flow of streams at this period.

All of this information has an important bearing on the development of the country. Mention has been made elsewhere in this report of the importance of an adequate water supply in the development of placer mines, but placer mining is not the only natural resource of Alaska which affords promising fields for development. Notwithstanding the fact that in the interior the ground is frozen the greater part of the year, during the summer, when it is thawed to a slight depth, the soil produces a luxuriant growth of vegetation, particularly in the lower Tanana basin. It is possible to raise many kinds of vegetables and small fruits, as well as hay and grain, and already agricultural pursuits are being followed more or less near the large towns. With the high prices for vegetables and general produce, the truck gardener in 1906 and 1907 found this occupation almost as lucrative as mining. It is obvious that in the agricultural development of any portion of this country it is important to know the length of the growing season, the amount of precipitation, and the number of sunshiny days which may be expected.

As meteorological records play so important a part in the development of Alaska, it is gratifying to note the number of places at which they are kept. The importance of the continuity of these records can not be too strongly impressed on the observers. For a number of years the Weather Bureau and the Signal Corps of the Army have kept records which cover most of the country in a general way.

During 1906 and 1907 the Geological Survey collected a considerable amount of climatological data in the Nome and Kougarok regions of Seward Peninsula and in the Fairbanks district. The daily records for these stations and the monthly summaries for all stations since 1902 are given in the following pages. All records up to 1902 are taken from Abbe's report, to which previous reference has been made.

SEWARD PENINSULA.

When stream-gaging work was begun in Seward Peninsula in the spring of 1906, it was thought advisable to obtain records of rainfall at several points distributed so as to cover in a general way the whole of the peninsula. Four rain gages were installed, the stations selected being Nome, on the southern coast; Salmon Lake, about 40 miles inland and south of Kigluaik Mountains; claim 15, Ophir Creek, near Council in the eastern portion of the peninsula; and Deering, on the coast of Kotzebue Sound to the north. No records were obtained from Deering, and therefore all the data procured here were for the area south of the mountains, where there are no striking differences in climate. In 1907 the scope of the observations was broadened, and an attempt was made to establish a line of rainfall stations from coast to coast of the peninsula across the Kigluaik Mountains. Additional rain gages were installed at Black Point, near the head of Nome River; at the forks of Grand Central River, in the heart of the mountains; and at Shelton and Taylor, north of the mountains. No records were obtained on the northern coast. The location of these stations is shown on Pls. IV, VII, and XII, and other information in regard to them is given in the following table:

Seward Peninsula rainfall stations.

Station.	Letter on Pls. IV, VII, and XII.	Latitude.	Longitude.	Elevation.		Observer.	Date established.
				Above sea level.	Above ground.		
				Feet.	*Feet.*		
Nome..........	A	64° 30′	165° 24′	40	20	Arthur Gibson......	June 14, 1906
Salmon Lake...	B	64° 54′	164° 56′	445	2	J. P. Samuelson and M. Donworth.	June 26, 1906
Ophir..........	C	64° 59′	163° 39′	200	2	C. Arnold...........	July 1, 1906
Black Point....	D	64° 51′	165° 16′	575	2	F. F. Miller.........	June 23, 1907
Grand Central	E	64° 58′	165° 14′	690	2	Cornelus Edmunds	July 10, 1907
Shelton........	F	65° 13′	164° 48′	60	2	Lars Gunderson....	July 12, 1907
Taylor.........	G	65° 42′	164° 48′	550	2	A. E. Edgtvet......	July 18, 1907

The records for 1907 show a striking difference between the Kigluaik region and the country south of the mountains. The totals for the three months July to September at Shelton and Taylor are only 2.51 and 2.79 inches, respectively. These are less than one-half the total at Nome, about one-third that at Black Point and Salmon Lake, and only one-sixth the amount at Grand Central. This deficiency is probably due to the fact that the heaviest rains are accompanied by southerly winds which loose most of their moisture by the time they have passed the mountains. The largest percentage of rain accompanied by winds from the south was 76 per cent at Black Point; the smallest, 35 per cent at Taylor. The whole region is subject to local showers, many of which are heavy in one valley and not felt in the next. The rain from a general storm is often very unequally distributed.

The following statement gives briefly the climatic conditions existing in this area during the years 1899–1907:

1899. July, four rainy days; August, fourteen rainy days; September, fourteen rainy days; recorded at Teller.

1900. June and July, warm and dry, tundra fires common; August to end of September, rain.

1901. June to August, inclusive, cold and foggy with some rain; September and October, usually clear and cold with one or two hard rains of a few days' duration.

1902. June, dry; July, ten rainy days; August, six rainy days; September, three rainy days; recorded at Teller.

1903. Summer warm; little rain, but considerable fog.

1904. June, dry; rainy days as follows: Ten in July, ten in August, ten in September; temperature moderate.

1905. Very wet and cold the whole season.

1906. Very warm and dry; tundra fires common; maximum temperature 85°.

1907. A heavy snowfall and a late spring; rainfall not excessive, but water supply of Nome region good on account of its even distribution throughout the season.

The records of rainfall, snowfall, temperature, and other weather elements observed in Seward Peninsula are given below:

Monthly rainfall, in inches, in Seward Peninsula, 1906-7.

Station.	June.	July.	August.	September.	Total, June to August.	Total, June to September.	Total, July to September.
1906.							
Nome	Trace.	2.38	2.50	1.02	4.88	5.90	5.90
Salmon Lake	Trace.	4.92	3.33	3.26	8.25	11.51	11.51
Ophir	Trace.	3.57	1.91	(a)	5.48		
1907.							
Nome	1.31	2.08	2.68	1.41	6.07	7.48	6.17
Black point	2.62	1.94	2.85	3.26	7.41	10.67	8.05
Salmon Lake	2.31	1.79	3.65	2.26	7.75	10.01	7.70
Grand Central	(a)	3.61	7.19	5.06			15.86
Shelton	(a)	.71	1.33	.47			2.51
Taylor	(a)	.66	.96	1.17			2.79

[a] No record.

Daily rainfall, in inches, at stations near Nome, 1906.

Day.	July.			August.			September.	
	Nome.	Salmon Lake.	Ophir.	Nome.	Salmon Lake.	Ophir.	Nome.	Salmon Lake.
1								0.14
2						Trace.	0.04	
3		0.12						
4		.35			0.17	0.01		
5		.35		0.07	.07	.05		
6		.10	0.02		.23	.03		
7	[a] 0.52	.17	.23	[b] .41	.28			
8	.37	2.32	1.30					.01
9	.92	.31	.19	Trace.	.29	.08		
10	.14	.25				.12		
11			.85			.01		
12	.04		.01		.10			
13			.02				.12	
14		.35	.01				.01	.03
15			.02					
16			.02					
17					.10		.14	.01
18			.01				.16	.28
19						.31	.23	1.06
20					.57	.31	.28	.99
21		.25	.01	.80			.04	.55
22			.01					.16
23	.08		.60	.22	.50	.22		.03
24	.27	.35	.25					
25	.04		.01	.04	.01	.05		
26				.37	.78	.40		
27			.01	.30	.23	.32		
28				.14				
29				.15				
30								
31								
	2.38	4.92	3.57	2.50	3.33	1.91	1.02	3.26

[a] Total, July 1-7. [b] Total, Aug. 6-7.

NOTE.—During June there was no measurable precipitation at any of the stations.

Daily rainfall and snowfall, in inches, at Nome, 1906-7.

Day.	October.	November.	December.		January.		February.		March.		April.	May.
	Rain.[a]	Rain.[a]	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Rain.
1		0.20										
2		.12			0.13	1.2						
3									0.52	4.2		0.05
4					.40	3.6						.03
5	0.14								.13	1.1		.39
6					.95	6.0						.08
7			0.17	2.0					.36	3.0		.12
8												
9	.13											
10					.23	1.6			.87	7.5		
11												
12												
13					.07	.5						
14	.09				.26	5.3						.09
15					.28	4.0						.04
16												
17									.57	5.5		
18									.09	1.0		
19												
20					.32	3.0						
21												
22												
23												.04
24			.74	5.5			0.56	4.5	.75	5.7	0.03	.04
25			.24	2.8			.30	3.0	.08	.8	.07	.24
26	.23		.08	1.0			.41	3.6				
27	.34			Tr.			.04	.5				
28							.15	2.3				
29			.38	5.0								
30												
31			.30	4.5								
	.93	.32	1.91	20.8	2.64	25.2	1.46	13.9	3.37	28.8	.10	1.12

[a] Most of the precipitation in October and November was in the form of snow; snowfall not measured.

Daily rainfall, in inches, at stations in Seward Peninsula, 1907.

Day.	June.			July.						August.		
	Nome.	Black Point.	Salmon Lake.	Nome.	Black Point.	Salmon Lake.	Grand Central.	Shelton.	Taylor.	Nome.	Black Point.	Salmon Lake.
1												
2											0.17	
3											.02	
4											.01	
5				0.03	0.12		[a] 0.12					
6	0.05	[a] 0.07		.48	.35	0.54	[a] .88					
7	.08	[a] .11		.30	.13		[a] .14					
8				.01	.14	.10	[a] .24					
9												
10						.10						
11				.03	.02	.12	[b] .12					
12				.02	.05		[b] .16	Tr.			.09	
13				.07	.07	.10	[b] .07			0.19	.04	0.40
14				.01	.04	.10	[b] .13	.01		.11	.10	
15					.02		[b] .11	.01		.04	.56	
16		[a] .26	[c] 0.46	.05	.07		[b] .07	.01		.38	.50	.39
17	.08	[a] .06								.07	.15	.65
18	.31	[a] .56	.63	.20	.12		[b] .12			.01	.02	.40
19	.06	[a] .21	.32	.06	.04		[b] .04			.05		
20	.21	[a] .34	.36	.05	.16	.20	[b] .40		.14	.22	.15	.32
21				.04	.28	.26	[b] .58	.06	Tr.	.06	.06	17
22									Tr.			
23	.02	.02		.22	.16		[b] .18	.05	.29	.01		
24	.03	.08		.47		.15	[b] .17	.53	.08	.11	.22	.10
25	.20	.22	.20	.04				.04		.02	.03	
26	.27	.69	.34						Tr.	1.02	.30	.65
27										.20	.22	.15
28										.07	.06	
29										.05	.05	.30
30					.17		.08		.12	.07	.10	.12
31						.12			.03			
	1.31	2.62	2.31	2.08	1.94	1.79	3.61	.71	.66	2.68	2.85	3.65

[a] Estimated by comparison of stations.
[b] July 10 to 16 total was 0.66; July 17 to 25 total was 1.49; these were distributed in proportion to rainfall at Black Point and Salmon Lake.
[c] Total June 1 to 16.

Daily rainfall, in inches, at stations in Seward Peninsula, 1907—Continued.

Day.	August—Continued.			September.						October.	November.
	Grand Central.	Shelton.	Taylor.	Nome.	Black Point.	Salmon Lake.	Grand Central.	Shelton.	Taylor.	Nome.	Nome.
1					0.10		0.05	0.01	0.03		0.04
2	0.20	0.01							.01		
3	.09	.15		0.14	.06		.04		Tr.		
4	.05	.05	0.09	.02	.16	0.34	32	.02	.33		
5							.04		Tr		.01
6				.10		.10		.01	.06		
7					.14		.07			0.02	
8				.07	.20	.10	.11	.01	.01		
9				.17	.36	.45	1.36		.27		
10				.61	1.40	.35	1.96	.20	.28		
11	.02		Tr.	.08	.33	.60	.66	.12			
12	.02		Tr.		.07	.17	.03		.01		
13	.08	.01	.03								
14	.10	.10	.07	.04	.07		.05				
15		.03	Tr.	.06	.22		.08		.17		
16	.70	09	Tr.						Tr		
17	.83	.11	.15								01
18	.40	.13	.13						Tr		
19	.02	.05									
20		.07							Tr.		
21	.48	.03	22	.03	.04		.03	.06			
22	.12		.01							.04	
23	.02		.01								
24	.20	.12	.07					Tr.		.05	
25	.14	.03	.02	.02	.05		*a*.05			.05	
26	.50	.20	.08		06	.15	*a*.21				
27	.20	.07	.03	.06							
28	.07							.04			
29	1.90	.08	Tr.	.01							
30	1.03		.05								
31	.02		Tr.								
	7.19	1.33	.96	1.41	3.26	2.26	5.06	.47	1.17	.16	.06

Daily mean temperature (°F.) at Nome, 1906-7.

Day.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.
1		23.5	8.5	9.5	− 0.5	37.5	41.0	45.5	54.0	40.5	40.0	11.5
2	2.0	29.5	− 1.0	1.5	15.0	37.0	45.0	48.5	54.5	41.0	33.0	13.0
3	2.0	14.0	− 5.5	20.5	13.5	40.0	42.5	44.5	54.5	37.0	25.5	3.5
4	−2.0	25.5	− 2.0	24.0	12.5	37.5	44.0	46.0	54.0	41.5	26.5	6.0
5	−2.0	15.5	−11.5	23.0	13.0	35.5	41.0	49.0	48.0	42.0	25.5	8.5
6	5.0	25.0	−13.5	20.5	− 0.5	33.5	46.0	50.0	44.0	38.5	26.0	6.0
7	1.0	24.5	− 1.5	28.5	.0	38.5	41.0	46.5	52.0	41.0	32.5	2.5
8	− .5	11.5	−10.0	26.0	− 2.0	43.0	38.0	46.0	58.0	44.5	33.0	− 3 0
9	−5.0	− 8.0	−15.0	25.5	10.0	43.5	52.0	51.5	50.5	46.5	24.0	− 0.5
10	− .5	4.0	−13.0	29.5	3.0	39.5	50.5	56.5	50.0	47.5	22.0	8.5
11	−3.0	20.5	−14.0	29.0	15.0	26.0	48.0	57.5	54.5	46.5	26.0	18.5
12	6.0	25.0	−25.0	21.5	26.0	20.5	51.0	49.0	57.5	42.0	26.0	19.0
13	3.5	24.0	−20.5	7.0	33.5	22.5	57.5	49.5	59.5	39.5	19.0	29.5
14	3.0	18.5	−19.5	− 4.5	29.0	28.0	50.5	51.0	56.0	40.0	21.0	28.0
15	17.0	16.0	−27.5	− 5.0	17.5	26.0	42.0	52.0	53.5	45.5	23.0	33.5
16	23.0	− .5	−22.0	− 4.0	13.5	25.5	42.5	51.5	50.5	38.0	23.5	23.0
17	16.5	− 7.5	−18.5	15.0	5.5	30.0	43.5	49.0	48.5	39.0	26.5	20.0
18	8.5	−20.0	−22.5	18.5	7.0	31.0	45.0	46.5	51.0	36.0	23.0	19.5
19	3.5	− 6.0	−15.5	− 5.0	8.0	31.0	40.0	46.5	48.5	36.5	27.0	13.5
20	− .5	11.5	−22.5	− 9.0	18.5	32.0	42.0	49.5	54.0	35.5	20.0	9.5
21	−4.0	11.5	−18.0	−15.5	24.0	36.0	45.0	49.0	53.0	43.5	27.0	14.0
22	2.0	1.5	− 6.0	−17.0	26.0	37.5	43.5	48.5	48.5	38.0	27.0	6.5
23	−1.0	23.0	− 1.5	−13.5	33.0	43.5	52.5	54.0	42.0	36.0	25.0	2.5
24	10.0	21.5	12.5	16.0	33.0	39.0	52.5	53.0	38.5	37.5	29.0	4.5
25	20.0	23.5	25.0	10.0	35.5	36.5	49.0	51.0	40.0	39.0	34.0	− 3.0
26	18.0	14.0	24.5	− 8.0	37.5	34.0	47.0	52.0	45.5	45.5	29.5	− 4.5
27	8.5	13.5	17.5	−10.0	37.0	29.5	42.5	47.0	45.5	42.0	21.5	− 4.5
28	7.0	10.5	6.5	−14.5	34.0	34.5	41.5	46.0	44.0	45.0	19.5	1.5
29	19.0	4.5		−18.5	36.0	36.0	44.0	51.5	47.0	45.0	9.5	.5
30	20.0	.5		−19.5	36.0	40.5	45.5	56.0	45.5	42.0	7.5	− 3.5
31	25.5	.0		− 6.5		38.5		57.5	41.0		7.0	
Mean	6.8	11.9	− 7.6	5.6	19.0	34.3	45.5	50.0	49.8	41.1	24.5	9.5

Daily barometer, in inches, at Nome, 1906–7.

Day.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	......	29.97	30.64	30.04	30.12	30.10	29.92	30.00	29.84	29.83	29.40	29.93
2	30.85	29.68	30.64	29.67	30.22	30.25	29.83	30.00	29.68	29.93	29.44	29.75
3	30.89	28.95	30.58	29.46	29.77	30.18	29.75	29.85	29.74	29.90	29.45	29.74
4	31.00	29.31	30.50	29.66	29.60	29.77	29.75	29.71	29.88	29.90	29.55	29.76
5	30.78	29.97	30.24	29.38	29.70	29.75	29.87	29.71	30.04	29.95	29.76	29.63
6	30.43	29.12	30.05	30.04	29.82	30.00	29.81	29.66	30.14	29.88	29.77	29.42
7	30.40	29.89	29.96	29.69	29.93	29.87	29.85	29.94	29.95	29.77	29.67	29.78
8	30.79	30.43	30.23	30.21	29.86	29.80	29.82	30.02	30.00	30.17	29.69	30.03
9	30.43	31.08	30.22	30.26	29.85	29.78	29.82	29.76	29.97	30.29	30.04	29.87
10	30.36	30.81	30.03	29.59	30.05	29.68	29.73	29.85	29.85	29.95	29.95	29.98
11	30.33	30.60	29.90	29.87	29.93	29.70	29.75	29.79	29.86	29.95	29.92	30.32
12	29.99	30.47	29.79	30.15	29.75	29.72	29.86	30.21	29.84	30.44	30.05	29.98
13	30.03	30.40	29.49	30.65	29.75	29.83	30.00	30.18	29.72	30.32	30.15	29.66
14	30.24	30.37	29.60	30.50	29.85	29.82	29.86	30.10	29.89	30.09	30.20	29.57
15	30 12	30.20	29.79	30.35	30.03	30.16	29.88	29.80	29.98	30.11	30.16	29.40
16	29.75	30.28	30.20	30.14	30.27	30.40	29.99	29.90	29.74	30.10	30.06	29.56
17	29.73	30.51	30.18	29.14	30.48	30.51	29.93	29.94	29.68	29.97	29.89	29.30
18	29.86	30.32	30.39	29.46	30.36	30.50	29.66	29.90	29.76	29.90	29.77	29.31
19	30.10	29.98	30.37	29.96	30.00	30.37	30.12	29.91	29.66	29.78	29.35	29.48
20	30.35	29 26	30.43	29.80	30.06	30.32	29.96	29.55	29.22	29.20	29.20	29.34
21	30.40	29.97	30.27	30.13	30.42	30.12	29.82	29.67	29.32	29.15	29.27	29.35
22	30.27	29.84	29.95	30.54	30.33	30.08	29.86	29.80	29.58	29.68	29.68	29.27
23	29.57	30.56	29.92	30.10	30.17	30.00	29.64	29.83	29.77	29.94	29.74	29.45
24	29.38	30.73	29.29	29.10	29.96	29.93	29.90	29.83	29.66	29.93	29.44	29.64
25	29.16	30.78	29.07	29.74	29.91	30.00	29.83	29.90	29.79	29.49	29.44	29.68
26	29.77	30.74	29.21	30.39	29.73	30.08	30.00	29.90	29.67	29.55	29.48	29.78
27	30.24	30.72	29.58	30.44	29.95	30.10	30.28	29.87	29.81	29.42	29.76	29.60
28	30.24	30.72	30.02	30.66	30.06	30.20	30.29	29.96	29.64	29.28	29.78	29.42
29	30.04	30.61	......	30.72	30.28	30.11	30.22	30.00	29.70	29.56	29.77	29.75
30	29.87	30.48	......	30.32	30.00	29.91	30.18	29.96	29.23	29.70	30.00	29.87
31	29.84	30.62	......	30.26	......	29.80	......	29.75	29.59	......	30.15	......
Mean	30.17	30.24	30.02	30.01	30.01	30.03	29.91	29.88	29.75	29.64	29.74	29.65

Summary of meteorological observations at Nome, December, 1906, to November, 1907.

Total precipitation, rain, and melted snow	inches	18.30
Total snowfall	do	91.9
Maximum temperature	° F.	69
Minimum temperature	° F.	−32
Mean daily maximum temperature	° F.	30.7
Mean daily minimum temperature	° F.	17.7
Mean of means of maximum and minimum temperature	° F.	24.2
Mean barometer	inches	29.92
Number of clear days		152
Number of partly cloudy days		50
Number of cloudy days		163

FAIRBANKS DISTRICT.

In connection with the stream-flow investigations begun in the Fairbanks district in 1907, it was considered advisable to establish a few rainfall stations at different places in the territory covered. Four rain gages were installed at the places listed in the following table. All records are kept by voluntary observers.

Rainfall stations near Fairbanks.

Station.	Letter on Pls. IX and XII.	Latitude.	Longitude.	Elevation.		Observer.	Date established.
				Above sea level.[a]	Above ground.		
				Feet.	*Feet.*		
Summit Road House.	G	65° 02′	147° 26′	2,310	3	Mrs. Annie M. Walsh	July 3.
Cleary	H	65° 05′	147° 26′	1,000	4	Charles Sinclair	June 25.
Poker Creek	K	65° 08′	147° 28′	750	5	G. M. Sabean	Aug. 3.
Faith Creek	L	65° 17′	146° 23′	1,400	4	M. T. Kerrick	July 1.

[a] Approximate.

The records kept at these stations, together with those being obtained by the United States Weather Bureau at Fairbanks, Central, and Circle, give a general idea of the rainfall distribution from Fairbanks on the Tanana to Circle on the Yukon, 150 miles to the northwest.

Mean monthly precipitation at stations in Yukon-Tanana region, 1902-1907.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Length of record.	
														Yrs.	*Mos.*
Central	0.80	0.24	1.31	0.70	0.73	3.56	3.11	1.85	0.52	0.70	0.80	0.35	14.67	1	7
Circle	1.05	.29	.52	.67	.83	.54	1.77	2.33	1.69	1.15	.30	.51	11.65	1	22
Fairbanks	1.99	.58	.93	.11	.36	1.26	2.16	1.98	1.56	1.37	.92	.88	14.10	1	18
Fort Egbart	1.01	.39	1.37	.18	.66	1.23	1.98	1.73	1.95	1.93	.72	.38	13.53	......	37
Fort Gibbon	.54	.49	.46	.10	.50	.74	2.80	3.04	1.05	.85	.52	.50	11.59	1	33
Kechumstuk	.46	.11	.12	.22	1.24	1.51	1.87	1.77	1.20	.62	.22	.21	9.55	2	18
North Fork	.70	.39	.18	.40	1.66	2.33	2.13	2.04	1.52	.42	.52	.29	12.58	1	13
Rampart	.90	.26	.67	.03	.42	1.04	2.04	2.66	1.60	.82	1.19	.33	11.96	1	17
Dawson	1.01	.67	.46	54	.97	.86	1.85	1.77	1.82	1.60	1.12	1.10	13.77	5	18

NOTE.—Values for the different months are averages of all observations for that month. In the column headed "Year" is given the total of these averages. Amounts given for the winter months, October to March, represent melted snow, and as a rule are taken as one-tenth of the snowfall.

Purington[a] publishes a summary of the rainfall data previous to 1903 as compiled by Cleveland Abbe, jr. These tables show not only the marked variation in rainfall along the coast, but the variations between the rainfall of the coast and that of the interior.

A record for thirteen years and eleven months at Juneau shows a yearly average of 93.1 inches, and one for fifty-two months at Eagle gives an average of 11.4 inches. A similar table compiled from records obtained subsequent to 1902, at stations in the interior, gives a range from 9.55 inches at Kechumstuk to 14.67 inches at Central. This table also shows that the heaviest precipitation occurs during the period from June to September, inclusive, and that the months of April and May are usually months of least precipitation. For the source of the data in this table see pages 142 to 149, inclusive, in this report.

The following tables show the daily and monthly rainfall at stations near Fairbanks:

[a] Purington, C. W., Methods and costs of gravel and placer mining in Alaska: Bull. U. S. Geol. Survey No. 263, 1905, page 48.

Daily rainfall, in inches, at stations near Fairbanks, 1907.

Day.	January.	February.	March.	April.	May.	June.		July.			
	Fairbanks.					Fairbanks.	Cleary.	Fairbanks.	Summit Road House.	Cleary.	Faith Creek.
1	0.05										
2	.22		0.05								0.02
3	.16							0.04		0.09	
4	.35		.04								
5	.35	0.03				0.15					.04
6	.04					.09			0.30		
7						.11		.35	.06	.30	.14
8	.36					.07		.01		.09	
9	.75		.04		0.15						
10	.20					.15			.50	.47	.03
11		.16	.17			.05		.02	.12	.09	.14
12		.04	.40					.05	.22	.32	
13		.07	.17		.06						.03
14	(a)	.17	.05						.30		.05
15	.20	.21		0.03		.02		.01	.05	.19	.28
16	.30	.07				.18		.19	.24	.20	.11
17	.05	.03				.10			.03	.01	.01
18			.80			.02		.09	.24	.15	.35
19			.40						.13		
20			.10					.14			.13
21	.02										
22								.01			
23	.20										
24	.05							.25	.22	.27	.23
25			.20					.18	.15		
26								.05	.02	.12	.31
27							0.01			.07	
28		.08				.23	.41				
29					.13	.30	.42		.13	.06	
30					.01			.12		.12	
31											
Total.	b 3.30	b .86	b 2.42	b .03	.35	1.47	c .84	1.51	2.71	2.55	1.87
Snowfall...	33.0	8.6	24.2	.30							

Day.	August.					September.			October.		November.
	Fairbanks.	Summit Road House.	Cleary.	Poker Creek.	Faith Creek.	Fairbanks.	Cleary.	Poker Creek.	Fairbanks.	Poker Creek.	Poker Creek.
1	0.72	1.27	1.17		0.49				0.02		
2	.01	.06	.12		.19			Tr.			
3											
4			.09		.20	0.18	0.08	0.10	Tr.	Tr.	0.08
5					.03	.03	.14		Tr.	0.05	
6	.13	.27	.04	0.05	.11				.10	.30	
7		.07	.22	.24	.15		.12	.01	.20	.10	
8	.01	.42			.15	.18	.11	.02	.05		
9		.11	.46	.33	.10	.02	.22	.01	.09	.17	.10
10	.25		.08	.05	.02	.05		Tr.	.23	.30	
11						.23		.63	.50	.20	.03
12						.71	.21	.88	.25	.10	
13					.01		.80				
14									.03		
15	.09				.07	.22	.85	.70		Tr.	
16				.01	.04	.27		.10			
17		.09		.01							
18	.12		.05	.07	.01						
19									.20	.13	
20						.15	.15	.40			
21		.19		.13		.15		.13			
22	.05	.04	.10	.02	.13	.16	.52	.27			
23		.20	.11	.13		.37	.23	.15			
24	.18	.13	.09	.04	.15	.01					
25	.12	.03	.13	.15	.36						
26					.03						
27											
28		.26		.02	.09				.30	.20	
29	.13	.13	.22	.15	.54	.35		.30	.47	.15	.04
30					.13	.50	.39				
31											
Total.	1.81	3.27	2.88	1.40	3.00	3.58	3.82	3.70	b 2.44	1.70	.25
Snowfall...									24.4	24.0	3.30

a Drifting. b Taken as 10 per cent of the snowfall. c June 25 to 30.

SUMMARY OF RECORDS SINCE 1902.

All meteorological records obtained at stations in Alaska up to 1902 have been compiled by Abbe.[a] The following tables complete the record of precipitation to 1907, inclusive. The values for 1903 to 1905 for Weather Bureau stations have been taken from the annual report of the Chief of the Weather Bureau. Those for 1906 and 1907 were obtained from the original records through the courtesy of the Bureau officials. The snowfall is given only for 1906 and 1907. For these years the amount of rainfall and melted snow is given in the first line and the snowfall in the second line.

Most of the amounts given for the winter season in the previous years represent melted snow, and many of them have been taken as one-tenth of the observed snowfall. The water equivalent of snowfall varies considerably, and in general is probably somewhat less than this proportion in Alaska. In many parts of Alaska the snowfall is accompanied by wind and piles up in the form of drifts in sheltered places. This renders the accurate measurement of the quantity of snow very difficult, and many of these records can therefore be regarded as only approximate. The locations of all rainfall stations are given on Pl. XII.

Summary of records of precipitation at stations in Alaska.[b]

D. BLACK POINT.

[Latitude, 64° 51′; longitude, 165° 16′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	......	......	2.62	1.94	2.85	3.26	......	......	......	......

1. CENTRAL.

[Latitude, 65° 33′; longitude, 145° 49′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906	0.56	0.06	0.05	0.47	0.86	4.91	4.82	1.85	0.52	0.70	0.80	0.35	15.95
	6.1	1.0	1.4	4.7	2.0	......	......	......	......	7.0	8.0	4.0	34.2
1907	1.04	.42	2.57	.93	.57	2.21	1.40	......	......	......	......	......	......
	10.0	4.0	24.0	8.0	1.5	......	......	......	......	......	......	......	......

H. CLEARY.

[Latitude, 65° 05′; longitude, 147° 26′.]

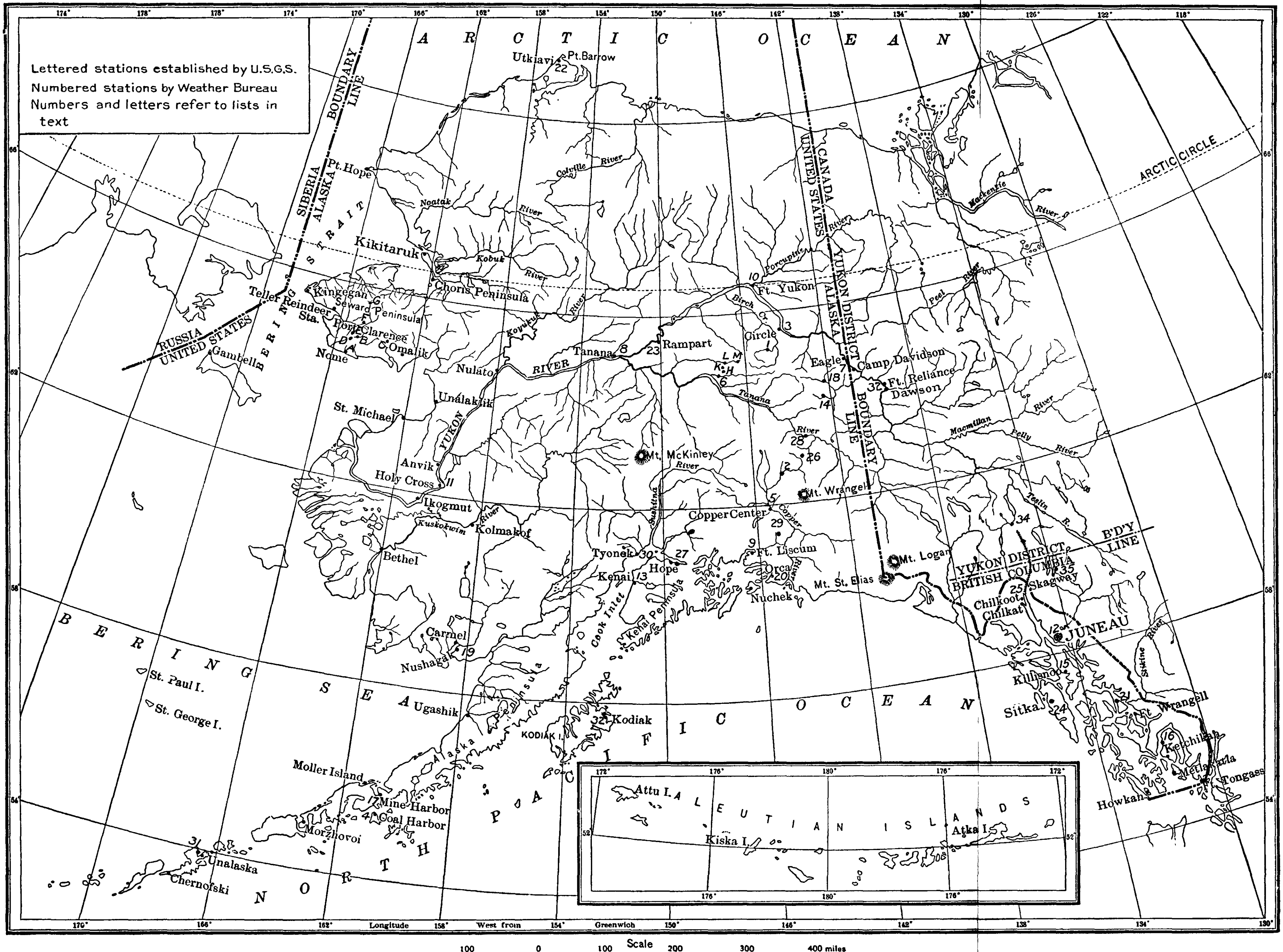
Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	......	......	......	2.55	2.88	3.82	......	......	......	......

2. CHISTOCHINA.

[Latitude, 62° 36′; longitude, 144° 44′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904	......	......	......	......	......	......	......	0.40	2.01	......	......	0.20	......
1905	0.05	0.02	0.08	0.00	0.48	0.90	3.19	3.20	3.11	1.68	0.03	.75	13.49
1906	.26	.60	.30	Tr.	.00	.81	1.78	1.48	......	......	.50	1.80	......
	2.5	6.0	3.0	......	......	......	......	......	......	1.0	5.0	18.0	35.5
1907	2.80	.20	.80	......	Tr.	1.50	2.82	2.21	2.07	1.34	......	......	......
	28.0	2.0	8.0	......	......	......	......	......	5.0	6.0	......	......	......

[a] Abbe, Cleveland, jr., Prof. Paper U. S. Geol. Survey No. 45, 1906, pp. 189-200.
[b] Numbers and letters refer to Pl. XII.



MAP OF ALASKA, SHOWING LOCATION OF RAINFALL STATIONS.

Summary of records of precipitation at stations in Alaska—Continued.

3. CIRCLE.

[Latitude, 65° 50′; longitude, 144° 4′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906	......	......	......	......	......	......	......	......	......	......	......	0.75	......
	......	......	......	......	......	......	......	......	......	......	......	9.5	......
1907	1.02	0.57	0.28	0.15	0.29	......	1.36	2.79	1.73	......	......	.63	......
	8.5	7.8	3.25	......	......	......	......	......	......	......	......	8.2	......

4. COAL HARBOR, UNGA ISLAND.

[Latitude, 55° 20′; longitude, 160° 38′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	3.90	7.32	1.90	2.26	2.77	2.05	3.66	3.64	5.29	2.52	2.52	4.69	42.52
1904	2.00	0.12	0.66	1.89	1.83	1.23	4.22	4.17	3.73	2.07	2.82	2.00	26.74
1905	0.17	9.05	1.20	18.92	6.76	4.44	1.75	2.20	2.95	3.03	9.25	4.64	64.36
1906	2.33	5.43	6.46	......	3.27	1.01	3.18	4.28	3.42	4.44	3.52	2.87	......
	5.8	1.9	4.2	Tr.	Tr.	......	......	......	......	......	7.3	2.25	......
1907	5.65	0.20	1.43	7.99	4.59	1.88	4.71	4.90	5.84	5.83	......	......	......
	3.5	1.2	Tr.	12.75	......	......	......	......	......	Tr.	......	......	......

5. COPPER CENTER.

[Latitude, 61° 58′; longitude, 145° 20′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	0.05	0.05	0.40	Tr.	0.60	1.38	0.99	1.16	1.34	1.71	0.20	0.75	8.63
1904	.67	.22	Tr.	0.24	.92	1.11	1.80	2.09	.73	.48	.36	.68	9.30
1905	.29	1.01	.20	Tr.	.48	.50	1.35	.72	1.94	.97	.94	.97	9.37
1906	1.14	.19	.69	.36	.43	1.19	2.14	.69	.37	.84	.99	.35	9.38
	17.2	2.8	9.2	3.0	Tr.	......	......	......	......	......	8.5	6.0	46.7
1907	......	.60	.30	......	.36	1.14	.97	.71	.25	1.35	.80	.35	......
	......	6.6	3.0	......	......	......	......	......	......	11.5	8.0	3.5	......

6. FAIRBANKS.

[Latitude, 64° 50′; longitude, 147° 44′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904					......	......	......	......	......	......	1.10	2.00	......
1905	0.92	0.50	0.05	0.20	......	......	......	2.63	0.86	......	1.20	0.60	......
	9.1	5.0	.5	2.0	......	......	......	......	......	......	12.0	5.1	......
1906	1.75	.37	.33	.10	0.36	1.05	2.82	1.50	.25	.30	.65	1.15	10.63
	17.5	3.7	3.3	1.0	......	......	......	......	......	0.6	6.5	11.5	45.1
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	.30	......	......	......	......	......	24.4	3.5	5.9	99.9

L. FAITH CREEK.

[Latitude, 65° 17′; longitude, 146° 23′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	......	......	......	1.87	3.00	2.97	......	......	......	......

7. FORT EGBERT.

[Latitude, 64° 45′; longitude, 141° 10′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	0.58	0.81	0.54	0.12	1.38	0.57	2.40	0.97	2.97	......	......	......	......
1905	......	......	......	......	.33	1.95	1.52	2.72	3.38	2.96	0.93	0.68	......
1906	......	.14	2.19	.00	.54	.51	2.54	1.28	.01	1.71	.51	.07	......
	......	1.0	11.0	......	......	......	......	......	......	4.6	8.5	1.0	......
1907	1.45	.21	......	.25	.40	1.89	1.48	1.98	1.45	1.12	.40	......	......
	2.0	2.0	......	.15	.55	......	......	......	......	13.0	4.0	......	......

Summary of records of precipitation at stations in Alaska—Continued.

8. FORT GIBBON.

[Latitude, 65° 12′; longitude, 152°.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	0.37	0.73	1.14	0.23	0.16	0.38	1.76	......	0.48	0.22	0.33	Tr.	......
1904	.08	.55	.35	.09	.22	.33	1.95	3.80	.35	.39	.07	0.70	8.88
1905	.37	.47	Tr.	......	.84	1.50	4.90	3.02	......	......	1.10	.18	......
1906	.65	.20	.30	Tr.	1.00	......	......	......	......	[a] .50	.99	.27	......
	6.0	2.0	3.0	......	......	......	......	......	......	[a] 5.0	9.9	2.7	......
1907	1.26	......	.53	......	.30	......	2.58	2.31	2.32	1.22	.03	......	......
	12.6	......	5.0	......	......	......	......	......	4.0	12.0	1.5	......	......

[a] October 7 to 31.

9. FORT LISCUM.

[Latitude, 61° 27′ 30″; longitude, 146° 27′ 34″.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	10.42	13.60	4.72	3.87	2.23	3.24	4.29	6.44	8.62	6.62	5.62	9.61	79.28
1904	6.80	.52	.10	4.50	.68	2.26	5.61	12.45	7.96	9.16	2.20	3.99	56.23
1905	3.63	5.73	7.17	2.96	7.02	3.83	3.49	9.85	......	6.06	10.37	7.75	......
1906	12.53	1.83	7.54	4.20	1.36	4.01	7.12	8.46	4.11	8.61	7.50	6.75	74.02
	97.6	13.5	103.2	31.6	.5	......	......	......	......	.5	57.5	63.5	367.9
1907	1.75	10.14	6.04	.82	4.05	2.83	11.25	10.61	11.98	16.77	7.94	7.13	91.31
	17.5	95.0	63.0	......	......	......	......	......	......	10.4	38.1	51.95	276.0

10. FORT YUKON.

[Latitude, 66° 34′; longitude, 145° 18′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	0.62	1.09	......	0.34	0.35	0.77	......	......	1.70	1.30	0.26	0.38	......
1904	.69	.93	0.80	3.08	4.60	2.40	1.67	......	......	......	......	......	......

E. GRAND CENTRAL.

[Latitude, 64° 58′; longitude, 165° 14′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	......	......	......	3.61	7.19	5.06	......	......	......	......

11. HOLY CROSS MISSION.

[Latitude, 62° 16′; longitude, 159° 50′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906	......	0.78	1.26	0.39	0.22	1.52	1.97	3.22	2.47	0.11	0.90	1.02	......
1907	2.08	.55	4.49	......	......	2.95	3.73	5.39	3.56	.38	.51	......	......
	15.5	3.5	......	......	......	......	......	......	......	......	......	......	......

12. JUNEAU.

[Latitude, 58° 19′; longitude, 134° 28′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	11.31	7.29	3.09	3.74	6.74	1.44	2.26	5.45	6.94	......	......	......	......
1904	......	......	......	7.84	6.50	10.40	8.15	4.04	9.20	9.34	8.36	8.89	......
1905	2.83	3.08	5.90	4.96	1.58	2.96	1.93	7.85	......	12.74	15.49	10.32	......
1906	4.35	1.57	.56	3.03	......	1.34	3.58	3.21	3.68	12.30	12.27	2.17	......
	......	......	Tr.	2.0	......	......	......	......	......	......	7.0	......	......
1907	.48	8.88	2.74	3.10	3.93	......	3.40	6.88	17.03	11.19	4.58	......	......
	......	......	......	......	......	......	......	......	......	3.0	8.5	......	......

Summary of records of precipitation at stations in Alaska—Continued.

KATALLA.

[Latitude, 60° 11′; longitude, 144° 31′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	7.70	4.85	8.29	14.95	11.41	12.34	25.62	12.44	......	....
	......	......	......	2.0	......	......	......	......	......	1.25	15.5	......	....

13. KENAI.

[Latitude, 60° 32′; longitude, 151° 19′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	0.83	2.18	0.44	0.67	0.54	1.16	2.48	3.78	2.72	0.77	0.78	0.18	16.53
1904	.46	.29	.02	.34	Tr.	.87	2.44	3.50	4.01	1.71	.48	.66	14.78
1905	.29	.92	.57	.46	.84	.84	1.06	6.26	.78	2.92	2.16	1.41	18.51
1906	.30	.10	1.24	.17	.29	.57	4.41	2.95	1.41	1.74	.39	1.16	14.73
	5.5	1.0	10.2	3.0	......	......	......	......	......	Tr.	7.8	10.0	37.5
1907	.68	.61	.67	.04	1.24	2.31	5.49	......	10.00	1.66	......	......	....
	5.0	15.5	8.8	Tr.	......	......	......	......	......	2.7	......	......	....

14. KECHUMSTUK.

[Latitude, 64° 07′; longitude, 142° 20′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904				......	1.80	0.83	2.23	0.94	0.64	0.30	0.03	0.23	....
1905	0.90	0.10	0.05	0.40	.20	1.58	.40	1.48	2.16	1.18	.36	.20	9.01
1906	.36	.05	.06	.27	1.69	1.61	3.25	2.51	.51	.31	.29	.20	11.11
	4.0	.5	1.0	5.0	......	......	......	......	......	4.3	.5	3.0	18.3
1907	.12	.20	.27	Tr.	1.30	2.03	1.60	2.14	.49	.72	.40	......	....
	2.0	3.0	4.0	......	12.0	......	......	......	2.0	9.0	4.0	......	....

15. KILLISNOO.

[Latitude, 57° 22′; longitude, 134° 29′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	4.05	2.4[illegible]	0.20	6.15	2.55	0.75	1.15	2.30	3.10	12.45	3.65	5.00	43.75
1904	4.30	1.25	1.20	1.35	1.75	3.35	4.60	2.30	7.70	8.20	9.20	8.55	53.75
1905	1.90	2.80	2.60	2.20	......	1.20	1.60	4.30	......	4.10	8.40	7.75	....
1906	6.90	2.70	.90	5.15	1.25	2.85	3.80	4.90	4.70	8.40	9.55	2.50	53.60
	31.0	1.5	......	......	......	......	......	......	......	......	4.0	10.0	46.5
1907	1.40	9.55	1.70	1.35	1.60	3.85	3.05	4.65	6.85	8.57	......	......	....
	14.0	31.5	7.0	......	......	......	......	......	......	......	......	......	....

16. LORING (FORKNAM HATCHERY.)

[Latitude, 55° 36′; longitude, 131° 37′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904	......	......	2.05	7.27	15.80	9.68	7.97	1.15	20.20	26.01	31.90	20.01	....
1905	5.18	13.19	16.53	11.65	9.46	.84	5.26	12.71	14.07	17.94	28.49	25.92	161.24
1906	21.66	6.08	8.56	24.52	5.59	10.09	4 99	15.21	17.28	20.49	21.57	8.41	164.45
	19.5	......	......	4.2	......	......	......	......	......	......	......	7.5	31.2
1907	.53	13.03	4.98	7.76	4.30	5 23	3.73	9.75	10.14	20.09	24.55	......	....
	15.0	19.2	24.2	......	......	......	......	......	......	......	1.0	......	....

17. MINE HARBOR.

[Latitude, 55° 45′; longitude, 160° 40′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	2.36	6.61	1.00	2.25	2.59	1.01	......	2.51	5.10	3.97	2.60	5.92	....
1904	3.00	.49	.29	1.42	.81	1.30	3.79	4.78	......	......	......	......	....

Summary of records of precipitation at stations in Alaska—Continued.

A. NOME.

[Latitude, 64° 30′; longitude, 165° 24′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906						Tr.	2.38	2.50	1.02	0.93	0.32	1.91 20.8	
1907	2.64 25.2	1.46 13.9	3.37 28.8	0.10	1.12	1.31	2.08	2.68	1.41	.16	.06		

18. NORTH FORK.

[Latitude, 64° 30′; longitude, 142° 10′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905								1.91	1.86		0.50	0.20	
1906	0.70 7.0	0.50 5.0	0.10 1.0	0.80 8.0	1.98	2.74	2.69	1.01	.72	0.42 3.2	.55 4.5	.38 4.5	12.59 33.2
1907	.69 15.5	.28 3.0	.27 3.0	Tr.	1.34 4.0	1.92	1.57	3.19	2.00 5.0	1.40 12.0	.20 2.0		

19. NUSHAGAK.

[Latitude, 58° 56′; longitude, 158° 24′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904							2.29	4.52	4.16	1.66	Tr.	0.56	
1905	0.20	1.45	0.40	0 40	2.51	2.75	3.84						

C. OPHIR CREEK (CLAIM 15).

[Latitude, 64° 59′; longitude, 163° 39′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906						Tr.	3.57	1.91					

20. ORCA.

[Latitude, 60° 35′; longitude, 145° 40′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	16.74	16.60						10.75	16 67	17.70	13.24	23.44	
1904	11.69		0.72	13.55					9.12	21.76	9.66	19.05	
1905	8.20	11.56	12.51	9.10	10.48	6.51	4.42	12.99		15.57	29.64	12.81	
1906	10.63 76.0	.94	5.34 39 0	7.54 17.0							17.08 3.0	8.56 39.0	
1907	3.26 3.0	8.48 100.0	2.15 25.0							29.15	13.16 17.0		

21. PETERSBURG.

[Latitude, 56° 49′; longitude, 132° 56′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904							9.20	2 33	15.33	12.89	13.89		
1905				7.17	3.03	1 95	4.46	10.76					

22. POINT BARROW.

[Latitude, 71° 17′; longitude, 156° 40′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	0 20	0.10				0.10	0 74	1.43	0.09		Tr.	0.05	
1904	Tr.	.37	0.40	0.30									

K. POKER CREEK.

[Latitude, 65° 08′; longitude, 147° 28′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906								1.40	3.70	1.70 24.0	0.25 3.30		

Summary of records of precipitation at stations in Alaska—Continued.

23. RAMPART.

[Latitude, 65° 30′; longitude, 150° 15′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905	......	......	......	......	......	1.33	1.99	2.19	1.70	1.20	1.43	0.33	......
1906	0.63	0.08	0.17	0.04	0.40	.15	1.86	2.40	.59	.61	.95	.33	8.21
	7.2	2.0	1.8	.5	......	......	......	......	......	......	10.2	3.5	25.2
1907	1.17	.44	1.17	.02	.44	1.64	2.29	3.38	2.52	.65	.55	......	......
	12.0	4.5	12.8	.25	......	......	......	......	......	......	6.3	......	......

B. SALMON LAKE.

[Latitude, 64° 54′; longitude, 164° 56′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906	......	......	......	......	......	Tr.	4.92	3.33	3.26	0.81	1.56	......	......
	......	......	......	......	......	......	......	......	......	......	18.0	......	......
1907	......	......	......	......	......	2.31	1.79	3.65	2.26	......	......	......	......

F. SHELTON.

[Latitude, 65° 13′; longitude, 164° 48′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	......	......	......	0.71	1.33	0.47	......	......	......	......

24. SITKA.

[Latitude 57° 03′; longitude 135° 19′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	6.61	8.68	2.57	4.25	3.65	0.90	2.85	3.90	5.80	14.52	6.50	14.97	75.20
1904	10.36	.43	3.04	3.39	3.80	3.22	5.95	3.74	13.27	10.38	8.78	8.13	74.49
1905	3.82	4.78	4.21	7.52	2.44	2.25	2.83	7.38	8.80	7.03	11.37	11.21	73.64
1906	7.25	1.89	1.58	10.64	3.46	3.34	7.45	4.66	5.78	15.22	15.59	6.61	83.47
	8.3	......	6.0	......	......	......	......	......	......	......	......	1.0	15.3
1907	2.36	3.55	1.75	2.16	3.84	3.66	4.66	12.60	15.75	11.77	12.13	......	......
	10.0	4.2	10.5	......	......	......	......	......	......	......	.70	......	......

25. SKAGWAY.

[Latitude, 59° 28′; longitude, 135° 20′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	2.08	1.44	0.43	0.48	1.10	0.56	0.02	2.08	1.41	9.99	1.60	3.35	24.54
1904	1.44	Tr.	.33	2.31	.84	.97	1.07	.18	2.80	5.35	6.28	......	......
1905	......	1.14	1.14	1.27	1.11	.10	.16	2.14	2.67	2.17	3.25	2.21	......
1906	......	1.16	.57	3.55	.37	2.63	2.11	2.26	1.30	5.58	6.47	.33	......
	......	......	Tr.	......	......	......	......	......	......	......	......	3.0	3.0
1907	.46	4.85	.47	1.08	.92	......	......	1.98	2.47	5.87	4.23	......	......
	Tr.	Tr.	Tr.	......	......	......	......	......	......	......	10.0	......	......

26. SUMMIT.

[Latitude, 62° 55′; longitude, 143° 48′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906	1.19	0.46	1.04	1.26	1.02	4.25	......	[a] 0.03	0.12	0.07	0.74	0.49	......
	11.0	5.0	12.0	13.0	5.0	......	......	......	......	......	14.0	7.0	......
1907	1.80	.10	.70	.40	.80	2.15	......	......	......	1.40	......	......	......
	18.0	2.0	7.0	......	4.0	......	......	......	......	14.0	......	......	......

[a] August 19 to 31.

G. SUMMIT ROADHOUSE.

[Latitude, 65° 02′, longitude, 147° 26′]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	Ju'y.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907	......	......	......	......	......	......	2.71	3.27	......	......	......	......	......

Summary of records of precipitation at stations in Alaska—Continued.

27. SUNRISE.

[Latitude, 60° 54'; longitude, 149° 35'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904	1.69	0.13	0.28	5.08	1.01	1.36	1.05	5.02	2.33	9.35	2.37	8.31	37.98
1905	2.12	1.93	1.64	3.41	.84	.69	1.40	4.46	1.86	4.36	9.47	8.48	40.66
1906	2.18	.29	3.63	1.17	2.35	2.46	1.84	3.70	1.54	6.67	3.87	2.30	32.00
	30.7	3.7	33.9	3.8						5.0	15.0	25.5	117.6
1907	2.05	1.93		1.41	1.30	.74	4.62	2.29	4.45	6.03	7.32	6.78	
	7.5	29.0		2.0						14.2	31.4	19.7	

28. TANANA CROSSING.

[Latitude, 63° 24'; longitude, 143° 24'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904					0.76		0.78	0.89	1.06	0.15	0.10	0.90	
1905	0.24	0.08	0.18	0.00	.14		.37	2.95		1.40	.60		
1906	.30	.00	Tr.										

G. TAYLOR.

[Latitude, 65° 42'; longitude, 164° 48'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1907							0.66	0.96	1.17				

29. TEIKHELL.

[Latitude, 61° 23'; longitude, 145° 18'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904			0.05	0.75	0.40	0.79	1.53	2.00	1.21	2.82	0.90	2.95	
1905	0.98	0.49	1.31	.04	Tr.	.80	1.05	1.02	1.41	1.48	4.90	2.34	15.82
1906	2.50	.20	1.87	.58	.25	1.39	2.70	.72	.62	2.90	3.52	.36	17.61
	25.0	2.0	26.2	5.5	Tr.				1.5	11.0	35.8	6.2	113.2
1907	.37	1.81	.56	.07	.80	.68	8.20	2.00	1.20				
	4.5	21.4	9.0	Tr.									

30. TYONEK.

[Latitude, 61° 03'; longitude, 151° 10'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	1.95	3.91	0.45	1.01	0.69	1.59	2.62	5.69	2.76	1.15	0.64	0.53	22.99
1904	1.07	.26											
1905						1.27			.92	3.19	3.10	1.24	
1906	.65	.49	1.32	.77	.39	1.00	2.96	2.95	1.67		1.04	1.38	
	16.0	7.0	26.0	20.0							12.5	14.0	
1907	1.96		1.66	.24		2.86	6.39	3.05	5.76	3.48			
	21.0		33.0	2.0						4.7			

31. UDAKTA (DUTCH HARBOR).

[Latitude, 53° 54'; Longitude, 166° 32'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905						4.69	1.73	3.39	3.46	5.00	13.78	8.28	
1906	3.09	9.46	12.19	3.07	6.82	1.14	3.56	3.10	2.29	7.91	5.38	5.76	63.77
		4.0											4.0
1907	8.76	2.49	2.93	2.97	5.39	1.27	2.11	3.25		7.79			
										1.0			

32. WOODY ISLAND (KODIAK ISLAND).

[Latitude, 57° 40'; longitude, 152° 25'.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1903	4.74	8.10	0.39	4.61	4.92	7.80	4.38	4.79	7.95	6.27	3.30	8.29	65.54
1904	3.63		Tr.	3.68	3.35	2.26	1.36	4.89	4.63	4.84	5.20	3.24	
1905	4.80	4.90	2.60	1.70	2.70	3.10	2.10		1.80	7.50	8.00	2.42	
1906	2.50	8.60	3.50	3.80	5.10	4.70		1.50	6.70	5.10	3.20		
	13.0		7.0							Tr.	3.5		
1907	1.00	4.00	Tr.	.61	6.30	5.20	3.50	3.70	9.00	8.70	7.70	6.5	56.21
	2.0	26.0	Tr.								4.5	5.5	38.0

Summary of records of precipitation at stations in Alaska—Continued.

33. DAWSON.[a]

[Latitude, 64° 05′; longitude, 139° 28′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1901	......	......	......	......	......	0.94	1.32	1.64	1.17	2.25	1.10	1.55	....
1902	1.73	0.20	......	0.50	0.46	.86	3.32	2.38	1.17	.92	1.10	.80	....
1903	.50	1.35	0.60	.60	.39	.50	1.11	1.47	2.41	1.25	.45	.65	13.01
1904	.82	.32	.20	.57	.96	1.71	2.14	1.66	1.01	.36	.80	1.45	12.00
1905	.23	1.30	.40	.94	.97	.25	1.93	2.51	3.52	1.84	.24	1.24	15.37
1906	1.26	.51	.22	.42	2.00	.92	1.20	1.46	1.14	.47	1.55	.93	12.08
1907	1.53	.34	.88	.23	1.06	.85	1.93	1.28	2.34	4.09	2.60	......	....

34. WHITE HORSE.[a]

[Latitude, 60° 46′; longitude, 135°.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905	1.72	0.00	0.18	0.10	0.15	0.20	3.30	0.92	2.10	1.50	1.20	0.30	11.67
1906	.55	.75	......	.20	.07	1.78	3.33	1.39	.50	.30	1.10	.20	....
1907	.55	.52	1.45	.75	.27	3.03	5.10	1.63	.86	.26	.90	......	....

35. ATLIN.[a]

[Latitude, 59° 45′; longitude, 133° 46′.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905	......	......	......	......	......	......	......	......	1.06	0.48	1.55	0.76	....
1906	1.37	0.72	Tr.	......	0.25	1.74	1.62	0.71	.78	1.45	2.55	.88	....
1907	.99	2.18	.55	0.09	.34	.32	.42	1.48	.58	.82	.51	......	....

[a] These data were furnished by the Canadian Meteorological Service.

INDEX.

RECENT SURVEY PUBLICATIONS ON ALASKA.

[Arranged geographically. A complete list can be had on application.]

All of these publications can be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they can be obtained, free of charge (except certain maps), on application.

2. A certain number are delivered to Senators and Representatives in Congress for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they can be had at prices slightly above cost.

4. Copies of all Government publications are furnished to the principal public libraries throughout the United States, where they can be consulted by those interested.

GENERAL.

The geography and geology of Alaska, a summary of existing knowledge, by A. H. Brooks, with a section on climate by Cleveland Abbe, jr., and a topographic map and description thereof, by R. U. Goode. Professional Paper No. 45, 1906, 327 pp.

Placer mining in Alaska in 1904, by A. H. Brooks. In Bulletin No. 259, 1905, pp. 18–31.

The mining industry in 1905, by A. H. Brooks. In Bulletin No. 284, 1906, pp. 4–9.

The mining industry in 1906, by A. H. Brooks. In Bulletin No. 314, 1907, pp. 19–39.

Railway routes, by A. H. Brooks. In Bulletin No. 284, 1906, pp. 10–17.

Administrative report, by A. H. Brooks. In Report on progress of investigations of mineral resources of Alaska in 1904: Bulletin No. 259, 1905, pp. 13–17.

Administrative report, by A. H. Brooks. In Report on progress of investigations of mineral resources of Alaska in 1905: Bulletin No. 284, 1906, pp. 1–3.

Administrative report, by A. H. Brooks. In Report on progress of investigations of mineral resources of Alaska in 1906: Bulletin No. 314, 1907, pp. 11–18.

Notes on the petroleum fields of Alaska, by G. C. Martin. In Bulletin No. 259, 1905, pp. 128–139.

The petroleum fields of the Pacific coast of Alaska, with an account of the Bering River coal deposits, by G. C. Martin. Bulletin No. 250, 1905, 64 pp.

Markets for Alaska coal, by G. C. Martin. In Bulletin No. 284, 1906, pp. 18–29.

The Alaska coal fields, by G. C. Martin. In Bulletin No. 314, 1907, pp. 40–46.

Methods and costs of gravel and placer mining in Alaska, by C. W. Purington. Bulletin No. 263, 1905, 362 pp. (Out of stock; can be purchased from Superintendent of Documents, Washington, D. C., for 35 cents.) Abstract in Bulletin No. 259, 1905, pp. 32–46.

Geographic dictionary of Alaska, by Marcus Baker, second edition by J. C. McCormick. Bulletin No. 299, 1906, 690 pp.

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Prospecting and mining gold placers in Alaska, by J. P. Hutchins. In Bulletin No. 345, 1908, pp. 54–77.

Water-supply investigations in Alaska in 1906–7, by F. F. Henshaw and C. C. Covert. Water-Supply Paper No. 218, 1908, 156 pp.

Topographic maps.

Alaska, topographic map of; scale, 1:2500000. Preliminary edition by R. U. Goode. Contained in Professional Paper No. 45. Not published separately.

Map of Alaska showing distribution of mineral resources; scale, 1:5000000; by A. H. Brooks. Contained in Bulletin 345 (in pocket).

Map of Alaska; scale, 1:5000000; by Alfred H. Brooks.

In preparation.

Methods and costs of gravel and placer mining in Alaska, by C. W. Purington. Second edition.

SOUTHEASTERN ALASKA.

Preliminary report on the Ketchikan mining district, Alaska, with an introductory sketch of the geology of southeastern Alaska, by Alfred H. Brooks. Professional Paper No. 1, 1902, 120 pp.
The Porcupine placer district, Alaska, by C. W. Wright. Bulletin No. 236, 1904, 35 pp.
The Treadwell ore deposits, by A. C. Spencer. In Bulletin No. 259, 1905, pp. 69–87.
Economic developments in southeastern Alaska, by F. E. and C. W. Wright. In Bulletin No. 259, 1905, pp. 47–68.
The Juneau gold belt, Alaska, by A. C. Spencer, pp. 1–137, and A reconnaissance of Admiralty Island, Alaska, by C. W. Wright, pp. 138–154. Bulletin No. 287, 1906, 161 pp.
Lode mining in southeastern Alaska, by F. E. and C. W. Wright. In Bulletin No. 284, 1906, pp. 30–53.
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Lode mining in southeastern Alaska in 1907, by C. W. Wright. In Bulletin No. 345, 1908, pp. 78–97.
The building stones and materials of southeastern Alaska, by C. W. Wright. In Bulletin No. 345, 1908, pp. 116–126.
Copper deposits on Kasaan Peninsula, Prince of Wales Island, by C. W. Wright and Sidney Paige. In Bulletin No. 345, 1908, pp. 98–115.

Topographic maps.

Juneau Special quadrangle; scale, 1:62500; by W. J. Peters. For sale at 5 cents each or $3 per hundred.
Topographic map of the Juneau gold belt, Alaska. Contained in Bulletin 287, Plate XXXVI, 1906. Not issued separately.

In preparation.

Physiography and glacial geology of the Yakutat Bay region, Alaska, by R. S. Tarr, with a chapter on the bed-rock geology by R. S. Tarr and B. S. Butler.
The Ketchikan and Wrangell mining districts, Alaska, by F. E. and C. W. Wright.
Berners Bay Special map; scale, 1:62500; by R. B. Oliver. (In press.)
Kasaan Peninsula Special map; scale, 1:62500; by D. C. Witherspoon and J. W. Bagley.

CONTROLLER BAY, PRINCE WILLIAM SOUND, AND COPPER RIVER REGIONS.

The mineral resources of the Mount Wrangell district, Alaska, by W. C. Mendenhall. Professional Paper No. 15, 1903, 71 pp. Contains general map of Prince William Sound and Copper River region; scale, 12 miles = 1 inch. (Out of stock; can be purchased from Superintendent of Documents for 30 cents.)
Bering River coal field, by G. C. Martin. In Bulletin No. 259, 1905, pp. 140–150.
Cape Yaktag placers, by G. C. Martin. In Bulletin No. 259, 1905, pp. 88–89.
Notes on the petroleum fields of Alaska, by G. C. Martin. In Bulletin No. 259, 1905, pp. 128–139. Abstract from Bulletin No. 250.
The petroleum fields of the Pacific coast of Alaska, with an account of the Bering River coal deposits, by G. C. Martin. Bulletin No. 250, 1905, 64 pp.
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Topographic maps.

The following maps are for sale at *5 cents a copy*, or $3 per hundred:
Casadepaga Quadrangle, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.
Grand Central Special, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.
Nome Special, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.
Solomon Quadrangle, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.

The following maps are for sale at *25 cents a copy*, or $15 per hundred:
Seward Peninsula, northeastern portion of, topographic reconnaissance of; scale, 1:250000; by T. G. Gerdine.
Seward Peninsula, northwestern portion of, topographic reconnaissance of; scale, 1:250000; by T. G. Gerdine.
Seward Peninsula, southern portion of, topographic reconnaissance of; scale, 1:250000; by T. G. Gerdine.

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