MINING IN SEWARD PENINSULA.

By Fred F. Henshaw.

GENERAL CONDITIONS.

The mining industry suffered a general state of depression all over Seward Peninsula during the season of 1909. The value of the total gold production fell from about $7,000,000 in 1907 and $5,000,000 in 1908 to only a little over $4,000,000 in 1909. The output by years since 1897, as closely as can be determined, is given in the following table:

Value of gold production in Seward Peninsula, 1897 to 1909.

1897	$15,000	1905	$4,800,000
1898	75,000	1906	7,500,000
1899	2,800,000	1907	7,000,000
1900	4,750,000	1908	5,120,000
1901	4,130,700	1909	4,260,000
1902	4,561,800		
1903	4,465,600		53,642,700
1904	4,164,600		

Foremost among the causes of this falling off in production was the extreme and widespread drought which affected practically every portion of the region and lasted from early July until the freeze-up in September. The previous summer had been marked by low-water conditions that were said to have been more severe than in any other year since mining began, more than a decade earlier. A comparison of the two years shows that the low-water period of 1909 was more protracted, although the discharge of most of the streams was never so low as during the fourth week in July, 1908. The snowfall at Nome was 41 and 38.5 inches, respectively, for the winters of 1907-8 and 1908-9, and the water equivalent approximately 2.7 and 3 inches. The snow disappeared faster in the spring of 1908 than in 1909, so that the shortage of water was felt earlier.

The rainfall at Nome during the summer months of June to September was 6.44 inches in 1908 and only 4.32 inches in 1909. Another fact which tended to cause lower water in 1909 was that there were no fall rains to saturate the ground before the freeze-up in 1908, while the fall of 1907 was very stormy and the ground-water conditions were good. All these influences had their effect on the season's mining activities.

The richer parts of the beach placers were virtually exhausted in 1908, as noted by Smith[a] in a previous report, and the falling off in production in 1909 was not due in any great degree to this cause. The summer season was longer than the previous one; the first large steamers arrived June 13, or three days earlier than in 1908, and the freeze-up was delayed until September 27 or 28, or about five days later than in 1908.

The mining developments at Nome and in the adjacent country have entered on practically the third stage in their history. The first was in the days when the present beach and the richer creeks were yielding their store of precious metal, from 1899 to 1904; the second, the years of the third-beach line, from about 1905 to 1908. Coincident with this second stage came the expenditure of a large amount of capital in ditches, which created an active demand for labor and for mining machinery and supplies, gave a strong impetus to business, and produced what is popularly called a prosperous camp. The third stage has already begun, and will be marked by improved methods for the handling of large bodies of gravel economically and also by a willingness on the part of the individual miner to work many creeks that have hitherto been regarded as of too low grade to yield adequate return for labor.

To the tendency just mentioned is believed to be due in no small degree the fact that the production for 1909 reached an aggregate of a little more than $4,000,000, or about the same as for the average year prior to 1905. On many creeks all over Seward Peninsula parties of two to half a dozen men were engaged in reworking old claims where the original operators had failed to extract all the values, in mining the less productive portions of the richer streams, or in opening new creeks which had not before been systematically prospected. The lack of water and consequent lack of work at most of the hydraulic mines left many old miners unemployed. Their number was augmented by a horde of foreign laborers brought in on the first run of steamers, without funds and almost wholly incapable of caring for themselves in a barren, unhospitable country, which could not even in a favorable season be expected to furnish all of them employment. The more resourceful and energetic of those thus thrown out of work resorted to working leases on such mining ground as was available, and it is believed that most of them made the equivalent of fair wages.

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[a] Smith, P. S., Recent developments in southern Seward Peninsula: Bull. U. S. Geol. Survey No. 379, 1909, pp. 267-301.

The era of greatest activity in ditch building in Seward Peninsula is probably past, as nearly all the water supplies available for use on proved mining ground have already been diverted and capitalists have become more cautious in advancing money without a careful examination of mining properties and conditions.

The dredge has proved its adaptability to Alaskan conditions, and the success of a few well-managed ventures has led almost every owner of a few river or creek claims to consider the possibility of installing such a machine. This movement in a way resembles the activity in ditch building that followed the success of the earlier ditches on Nome River and Ophir Creek and at Bluff. It is to be feared that there will be the same tendency to install excavating machinery unsuited to local conditions as there was to build ditches in districts where the water supply has since proved insufficient for the needs of hydraulic plants. There will be smaller justification for failures in dredging enterprises than in projects involving the use of water. The features controlling the suitability of a mining claim for being worked by dredging, such as depth of gravel, character of bed rock, and existence of frozen ground or bowlders, can always be determined beforehand by drilling, whereas the water supply available in a stream can not be predicted from one year to the next with any degree of certainty unless a number of years' records of discharge are available.

The writer visited most of the important mining fields of Seward Peninsula at one time or another during the season of 1909. As his examination of placer-mining operations was incidental to the carrying on of systematic stream measurements, all the mines could not be visited, and only the more salient features of the season's developments will be mentioned in the following notes. The operations of previous years have been covered in previous reports of the Geological Survey,[a] and no especial mention will be made of them, except as they bear on the work done in 1909.

[a] Brooks, A. H., Placer mining in Alaska: Bull. U. S. Geol. Survey No. 259, 1905, pp. 19-24.
Moffit, F. H., Gold mining in Seward Peninsula: Bull. 284, 1906, pp. 132-141.
Moffit, F. H., The Nome region: Bull. 314, 1907, pp. 126-144.
Smith, P. S., Gold fields of the Solomon and Niukluk River basins: Idem, pp. 146-156.
Smith, P. S., Geology and mineral resources of Iron Creek: Idem, pp. 157-163.
Brooks, A. H., The Kougarok region: Idem, pp. 164-179.
Collier, A. J., Hess, F. L., Smith, P. S., and Brooks, A. H., Gold placers of parts of Seward Peninsula: Bull. 328, 1908.
Smith, P. S., Investigations of the mineral deposits of Seward Peninsula: Bull. 345, 1908, pp. 206-250.
Knopf, A., The Seward Peninsula tin deposits: Idem, pp. 251-267.
Knopf, A., Mineral deposits of the Lost River and Brooks Mountain region: Idem, pp. 268-271.
Knopf, A., Geology of the Seward Peninsula tin deposits: Bull. 358, 1908.
Smith, P. S., Recent developments in southern Seward Peninsula: Bull. 379, 1909, pp. 267-301.
Smith, P. S., The Iron Creek region: Idem, pp. 302-354.
Henshaw, F. F., Mining in the Fairhaven precinct: Idem, pp. 355-369.

NOME REGION.

BEACH PLACERS.

As previously stated, the season of 1908 showed a marked decrease in the production of the beach placers, and in 1909 practically all the gold from this source came from the so-called "sloughover" and from the intermediate beach near Center Creek. Prospecting on the coastal plain was continued during the winter of 1908–9, but it was rewarded with little that appeared worth developing, and the impetus to further search has been generally lost. The beach mines did not receive the writer's special attention and have been described in considerable detail in previous reports.

The most notable feature of the drift-mining operations in 1909 was the application of artificial freezing to check the flow of water from unfrozen ground into the drifts. The first experiment of this character was tried on the Cyrus Noble bench near Bourbon Creek for the purpose of shutting off an inflow of some 6 or 8 miner's inches of water. An ice machine from the Nome cold-storage plant was moved to the mine and a grillage of ammonia pipes was installed underground. This was applied to the unfrozen portion of the wall of the drift and the freezing mixture turned on. After the frost had penetrated a few inches the pipes were removed, a layer of thawed gravel placed against the face, and frozen against the other by the same method. This process was repeated until a wall was formed of sufficient thickness to withstand the water pressure. The small hole through which the water had been allowed to enter was then plugged up and the inflow stopped.

The Bessie mine presented a much more difficult problem. There was a misconception as to the extent of the flooded and abandoned workings of an adjoining claim, and late in May, 1909, a steam point was driven through the frozen wall into this subterranean reservoir. The rush of water filled the workings on the Bessie, and it seemed for a time that a considerable body of ground that had been blocked out was lost beyond recovery. A drill operator finally undertook to free the mine of water. Drill holes were sunk every few inches to form a line across the drift in which the water had been encountered. Small pipes were inserted inside the casings and the ammonia was pumped in. A solid wall of ice was thus formed across the drift and the inflow of water stopped. The mine was then pumped out and operations were resumed. It seems not unlikely that a similar method will be tried on other claims on the third-beach line where water has prevented work, and it may result in making possible the exploitation of much valuable ground.

Another plan that has been suggested for disposing of surplus water is the building of a drain tunnel, about 2 miles in length, to extend from the ancient beach to a point at sea level near Nome. Such a tunnel could be given a fall of 60 to 70 feet, which would be ample to carry off the water. The uncertainty as to whether such a tunnel could be kept open during the winter, together with the difficulty of organizing a large number of individul claim owners for such an expensive and questionable undertaking, has thus far prevented any progress in the venture.

DREDGING.

Dredging bids fair to become an important factor in the working of the deposits of gold-bearing gravels in the coastal plain. Two large dredges were erected near Nome in 1908—one on Bourbon Creek near its junction with Dry Creek, the other on Wonder Creek just south of the third-beach line. The Bourbon dredge has a chain of 66 buckets, close connected, of 9 cubic feet capacity, and a nominal capacity of some 5,000 cubic yards a day. When first built, the bucket ladder was poorly balanced, and when digging near the water surface the heavy weight on the forward gantry sank the bow of the dredge so low that the deck was awash. When the machine was digging on bed rock, the bow was higher than the stern. This dredge was completed in August, 1908, and worked for a few days. An accident caused by the buckets coming into contact with the hull resulted in the sinking of the dredge, and it was not raised in time to start again that season. In 1909 the dredge was thoroughly overhauled, the bow gantry, the tackles for hoisting the ladder and spud, and the supports of the revolving trommel were strengthened, and the sluices were essentially modified. A 6-inch sand pump was installed, which is sufficient to handle the sluice water from one side only.

The gravel in the channel of Bourbon Creek is mostly fine, fully 70 or 80 per cent of the total passing through the screens. The sluices are ill adapted to handling so much fine material, and it has been found impracticable to fill the buckets more than half full. The ladder is arranged to dig to a depth of about 30 feet below the water level. Much of the ground is deeper than this and it may be found necessary to lower the water level in the pond by pumping. The strip of ground being worked was only about 180 feet wide, and it was sometimes found necessary to cut into tongues of frozen ground in order to keep a sufficient width of face, thus causing an excessive amount of wear of the buckets and machinery.

The second large dredge, on Wonder Creek, carries a chain of 40 buckets of 7 cubic feet capacity, open connected, on a ladder 100 feet in length, and is adapted to digging 40 to 45 feet below the water level. Wonder Creek is dry during a summer like 1909, and water to float the dredge had to be obtained from one of the ditches. The bed rock is about 50 feet deep, and the water surface was kept about 10 feet below the ground level in order to reach it. The water in the pool was used over and over and became very thick and muddy. The gravels are nearly as fine as those in Bourbon Creek, about 70 per cent passing through the screens. Considerable difficulty was experienced by the grounding of the stern in the deposits of fine tailings, and it was found necessary to make two settings of the spud in order to use the entire width of the cut, nearly 300 feet, for dumping the tailings. A number of large bowlders and slabs of rock were encountered near bed rock, some of them at least 4 or 5 feet in length. These seemed to be handled without difficulty, but the dredge had to be stopped while they were removed from the buckets with a hoist block.

Both the Bourbon and Wonder Creek dredges are electrically driven with current generated from a power station located near the former. It was not learned just why the plant was built at this point instead of on the beach, where fuel could have been landed direct from the lighters instead of having to be hauled from 1 to 2 miles.

A third large dredge was in process of erection in 1909 on Dry Creek near the mouth of Bourbon. It is a second-hand machine, having been originally built to mine black sand in Oregon. It has a 5-cubic-foot open-connected bucket line and is operated by steam, crude oil being the fuel used. The dredge was not completed in time to test its adaptability to conditions in its present location.

It is reported that several new dredges will be built near Nome in 1910. The experience gained by both the successful and unsuccessful operations of the last few years, if wisely utilized, should assure the avoidance of the blunders of the past.

DITCHES.

Extensive operations were carried on near Little Creek by drifting and open-cut work in the summer of 1909. Five large dumps, said to contain a total of nearly 100,000 cubic yards, were taken out between Little and Moonlight creeks during the winter. These were nearly all sluiced up with water from the Pioneer Nome River ditch, but when the water supply became short the last two were finished with pumped water. During the summer the work was carried on near Moonlight Creek, in what is probably an old channel of Anvil Creek, or of a stream that occupied approximately the location of the present Anvil above Discovery claim. The bed rock is very uneven, and the depth varies less than 10 to more than 20 feet in a few depressions. The gravels were entirely frozen and covered with frozen muck. This overburden was first ground-sluiced off; the gravels were then worked by shoveling into buckets which were trammed with a track system to derricks and hoisted to the dump box of the sluices. The Pioneer ditch furnished sufficient water at all times for one string of boxes, but two or three strings would probably have been used had the water been available. The pits were kept dry by small reciprocating steam pumps, similar to those used for underground work.

The ground in this locality lying between Anvil and Little creeks near the edge of the foothills is well adapted for hydraulicking with a hydraulic elevator. The depth is not more than 30 to 40 feet, including the overburden of muck, which is easily ground-sluiced off, and in many places there is not over 10 feet of gravel. Values are found through a considerable thickness of the section. The gravels are mostly fine, although they contain some good-sized bowlders. The cost of hydraulicking would probably be much less than that of the methods that have been used and the values would be more completely recovered. It is believed by the owners that there still remains a large body of rich ground and it is possible that arrangements may be made to work it with water under pressure.

Some work was done on Newton Gulch, a short distance above the third-beach line, by means of water from the Seward ditch. The gravels are shallow and the grade is sufficient to handle them through bed-rock flumes without elevating.

The Miocene ditch water was used mostly on Grass Gulch, which has been operated since 1906 and is now said to be nearly worked out. About 120 inches (2.4 second-feet) of water is pumped from the ditch to a reservoir near the Anvil-Dexter divide and used for hydraulicking. The pressure available on some parts of the claim has not exceeded 60 feet, but by careful handling a large duty has been obtained. The giants have been set close behind the gravel to be moved and steel flumes without riffles have been kept close to the face to carry the dirt to the sluices. From 300 to 400 inches of water was delivered at the head of the sluices, either by gravity from the ditch or through a centrifugal pump lifting about 12 feet. A hydraulic elevator was operated on Glacier Creek about a mile below Snow Gulch for a short time early in the season, but was obliged to close down early in July on account of shortage of water. Practically none of the other ditches in the vicinity were able to work for more than a few weeks in June and July.

Hardly any progress was made on the ditch and pipe line to Grand Central River, as only enough work was done to hold the water rights.

SOLOMON AND CASADEPAGA REGIONS.

On Solomon River practically the only mining in 1909 was carried on by the two dredges near the mouth of Shovel Creek. Hydraulicking was greatly hindered by the shortage of water, which began almost as soon as the ditches could be cleaned out and put into condition for carrying water. Of the ditches in the Solomon River drainage basin only two were used at all—one from East Fork to Big Hurrah Creek and the other from California Creek to Mystery Creek, a tributary of Shovel Creek. The operation of the dredge is not affected by shortage of water and its season is limited only by the presence of the annual frost. It seems not unlikely that the total yardage handled by the two dredges on Solomon River in 1909 was equal to the total for the hydraulic mines in the whole peninsula. The Big Hurrah lode mine was shut down, except for a short time during the winter.

Mining in the Casadepaga region was carried on at several points on a small scale. A party of five men were at work on a bend of the river near Ruby Creek ground-sluicing and shoveling in, using water from Ruby Creek through a short ditch. Two parties were working on Lower Willow Creek above Wilson Creek, both hydraulicking, using Ruble elevators when sufficient water was available. The grizzly of one of the machines was too short and some of the gold was carried over it by the stream from the giant. It was stated that portions of the tailing pile contained enough values to pay to rework with a rocker. Of the two ditches on Canyon Creek neither was in use at the time of the writer's visit to this region in August. The lower or McKay ditch had not been opened at all, and the ditch of the Canyon Creek Gold Mining Company was short of water. On Goose Creek a small dredge was installed, having a hull 15 by 30 feet and buckets of 1 cubic foot capacity. It was assembled on a portion of the creek where the low-water flow sinks in the bed rock, and as there was no water to float it when completed it was unable even to start work. There were a few other outfits at work besides those mentioned, but they probably contributed little to the total production of the region. On the whole, the season in the Casadepaga basin was one of retrogression, but this was largely due to the shortage of water, and a favorable year might have seen much greater activity.

Bluff was not visited, but it was learned from operators that little mining was in progress. During most of the season the water supply of the Topkok ditch was small, even at the intake, and this was lost before it reached the outlet. Values were found on Daniels Creek in crevices and potholes in the limestone below what had previously been supposed to be the bed rock, and some of these deposits were being shoveled into buckets and hoisted with a derrick for sluicing when water became available.

COUNCIL DISTRICT.

The Council district, and particularly Ophir Creek, probably suffered less from the shortage of water in 1909 than any other portion of Seward Peninsula. The Canyon and Pargon ditches, from which the mines on Ophir Creek receive most of their water, head in the

Bendeleben Mountains, where the rainfall is much heavier than in the areas of lower elevation. The records of discharge of these ditches (see pp. 377–380) show that the mean discharge for 1909 was not far below that of the average year. The amount diverted by the Canyon ditch for the last four seasons, as shown by records kept near the intake, is given below:

Mean yearly discharge of Canyon ditch near intake, 1906 to 1909.

Year.	Date of opening.	Date of closing.	Length of season (days).	Seasonal discharge.	
				Minimum [a] (second-feet).	Mean [b] (second-feet).
1906	About June 15	Oct. 9	117	38.6	54
1907	June 20	Sept. 29	102		57
1908	About June 10	Sept. 22	105	18.1	44
1909	June 5	Sept. 26	114	21.0	40
Mean	June 12	Sept. 29	110		49

[a] The minimum does not represent low discharges occurring either before the Pargon ditch water was turned in or on days when the water was turned out for part of the time. Records for 1907 cover only a few weeks, and the minimum for that year is not known, but it was stated by the ditch walker that there was nearly a full supply at all times, as it was a season of heavy rainfall.

[b] The means for 1906, 1907, and 1908 are approximate, as the records are not complete.

In 1908 the Wild Goose Mining and Trading Company began the systematic development of its extensive properties on Ophir Creek. During the last two seasons the ground has been thoroughly prospected, mostly with the hand drill. The stream bed of Ophir Creek lends itself readily to the use of this machine. The gravels are of moderate depth, 8 to 15 feet as a rule, unfrozen, and contain no large rocks. A relatively light 5-inch drill was used, which could be operated by three men. It consisted primarily of a tripod, carrying a pulley, through which was passed a rope, to one end of which is attached the drilling tool and to the other the pump. The casing is driven by the impact of a rammer and not rotated except in pulling. It thus differs somewhat from the hand drill as described by Hutchins,[a] being lighter and simpler. A steam-power drill was first used for this work, but was given up in favor of the hand machine. In some parts of Ophir Creek, where the flow sinks into the bed rock at low water, shafts were used instead of drill holes, as the lack of water is an advantage in sinking them, while it practically prevents the use of the drill.

Coincident with the prospecting the company began to work its claims in a systematic manner. In previous years it had been the practice to work only the richer spots. This plan necessitated the frequent removal of pipe, elevators, and flumes from one claim to another. The work is now carried on by beginning at the lowest claim and working upstream, dumping the tailings from one pit into

[a] Hutchins, J. P., Prospecting and mining gold placers in Alaska: Bull. U. S. Geol. Survey No. 345, 1908, p. 61.

the next below, and handling all gravel that will pay a profit over operating expenses. The principal operations in 1908 were confined to Discovery claim at the mouth of Sweetcake Creek, which had been partly worked in 1905 and 1906. When this claim was finished, the equipment was moved upstream to claims 4, 5, and 10, and 4 hydraulic elevators were operated on these claims during the whole or part of the season of 1909.

The Blue Goose dredge, which has been mining on claims 1, 2, and 3 below Discovery during the last four years, finished this part of the creek early in the season of 1909 and began to move upstream; during August and September it was at work on claim "No. 2 above." It is planned to dredge practically all the claims that will not be hydraulicked, including about six in the richer portion of the stream. Thus the entire pay streak of Ophir Creek will be thoroughly mined out. It is estimated by the operators that it will require some six or eight years to finish this work.

Only three claims aside from those already mentioned were being operated on any extensive scale in 1909. A combined steam scraper and derrick was installed on "No. 3½ above," and a force of 50 or 60 men was employed. This method of mining is more costly than either dredging or hydraulicking as they are practiced at present, and it will probably not be used as extensively in the future as in the past. The small dry-land dredge, which was built on No. 24 in 1908, was remodeled and a new revolving screen, belt stacker, and sluices were installed. It was operated for some six weeks at the end of the season, being delayed only by shortage of water for the sluices. The water was furnished by a small ditch, taking its supply from Ophir Creek above Crooked Creek, and the supply was small during most of the summer. This machine seemed well adapted to the favorable conditions found in this part of the creek, the fine gravel and decomposed schist bed rock being easily handled by its rather light machinery. A hydraulic elevator was installed on Albion Gulch, a tributary of Crooked Creek, and run by water conveyed in a small ditch from Portland Gulch, a tributary of Oxide Creek. The water supply was insufficient for continuous operation after the middle of July, but by storing it in a small reservoir at the lower end of the ditch the elevator was run intermittently.

On Ophir Creek, as in other portions of Seward Peninsula, the dredge apparently handles ground for which it is adapted at somewhat less cost than the hydraulic elevator, but where the bed rock is a very uneven, heavy, slabby limestone, as it is in the portion of Ophir Creek where the best values are found, the dredge is unable to recover nearly all the values and the greater efficiency of the hydraulic elevator in saving the gold more than offsets its greater cost of operation. On the whole, it appears that Ophir Creek will continue for several years to yield a production approximately equal to that of the last two seasons.

Of the other streams in the Council district, Goldbottom Creek deserves special mention. Two small dredges were built in 1909 at the mouth of Warm Creek, one being intended to work up Goldbottom and the other up Warm Creek. They are strongly-built machines, with hulls 26 by 60 feet and 2¾ cubic-foot open-connected buckets, and are driven by two gasoline engines, one of 40 horsepower for driving the bucket chain and one 25 horsepower to run the pumps and lines. The steam scraper near the mouth of Melsing Creek operated successfully, but practically all other work in this district was hindered by the shortage of water.

IRON CREEK REGION.

Iron Creek and its tributaries presented signs of considerable activity in 1909. The tunnel for sluicing the gravels of lower Iron Creek into Kruzgamepa River was practically completed during the previous winter. A wooden flume 3 feet 8 inches wide and 2 feet high, lined on the bottom with steel plates, was built inside it. It had been planned to extend the tunnel under the bed of Iron Creek and to open up ground on the right of the stream, but this plan was found to be impracticable on account of the wet and unfrozen condition of the river bed. The upper end was accordingly given an increase in grade so as to come out above the water level. The water was then turned into the tunnel by means of a diversion dam. A shaft located about 80 feet from Iron Creek was enlarged with a view to converting the upper end of the tunnel into an open cut. Most of the material was frozen muck or clay which thawed very slowly, and steam thawing was undertaken in order to hasten the work. A small stream of water would have accomplished the same purpose, but it could not have been obtained without pumping. The amount of water used through the tunnel varied from 10 to 25 second-feet and averaged about 18 second-feet. This gave a depth of about 8 inches in the sluice, or not over half of what it would carry. Large stones up to 8 or 10 inches in diameter were put through without blocking and a large amount of fine material was carried, but the transporting capacity of the flume was not thoroughly tested. The current of the Kruzgamepa removed the small gravel from the outlet, but it was evident that the stream would require more than its own unaided force to handle the coarser material. The work of extending the flume on grade had been begun when, about August 12, an accident resulted in blocking it at the upper end. This would not have been serious earlier in the season, but as it was seen that the work could not be finished in time to do any sluicing that summer the work was suspended.

On the upper portion of Iron Creek, locally known as Dome Creek, six parties of laymen, comprising about a dozen men altogether, were at work the greater part of the season, for the most part reworking portions of the creek that had been mined unsystematically in earlier years. The best values were found on a piece of virgin ground near the mouth of Hardluck Creek. It is probable that most of the men made at least fair wages. A steam scraper worked for a few weeks on the flat near the mouth of Discovery Creek, where an attempt was made to mine with hydraulic elevators in 1906 and 1907. Conditions were favorable for the scraper, the gravels being 4 or 5 feet deep and the bed rock soft and easy to clean. Such equipment is better adapted to working bodies of shallow ground than expensive ditches and hydraulic machinery. Near the mouth of Easy Creek work was continued, water being conveyed through a small ditch from the spring that issues from the mountain to the right of Iron Creek. The ditch that was built from Iron Creek in 1907 is almost hopelessly out of repair, especially the flumes that were used for a considerable part of the distance.

KOUGAROK REGION.

The most notable feature of operations in the Kougarok region during the season of 1909 was the development of drift mining. Several dumps were taken out on lower Coffee Creek and on upper Kougarok River, mostly between Macklin Creek and Taylor. No definite information was obtained as to the gold tenor or production, but it is believed that the work was conducted at a fair profit. The great handicap to drifting has in the past been the excessive cost of fuel; coal taken into the upper Kougarok by way of Lanes Landing has cost $80 to $100 a ton, even in winter. In the fall of 1908 a shipment of coal was laid down at Davidsons Landing. Freight can be delivered at this point as cheaply as at Nome, as only one transshipment is necessary, this being made at Teller from ship to river steamer. The fuel was then hauled in over the snow to Taylor and was retailed there at about $60 a ton.

The operations of the ditches probably added but little to the total production of the region. Though the snowfall in the upper Kougarok is not excessive, it drifts so badly that it is hard to get a ditch cleaned out and ready for work before the middle of June. The North Star ditch was opened about June 20 and the Homestake on July 9. The Arizona, Coarse Gold, and Windy Creek ditches lie at a little lower elevation and in a smoother country and were all opened in the latter part of May. All the ditches were short of water by July 15 and were able to do very little after that date. The water of all the ditches except the one on Windy Creek was used on what appears to be an old channel of the Kougarok lying on the right of the present stream, at an elevation above the river varying from 15 or 20 feet at the mouth of Taylor Creek to over 100 feet below Coarse Gold Creek. The channel has been opened at three points—opposite the mouth of Taylor Creek, below Arizona Creek, and above Twobit Gulch not far below Coarse Gold. It has been located by prospecting at several intermediate points and is probably fairly continuous.

Five outfits were at work on the main river above Taylor Creek. Most of the work was with pick and shovel, but on one claim below Macklin Creek from two to four pairs of horses were used for scraping into the boxes. A large pit 110 feet wide was being worked. Water for sluicing was conveyed from the river by a ditch about three-fourths of a mile long.

About a mile above Macklin Creek, near Trinity, a cut has been made across a bend in the river. This was started in 1907 with water from a small ditch. The sod was removed from the surface and the water allowed to cut down the gravel. In 1908 a dam was built across the river below the head of the cut, and in the spring of 1909 the dam was closed and the entire river turned through. Thus the ground was rapidly stripped of its overburden and prepared for mining. Two teams were being used for scraping at the time the claim was visited in July. About a mile above this point good values are said to have been found on two adjoining claims. On the upper one five men were at work shoveling into boxes at the time of the writer's visit, but it was stated that the force had just been reduced on account of the drought. Water for sluicing and running a water lift was supplied by a ditch about 2 miles long, giving a head of about 40 feet. The pay streak was said to extend into both banks for a total width of over 100 feet. On the claim below values had been found just outside the river bed. Water for sluicing was pumped from the river with a gasoline engine. Several parties were at work on Macklin Creek while there was sufficient water, but they were forced to close down early in July.

Work on Windy Creek was confined to stripping and hydraulicking on a bench lying to the left of the creek near Anderson Gulch, water being obtained from the Windy Creek ditch. The water supply ran short early in July, and work was suspended while the ditch was enlarged to a bottom width of 5 feet.

In the Noxapaga basin work was mostly confined to Boulder Creek. A dam about 15 feet high was built of sod and earth during the early summer. It was intended to use this for booming, but the slight grade and the shortage of water rendered the attempt a failure. The dam was then used to store the water during the night to be used for a few hours in the daytime. Thus it was possible to accomplish some work with the small supply of water that the creek furnished, amounting to only 0.5 second-foot (20 inches) on August 28. The ditch from Turner Creek carried very little water during 1909.

The developments for the last two seasons seem to show that hydraulicking is not the method best adapted for developing the gold-bearing gravels on Kougarok River and its tributaries. The scanty water supply, the small amount of fall in the streams, and the uneven distribution of values militate against the success of a hydraulic-mining enterprise. The future of the district seems to lie rather in the working of the richest parts of the pay streak either by winter drifting or by shoveling or scraping into boxes in the summer.

FAIRHAVEN PRECINCT.

The mining operations in the Fairhaven district were examined in rather more detail than in the other parts of Seward Peninsula. The writer spent about two weeks in the region in the first part of the summer, but most of the matter in the following pages is based on notes taken by G. L. Parker, who spent about two months in the district, engaged primarily in stream-gaging work. Mining was in progress on all the streams mentioned in the writer's former report,[a] except on Bear Creek, and was for the most part a continuation of the work of previous years.

GOODHOPE RIVER.

To consider the area from west to east, the first river on which there was any activity was the Goodhope. Mining was confined to Esperanza Creek, where workable placers were first found in the spring of 1908. Esperanza Creek is a small stream which drains an area of about 20 square miles. It has a flat grade, especially in the lower portion, where the fall is only 5 to 7 feet to the claim, or about 25 feet to the mile. The stream has a narrow channel winding between muck banks and its general appearance is similar to that of Candle Creek. The pay streak, so far as developed, lies in a narrow, shallow strip in the creek bed. When the creek was visited, on June 24, preparations had been made to mine on six claims near the lower end of the creek. Ditches had been dug to convey water for sluicing and diversion dams had been put in. These ditches were for the most part about a claim in length and were built with very light grade, but even then they gave hardly enough head to raise the water into the sluice boxes. The discharge of the creek was measured June 25 and found to be 2.8 second-feet (112 inches). It fell rapidly after that date, and on July 21 there was only 0.25 second-foot (10 inches) flowing. The shortage of water prevented any sluicing, but a little gold was taken out by rocking.

[a] Henshaw, F. F., Mining in the Fairhaven precinct: Bull. U. S. Geol. Survey No. 379, 1908, pp. 355-369.

Placer Creek, a tributary of Goodhope River below Esperanza Creek, was prospected by shafts during the winter, but no values were found. A hole was sunk about 6 miles above the mouth, through muck and angular material, to a depth of about 45 feet, where heavy lava bowlders were encountered.

Some prospecting was done on Humboldt Creek, which rises near the hot springs north of Taylor Creek and enters the Goodhope about 10 miles from its mouth. Values were found, but nothing rich enough to pay to shovel.

INMACHUK RIVER.

The basin of the Inmachuk was the scene of fully as great mining activity as during the previous year. Operations were continued on the Utica group of claims with one to three hydraulic elevators, using water from the Fairhaven ditch. An average flow of about 30 second-feet (1,200 inches) was used from June 14 to September 21. Some interruption was caused by breaks in the ditch. (See pp. 402–403 for discharge of Fairhaven ditch.) Work was started on the construction of a pipe line extending to claims above the mouth of Pinnell River. The Homestake group was worked to some extent by winter drifting. On claim No. 1 below Pinnell a large dump was taken out during the winter and work was continued during a part of the summer season. Chicago Creek coal was used for fuel.

Open-cut operations were continued on the lower river between Washington and Cue creeks, at the same point as in 1908, and it was stated that good values were being found. A little work was carried on in the bed of Hannum Creek near the mouth of Milroy, so far as the scanty water supply permitted.

In the fall of 1908 water rights were staked by two different parties at the springs of the upper Inmachuk. The first locator posted his notice late in September, and by an error in wording claimed 2,000 "cubic inches per second," the water to be used on claims on the Inmachuk above and below Hannum Creek. Before an amended notice could be posted the water had been staked by others, who proposed to divert it around to tributaries of Old Glory Creek. Both parties took steps to start construction work, but the first actual diversion of water was made by the second locator. During 1909 work was being prosecuted on two ditches, located less than 10 feet apart in elevation, so close that the lower bank of the upper ditch was sloughing into the lower ditch. In September steps were being taken by the owners of the lower ditch to procure an injunction against the continuation of work by their rivals. This is a rather unusual instance of the controversies arising over conflicting claims to water rights in the present unsatisfactory status of the law governing the appropriation of water for mining purposes.

An old ditch for bringing water from springs on Old Glory Creek to Nelson Gulch, a tributary from the north, was reopened and a little hydraulicking was done, the small supply of water being stored in the lower end of the ditch and used during a portion of the time.

Some prospecting has been carried on for several years under the lava rims which are such noticeable features in the topography of the lower Pinnell and Inmachuk valleys, and many interesting facts have been brought to light. Two old channels have been located on both sides of Perry Creek near its junction with Pinnell River. The lower channel is at least 200 feet in elevation above the river, and the upper channel is 52 feet higher. In the lower channel there is 3 to 9 feet of gravel covered with about 20 feet of muck, and this is overlain with lava except where the lava has been eroded away. There is no muck overlying the upper channel, and the lava and gravel are mixed, a fact which seems to show that this channel was later than the lower one and was occupied by the stream at the time of the extrusion of the lava sheet. Pieces of wood were found on top of the gravels of the lower channel. A log 3 feet in diameter is said to have been encountered in one hole, but its relation to other deposits was not learned. The old channel can be traced down the Pinnell, following the left of its valley to its mouth. It then crosses the Inmachuk to its left or north side and extends for 3 or 4 miles to a point above the Homestake group of claims, where it crosses again to the right. It was not learned whether more than one channel had been located in this portion of the valley. Fair prospects were found under the lava at the mouth of Perry Creek and also just below the upper crossing of the Inmachuk and nearly opposite the mouth of Pinnell River. The fact that some of the richest portions of the present stream channel have been found on Claim No. 1 below Pinnell and on the Homestake group seems to indicate the possibility that its gold was derived largely from the older channel and this should lend encouragement to further prospecting.

KUGRUK RIVER.

In the Kugruk River basin the mining of coal commands more attention than the search for gold. The mine on Chicago Creek was again operated during the winter of 1908–9, and the production was considerable. A second mine was also opened on the right bank of the Kugruk about 5 miles above Chicago Creek and just above Reindeer Creek. The coal bed outcrops on a bluff at the water's edge. It has a strike of about N. 4° E. (or about N. 18° W. magnetic), a westerly dip of about 78°, and a thickness between 50 and 60 feet.[a] These data were determined on an exposure of the bed made by a prospect shaft and tunnel on the opposite side of the river, a few

[a] Determined by Charles Estmere, of Candle.

hundred feet from the mine, but they are believed to represent the general position of the bed. This strike agrees fairly well with that observed in the Chicago Creek mine (N. 8° E.) and also with the direction of a line joining the outcrops, facts which seem to indicate that these are two outcrops of the same vein. The geology of the region is so complex, however, that the evidence can hardly be regarded as conclusive. The coal bed is somewhat thinner and lies steeper on the Kugruk than on Chicago Creek. At the upper mine a tunnel and inclined shaft had been driven parallel in a general way to the walls of the vein and extending about 250 feet in and 100 feet down from the adit. The general character of the coal seems to be much the same as in the mine on Chicago Creek.

Gold mining was carried on more extensively in the Kugruk basin than for several years past. Some prospecting was done in the winter on the flood plain of the river, about 3 miles above Chicago Creek, and a small dump was taken out. A party of men worked for a part of the season mining the surface gravels of a river bar near Reindeer Creek, but without much success. During the latter part of the summer workable prospects were found on Mina and Chicago creeks. The water supply in both streams is scanty, and with coal so near at hand drifting may prove to be the cheapest method of mining.

Contrary to the impression which the writer received in 1908, it was learned that prospects have been found rather widely but irregularly distributed in the flood plain of the Kugruk below Reindeer Creek, but nothing has been encountered that would pay to handle by drifting, except on Discovery claim, about 1 mile above Chicago Creek. The section seems to consist in general of about 5 to 7 feet of overburden and 8 to 10 feet of gravel lying on a bed rock of schist or of a decomposed limestone which is cubical rather than slabby. In the river channel the gravel is shallow, being 4 to 8 feet in depth. It is not unlikely that it may be found profitable to mine portions of the flood plain by dredging. The gravels would have to be thawed, but coal is close at hand and easily mined. The feasibility of such a plan can be determined only after much more extensive and careful prospecting than has been done heretofore.

KIWALIK RIVER.

As in previous years, Candle Creek was the largest producer of gold in the Kiwalik basin, but it can no longer claim the distinction of being the only one, as considerable mining was done on Glacier Creek and Gold Run. Winter drifting was conducted on Candle Creek and its tributaries on about the same scale as in previous years, but the production was slightly less than for the winters of 1904 to

1907, as the richer ground is becoming exhausted. The claims worked include two on Candle Creek below Jump Creek, four between Jump and Patterson, five between Patterson and Blank, six bench claims between Jump and Patterson, and seven claims on Patterson, or about 24 in all. The total winter production was not far from a quarter of a million dollars. The value of the gold taken out in the summer amounted to hardly anything. Open-cut work was carried on in June on about five claims, but little sluicing was done after July 1, as there was practically no water in Candle Creek. (See measurements on p. 406.) Most of the miners were forced to remain idle or to seek other creeks where water was available for sluicing.

The Candle ditch was opened early in the spring and water was first used from it on May 15. There was an ample supply from the melting snow for four or five days. The ditch was opened as far as Rock Creek, within two miles of the intake, by June 1. This creek and those lower down furnished at least 200 to 300 inches of water for a fortnight. Large banks of snow had drifted into the ditch along Glacier Creek between Rock Creek and the intake, and this section was not opened until June 16. From 300 to 600 inches was delivered at the mine from this time until June 30, when the water was shut off on account of legal difficulties. The water was used for stripping the overburden on the bench on John Bull Hill. A large cut was ground-sluiced off; the amount of material removed was not measured, but it must have been at least 100,000 cubic yards. The greater portion of this material was thawed by the sun and the water from the giant was used mostly to wash the soft mud into the Kiwalik. This material formed a fairly firm deposit in the river, forcing the current toward the opposite bank. At the landing place in front of Candle the river was so filled with slickens that the depth of water at low stage was reduced from 5 or 6 feet to about 2 feet. This caused some inconvenience to the boats plying on the river and aroused a strong protest from their owners. There was no decrease in depth, however, on the bars and riffles below Candle, which determine the navigable depth of the river, and the difficulties encountered by the river men in 1909 were due rather to the low stage of water than to the deposits of sediment formed in the pools. (See p. 406 for discharge of Kiwalik River.) High water in the fall would probably have gone far toward restoring the river to its original condition.

Six parties of one to three men each were engaged in mining and prospecting on Glacier Creek for the whole or a part of the summer. Values were found from the Candle ditch intake up to the forks of the creek, about 1½ miles above, and mining was in progress at three points. The returns were not as good as had been indicated by reports received the previous fall, but were probably better than the equivalent of wages. Gold was found late in the fall of 1908 on the upper part of Gold Run and on Trio Creek, a tributary, and some development work was done in 1909. The ground is 6 to 12 feet deep, but the fall is considerable and the bed rock can be drained by cuts. Cuts aggregating about 250 feet in length had been worked when the creek was visited in August. Mining on Glacier Creek and Gold Run is very costly, as supplies have to be hauled from Candle, a distance of 30 to 40 miles, over poor roads.

WATER-SUPPLY INVESTIGATIONS IN SEWARD PENINSULA IN 1909.

By Fred F. Henshaw.

INTRODUCTION.

SCOPE OF WORK.

It is the purpose of this paper to present briefly the results of the work carried on in 1909 in the further investigation of the water resources of Seward Peninsula. The work for the years 1906 to 1908 has been described and its results outlined in previous reports,[a] and in the present paper it is proposed to present the new data in a preliminary form in advance of the publication of the full report, now in preparation.

The investigation in 1909 carried on by the writer, assisted by G. L. Parker, embraced the districts where records had previously been obtained and, in addition, a considerable body of information was collected in regard to the Council country. In southern Seward Peninsula most of the old stations were continued, especially those in the drainage basins of Nome and Grand Central rivers. In the Kougarok region the results obtained were fewer and somewhat less satisfactory than in previous years. In the Fairhaven precinct the work covered a larger area and extended over a longer period than the 1908 investigations. Only two field trips were made to the Council district, but, thanks to the cooperation of the engineers of the Wild Goose Mining and Trading Company, the discharges of their ditch were obtained, not only for the current year but also for some previous years.

The season of 1909 was one of long-continued drought over the whole of Seward Peninsula, and the results of the year's measurements are of special value, for they can probably be taken as indicating the low-water flow of the streams. This condition, while, of course, very detrimental to the mining interests, was favorable to the obtaining of accurate records of stream flow. The range of stage was relatively small on most of the streams and a correspondingly small

[a] Hoyt, J. C., and Henshaw, F. F., Water supply of the Nome region, Seward Peninsula, Alaska, 1906: Water-Supply Paper U. S. Geol. Survey No. 196, 1907. Henshaw, F. F., and Covert, C. C., Water-supply investigations in Alaska, 1906–7: Water-Supply Paper U. S. Geol. Survey No. 218, 1908. Henshaw, F. F., Water-supply investigations in Seward Peninsula, 1908: Bull. U. S. Geol. Survey No. 379, 1909, pp. 370–401.

number of measurements were required to rate the stations. A break of a few days in record at a station could be estimated with reasonable accuracy from the known behavior of neighboring streams, as they would usually be practically constant or falling uniformly. The tundra and trails were dry and easy to traverse, so that a longer distance could be covered in a day than in a wet season. Moreover, fewer days were lost on account of storms than in previous seasons.

COOPERATION.

As in earlier years, it was possible to cover this large area properly only through the assistance rendered by ditch and mining companies and others interested in the work. A considerable number of measurements were made by persons outside of the Geological Survey, and were of great value in defining the ratings for stations which could be visited only two or three times during the season by the engineers of the Survey.

Special acknowledgment for discharge measurements is due to C. H. Munro, W. H. Lanagan, A. B. Shutts, and R. G. Smith, of the Wild Goose Mining and Trading Company; to C. T. Law, of the Taylor Creek Ditch Company; to F. F. Miller and J. W. Warwick, of the Miocene Ditch Company; and to H. M. Long and R. S. Dimmock, of the Candle-Alaska Hydraulic Gold Mining Company.

The following persons or companies have furnished gage readings and rendered assistance in other ways: B. Deleray, manager, and employees of the Miocene Ditch Company; C. H. Munro, general manager, and employees of the Wild Goose Mining and Trading Company; Jafet Lindeberg, president, and employees of the Pioneer Mining Company; Andrew J. Stone, general manager, and employees of the Taylor Creek Ditch Company; employees of the Kougarok Mining and Ditch Company, Fairhaven Water Company, and Candle-Alaska Hydraulic Gold Mining Company; F. H. Waskey, C. F. Merritt, and George Wallin.

The numerous gage observers all rendered efficient services and special thanks are due to them, but lack of space forbids individual mention.

METHODS OF WORK.

The methods of carrying on the work were substantially the same as those described by C. E. Ellsworth elsewhere in this volume (pp. 257–259), in his report on the results of stream measurements in the Yukon-Tanana region.

ARRANGEMENT OF DATA.

For the purposes of description, Seward Peninsula may be divided in a general way into three portions: (1) A southern portion, from the seacoast near Nome back to and including the Kigluaik and

Bendeleben mountains; (2) a central portion, extending from the lowland areas north of the mountains to the divide at the headwaters of streams draining into Kotzebue Sound and sometimes designated as the Kougarok region, from its most important river; (3) the Fairhaven precinct, embracing the area from which the waters drain into Kotzebue Sound.

Within these three portions the streams will be considered in order from the head of Norton Bay around the coast to the head of Kotzebue Sound. Under each basin the stations on the main stream will be taken up first, beginning with the upper point of measurement, then the stations on tributaries in the same manner, beginning with the highest. Miscellaneous measurements for the whole area are given after the discharges, near the end of the report (pp. 407–414), and are arranged in the same order as the data for regular stations.

SOUTHERN SEWARD PENINSULA.

DESCRIPTION.

Southern Seward Peninsula is here taken as embracing the area from the coast to and including the Kigluaik and Bendeleben mountains. The region shows three types of topography—a coastal plain, an upland, and a mountain mass.

Bordering the coast line is an area of low relief, absent at Point Rodney, Cape Nome, and Topkok Head, but more than 10 miles wide back of the lagoon at Port Safety. This lowland is made up of wet moss-covered ground, rising with a gentle slope to an elevation of 200 or 300 feet at the southern margin of the upland.

The upland consists of limestone and schist hills, ranging in elevation from a few hundred to over 2,000 feet. The general trend of the ridges is north and south, especially in the area back of Nome, and the streams flowing into Bering Sea are roughly parallel. This upland extends back about 30 miles from the coast and presents a steep escarpment toward a wide, gravel-filled valley that separates it from the mountain mass.

North of the depression the Kigluaik Mountains, locally known as the Sawtooth Range, and the Bendeleben Mountains, farther east, rise abruptly, constituting a rugged east-west mass, sharply dissected, with serrated crest line. These mountains have been the center of local glaciation in recent times and their valleys are characterized by cirques.

Nome River is the only stream which crosses the depression and brings water from the mountains to the vicinity of the rich placer ground near Nome. Hence its waters have been the most sought after for mining purposes, and the three largest ditches in this region have been built to divert them. West of Nome River the Sinuk follows this depression and collects the drainage from the south slope of the mountains. The valley to the east is occupied by Salmon Lake and Kruzgamepa River, which flows in a broad sweep around the east end of the mountains to Imuruk Basin. The divides between the Nome and Grand Central and the Nome and Sinuk valleys are low—785 and 1,012 feet, respectively—a fact which makes it possible to divert water from the headwaters of these rivers to Nome River, where it can be carried in the existing ditches to the mines. Similarly in the more easterly mountain area Ophir Creek, rising near Mount Chauik, the dominant peak of the vicinity, extends into an area of placer deposits, and water has been diverted from Pargon River over a low, flat divide into the head of Ophir Creek.

The mountains have a heavy precipitation, reaching 50 to 60 inches a year for some small areas, as indicated by run-off records, and therefore constitute an excellent source of water for mining purposes. The area south of the mountains has a rainfall of 15 to 25 inches, or fully twice that of the country north of the steep mountain wall.

In this region the flow of the streams comes in the early summer from the melting snow and later from the rains. When the snowfall is heavy, as in 1907, it remains until some time in July, and if the rains come early the streams maintain a good flow all summer. In 1908, on the other hand, the snowfall was light and disappeared early, the ground became dry, and the rains were late, so that the run-off for July was small. In the mountains the snow is protected in the steep gorges and cirques and remains well into the summer. The ground is generally frozen within a foot or two of the surface, a condition which prevents any water from being taken up as ground storage and causes the rain to run off immediately, producing rapid fluctuations of stage. The greatest regulating effect is produced by the limestone springs that occur on some streams, notably Hobson Creek, Moonlight Creek, Canyon Creek, and tributaries of Solomon and Grand Central rivers.

Investigations of flow have been made on the following streams and their tributaries, in 1909:

Fish River.
Solomon River.
Nome River.
Sinuk River.
Cobblestone River.
Kruzgamepa River.
Iron Creek.

FISH RIVER DRAINAGE BASIN.

Fish River rises in the Bendeleben Mountains about 50 miles north of Golofnin Bay. After emerging from the mountains it meanders for some 20 miles across the lowland basin known as the Fish River flats. It then traverses a narrow valley, locally known as the canyon, for about 15 miles, and after receiving the waters of Niukluk River enters the lowland at the head of Golofnin Sound, into which it empties. The total drainage area above tide water at White Mountain is 2,110 square miles.

Fish River receives many tributaries, some of the largest being Mosquito Creek, Rathlalulik and Etchepuk rivers, and Cache Creek from the east, Boston Creek and Pargon River from the northwest in the flats, and Niukluk and Fox rivers, which join the main stream below the canyon.

Niukluk River has nearly as large a drainage area as Fish River at their junction. It rises in the Bendeleben Mountains adjacent to the headwaters of Pargon River and flows southwestward into a lowland basin, thence southeastward to its junction with Fish River. Its principal tributaries are Shoestring, Goldbottom, Ophir, and Melsing creeks from the east and Libby River, American Creek, and Casadepaga and Bear rivers from the west. Council, the largest settlement in southern Seward Peninsula outside of Nome, and headquarters of the Council precinct, lies on the Niukluk at the mouth of Melsing Creek.

The upper Fish River basin above the Niukluk is of little economic importance, practically the only mining in this area having been at the Omalik silver mine. Ophir Creek and Casadepaga River, with their tributaries, have been the leading producers of gold, especially the former, which was the scene of the first discoveries in Seward Peninsula.

Several ditches have been built to convey water for working the placers on these two streams. The six in the Casadepaga basin are mostly short, ranging from 2 to 4 miles in length. There are seven on Ophir Creek. Four of them are relatively short and furnish water under heads of 20 to 90 feet for sluicing and running china pumps. Three are larger and give sufficient pressure for hydraulicking.

The Canyon ditch of the Wild Goose Mining and Trading Company is the only one on which continuous records were kept. It diverts its water from Ophir Creek, near the upper end of the canyon, and extends to Discovery claim, at the mouth of Sweetcake Creek, having a total length of 17 miles. The Pargon ditch diverts water from Pargon River and its tributaries, Dillon, McKelvie, and Helen creeks, over a low divide into the head of Ophir Creek, where it is picked up by the Canyon ditch.

The investigations of water supply carried on in this basin have been largely confined to streams capable of furnishing water to the placers of these two mining districts. Some measurements were made in 1907 of Casadepaga River and American Creek.

No stream gaging was done on Ophir Creek and adjacent streams until 1909. Several gages had been installed on the ditch system of the Wild Goose Company in earlier years, and others were installed in the spring of 1909.

A number of measurements, made by engineers of the company, were of great assistance in defining the ratings for the gages. The following stations have been maintained, and the discharges are now available for the first time:

Pargon River below Pargon ditch intake, 1909.
Pargon ditch at intake, 1909.
Pargon ditch below McKelvie Creek, 1908–9.
Pargon ditch below Helen Creek, 1906–1909.
Canyon ditch near intake, 1906–1909.
Canyon ditch above claim 10, 1909.

Discharges for Ophir Creek at Canyon ditch intake have also been computed for 1909. A list of miscellaneous measurements, made in the Fish River basin in 1909, is given near the end of this report (pp. 407–408).

Daily discharge, in second-feet, of Pargon River below Pargon ditch intake and of Pargon ditch at intake for 1909.

[Elevation, 730 feet; drainage area, 20 square miles.]

Day.	July.		Aug.		Sept.	
	River.	Ditch.	River.	Ditch.	River.	Ditch.
1	48	0	1.0	8.6	1.0	18.6
2	62	0	1.0	10.7	1.0	18.0
3	48	0	1.0	8.2	1.0	16.8
4	70	0	1.5	18.0	1.0	16.8
5	48	0	2.0	20.6	1.0	16.3
6	89	0	1.0	15.8	1.0	15.8
7	54	0	1.0	13.7	1.0	15.2
8	29	5.4	1.5	12.0	1.0	14.2
9	35	5.4	35	20.6	1.0	13.7
10	29	8.2	24	20.0	1.0	13.7
11	48	11.6	16	18.0	1.0	12.5
12	35	11.6	16	20.6	1.0	12.5
13	29	15.8	29	18.0	1.0	12.0
14	16	20.6	4.5	18.0	2.3	17.4
15	16	20.6	9.0	18.0	1.5	16.8
16	9.0	20.6	29	18.0	2.3	18.6
17	7.0	21.7	4.5	20.6	1.5	15.2
18	4.5	21.7	4.5	20.6	1.5	14.2
19	4.5	24.1	4.5	20.6	1.0	12.5
20	2.0	20.6	4.5	20.6	1.0	12.5
21	2.0	20.6	2.8	20.6	1.0	13.7
22	1.5	19.1	1.5	19.7	1.0	12.5
23	1.5	18.0	1.0	18.6	1.0	12.0
24	1.5	17.4	1.0	18.0	1.0	12.0
25	1.5	13.7	.7	17.4	1.0	11.6
26	1.0	12.5	.7	17.4		
27	1.0	13.0	.7	16.8		
28	1.0	11.6	.7	18.0		
29	1.0	10.2	.7	17.4		
30	.7	9.4	1.5	19.7		
31	.7	8.6	1.0	18.0		
Mean	22.5	11.7	6.54	17.5	1.16	13.4
Mean total	34.2		24.0		14.6	
Mean per square mile	1.71		1.20		.730	
Run-off (depth in inches on drainage area)	1.97		1.38		.68	

NOTE.—The combined discharges for the river and ditch give the total above the diversion dam. Values for the river are only approximate; they were obtained from gage heights, which were not of the best, by means of a rating table which was extended from measurements at low stages. They were computed in order to give a general idea of the total flow of the river. Values for the ditch are based on a rating table well defined above 12 second-feet discharge.

Daily discharge, in second-feet, of Pargon ditch below McKelvie Creek for 1908 and 1909.

Day.	1908.			1909.			
	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1	17.7	25.4	22.8	....	24.7	9.8	21.0
2	15.4	25.4	22.8	....	24.7	10.9	20.1
3	20.4	25.4	22.8	....	24.7	9.2	18.6
4	25.4	22.8	22.8	....	24.7	22.8	17.7
5	22.8	0	22.8	....	25.4	22.5	18.6
6	16.5	5.0	25.4	....	25.4	18.6	17.7
7	16.5	25.4	25.4	....	25.0	15.4	16.5
8	13.4	25.4	25.4	....	25.4	14.4	16.3
9	11.2	25.4	25.4	....	24.7	12.1	14.6
10	11.2	25.4	25.4	....	25.4	3.3	14.1
11	13.4	25.4	24.1	....	25.4	25.4	14.4
12	13.4	25.4	24.1	....	25.0	26.0	14.4
13	13.4	25.4	....	....	25.4	25.4	13.4
14	10.3	25.4	....	....	24.7	25.4	18.6
15	10.3	25.4	....	....	25.7	25.4	18.3
16	10.3	25.4	....	....	25.0	25.0	18.3
17	10.3	25.4	....	....	24.7	25.4	17.4
18	11.2	25.4	....	....	26.0	25.4	15.4
19	9.4	25.4	....	....	25.4	25.4	14.4
20	11.2	25.4	....	....	24.1	25.4	12.8
21	10.3	24.1	....	....	23.1	25.4	13.4
22	9.4	24.1		19.2	21.0	24.7	13.8
23	9.4	24.1	....	20.4	20.4	23.4	13.8
24	9.4	24.1	....	25.4	16.3	22.8	13.4
25	7.8	22.8	....	24.7	14.9	21.9	12.4
26	7.8	22.8	....	22.8	13.4	21.3	....
27	7.8	23.4	....	23.8	12.8	20.4	....
28	7.8	22.8	....	22.8	11.8	21.6	....
29	7.1	22.8	....	17.7	11.2	21.6	....
30	25.4	22.8	....	21.9	11.2	21.6	....
31	25.4	22.8	....	....	9.8	20.4	....
Mean	13.3	23.1	24.1	22.1	21.5	20.6	16.0

NOTE.—These discharges are based on a rating table which is well defined above 6.0 second-feet discharge.

Daily discharge, in second-feet, of Pargon ditch below Helen Creek for 1906 to 1909.

Day.	1906.			1907.			1908.			1909.			
	July.	Aug.	Sept.	July.	Aug.	Sept.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1	....	31.0	36.4	....	34.6	28.8	31.7	31.7	36.4	....	31.7	14.9	25.7
2	....	28.8	31.7	....	34.2	28.8	26.1	31.7	36.4	....	32.4	15.4	24.4
3	....	28.8	31.7	....	34.6	28.8	26.1	23.2	31.7	....	34.2	16.0	23.8
4	....	31.0	31.7	....	34.9	28.8	31.7	18.1	34.9	....	34.2	24.8	23.8
5	....	34.2	33.1	....	34.2	28.8	28.8	0	34.9	....	35.6	24.8	23.2
6	....	37.1	33.1	....	16.6	28.1	21.9	11.1	34.9	....	37.1	21.6	22.5
7	....	13.0	33.1	....	34.2	28.8	19.3	31.7	34.9	....	35.6	19.0	21.9
8	....	35.6	33.1	....	35.3	28.8	18.1	33.1	34.9	....	35.6	18.1	21.9
9	....	34.9	33.1	....	34.6	27.4	18.1	33.1	34.9	....	34.2	28.1	20.9
10	....	18.2	33.1	....	33.1	9.0	18.1	33.1	34.9	....	33.1	15.2	20.6
11	....	36.4	33.1	....	33.1	0	20.6	33.1	33.1	....	33.1	29.9	20.3
12	....	18.2	26.1	....	34.9	0	20.6	36.4	33.1	....	30.6	31.0	19.6
13	....	17.4	26.1	....	34.2	0	20.6	36.4	33.1	....	31.0	32.4	20.0
14	....	34.2	31.7	....	34.9	0	13.2	36.4	33.1	....	31.0	31.7	23.2
15	....	0	31.7	32.4	16.6	0	14.3	36.4	33.1	....	30.2	31.0	23.5
16	....	15.8	31.7	30.6	33.1	0	11.1	34.9	33.1	....	29.5	32.4	23.2
17	....	31.7	31.7	21.9	18.1	0	11.1	34.9	33.1	....	29.5	31.7	21.6
18	....	31.7	31.7	27.4	4.5	13.2	13.2	34.9	33.1	....	31.0	31.3	20.6
19	....	31.7	4.5	30.2	19.3	15.4	11.1	34.9	31.7	....	31.0	30.6	19.3
20	....	34.9	0	30.2	18.1	19.3	11.1	36.4	30.2	31.7	28.5	30.2	18.1

Daily discharge, in second-feet, of Pargon ditch below Helen Creek for 1906 to 1909—Cont'd.

Day.	1906.			1907.			1908.			1909.			
	July.	Aug.	Sept.	July.	Aug.	Sept.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
21	35.6	34.2	9.0	26.1	16.6	21.2	11.1	34.9	31.7	28.8	28.1	30.6	20.0
22	0	33.1	13.2	31.0	15.4	25.4	11.1	34.9	31.7	30.2	25.4	29.5	19.3
23	37.1	31.7	13.2	31.0	24.8	24.8	9.0	34.9	....	31.7	24.1	28.1	19.3
24	34.9	31.7	13.2	15.1	26.1	27.4	9.0	35.6	....	31.7	20.6	27.4	19.0
25	32.4	31.7	13.2	15.1	26.1	27.4	8.1	35.6	....	26.8	19.3	27.1	17.8
26	36.4	15.8	....	29.5	26.1	27.4	7.3	34.9	....	31.7	18.7	26.1	......
27	36.4	0	....	30.2	27.4	27.4	6.5	34.9	....	34.9	19.6	26.1	......
28	35.6	0	....	33.1	27.4	27.4	6.5	34.9	....	33.1	17.5	26.8	......
29	33.1	13.2	....	34.2	28.8	28.8	6.5	34.9	....	26.8	16.6	26.1	......
30	34.2	21.9	....	34.9	28.8	28.5	26.1	34.9	....	1.0	16.0	26.8	......
31	33.5	13.2	....	34.2	28.8	....	13.2	34.9	....	....	15.4	25.4	......
Mean	31.7	24.9	25.6	28.7	27.4	18.7	16.2	31.8	33.6	30.8	28.1	26.1	21.3

NOTE.—These discharges are based on a rating table which is fairly well defined between 16 and 32 second-feet discharge. The gage is located in the flume across Helen Creek above the Helen Creek lateral and is assumed to be an index of the discharge below the junction, but when a large portion of the water is coming from Helen Creek the discharge may be greater for the same gage height. Discharges from about July 14 to 29, 1908, are questionable; they are not consistent with those for the stations below and above and may be 5 or 6 second-feet too small.

Daily discharge, in second-feet, of Canyon ditch near intake for 1906 to 1908.

Day.	1906.					1907.			1908.		
	June.	July.	Aug.	Sept.	Oct.	June.	July.	Sept.	July.	Aug.	Sept.
1	....	36.0	54.9	63.0	50.1	....	....	....	41.3	44.4	63.0
2	....	36.0	50.1	63.0	38.6	....	....	....	28.4	41.0	63.0
3	....	40.0	50.1	63.0	38.6	....	....	....	33.2	40.0	63.0
4	....	47.9	50.1	63.8	38.6	....	38.6	....	30.7	50.1	63.0
5	....	53.4	57.9	63.8	38.6	....	47.2	....	30.7	47.2	61.0
6	....	54.1	61.0	63.8	38.6	....	56.4	....	33.2	53.4	57.9
7	....	50.8	50.1	63.8	38.6	....	59.4	....	33.2	56.4	56.4
8	....	58.7	54.9	63.8	38.6	....	59.4	....	28.4	57.9	56.4
9	....	54.9	63.0	63.0	38.6	....	59.4	....	28.4	59.4	53.4
10	....	63.0	51.9	63.0	....	....	61.0	....	25.9	59.4	53.4
11	....	63.0	63.0	63.0	....	....	....	....	28.4	59.4	53.4
12	....	63.0	56.4	63.0	....	....	....	....	30.7	59.4	50.1
13	....	63.0	50.1	63.0	....	....	....	....	25.9	59.4	50.1
14	....	63.0	63.0	63.0	....	....	....	....	25.9	59.4	50.1
15	....	63.0	41.3	63.0	....	....	....	....	22.8	59.4	59.4
16	....	63.0	38.6	63.0	....	....	....	....	22.8	50.1	53.4
17	....	44.4	56.4	63.0	....	....	....	....	22.8	59.4	51.5
18	....	57.9	56.4	63.0	....	....	....	....	22.8	59.4	47.2
19	....	57.9	56.4	63.0	....	....	....	....	19.9	59.4	48.6
20	....	57.9	63.0	63.0	....	33.2	....	....	25.9	57.9	41.3
21	....	61.0	63.0	63.0	....	45.8	....	59.4	23.8	56.4	53.4
22	....	53.4	63.0	63.0	....	50.1	....	59.4	20.7	56.4	41.3
23	....	61.0	63.0	63.0	....	50.1	....	59.4	20.7	56.4	....
24	....	59.4	63.0	63.0	....	53.4	....	59.4	19.9	63.0	....
25	....	61.0	53.4	63.0	....	53.4	....	59.4	19.9	63.0	....
26	....	63.0	63.0	63.0	....	54.9	....	59.4	19.9	63.0	....
27	....	59.4	63.0	63.0	....	50.1	....	59.4	19.9	63.0	....
28	33.2	59.4	63.0	63.0	....	51.5	....	59.4	18.1	59.4	....
29	33.2	59.4	26.7	63.0	....	56.4	....	59.4	18.1	56.4	....
30	33.2	58.7	63.0	63.0	....	56.4	....	....	28.4	54.9	....
31	....	57.9	63.0	....	....	....	....	....	44.4	56.4	....
Mean	33.2	56.3	56.0	63.1	39.9	50.5	54.5	59.4	26.3	56.1	54.1

NOTE.—These discharges are based on a rating curve which is well defined between 20 and 60 second-feet discharge. The gage and channel conditions are believed to be permanent. No record was kept between July 10 and September 21, 1907, but the ditch was full practically all the time. The records do not cover the full period at the beginning of 1906 and 1908, water having been turned in early in June both years.

Daily discharge, in second-feet, of Canyon ditch near intake and above claim 10 for 1909.

Day.	Near intake.				Above claim 10.		
	June.	July.	Aug.	Sept.	July.	Aug.	Sept.
1	....	56.4	21.0	38.0	....	11.4	35.4
2	....	56.4	21.0	37.3	....	10.8	34.3
3	....	56.4	23.8	36.0	....	12.5	33.9
4	....	55.6	40.0	36.0	....	30.1	33.9
5	18.1	55.6	34.8	36.0	....	25.8	34.3
6	18.1	57.2	31.6	34.8	....	26.5	31.6
7	18.1	57.2	28.4	33.8	....	22.5	31.6
8	18.1	53.4	27.8	32.5	....	22.2	30.1
9	38.6	55.6	49.7	31.9	....	31.6	29.4
10	41.3	56.4	50.1	31.9	39.6	40.0	29.4
11	45.8	53.4	47.9	31.3	37.3	35.0	29.4
12	45.8	53.4	48.6	30.7	37.7	39.3	27.9
13	47.2	51.2	53.4	30.7	33.9	41.6	27.9
14	44.4	47.2	52.6	39.3	31.6	44.4	35.4
15	41.3	45.8	48.3	36.0	30.1	41.2	33.5
16	41.3	44.4	51.9	36.0	30.1	42.8	32.8
17	41.3	43.4	49.4	37.6	31.6	42.0	33.9
18	41.3	44.4	47.2	30.7	30.5	40.8	27.5
19	41.3	43.4	46.5	31.3	30.1	40.8	28.1
20	41.3	40.0	45.8	28.9	27.9	38.5	25.7
21	45.8	37.3	45.1	30.1	24.3	38.9	26.9
22	48.6	37.3	44.0	35.7	22.5	37.7	31.6
23	51.9	33.8	42.7	34.1	22.9	36.9	30.9
24	51.9	29.5	41.0	34.8	19.3	35.0	32.4
25	44.4	27.0	40.0	31.0	17.4	35.0	29.7
26	44.4	25.9	40.0	11.9	16.1	35.0	22.9
27	50.1	27.0	39.3	....	16.1	35.4	....
28	56.4	25.1	40.3	....	15.5	37.3	....
29	56.4	22.6	39.3	....	13.0	37.7	....
30	56.4	21.9	40.0	....	12.5	36.9	....
31	....	21.6	38.0	....	11.6	36.2	....
Mean	41.9	43.1	41.0	33.0	25.1	33.6	30.8

NOTE.—Discharges for the station above claim 10 are based on a rating table which is fairly well defined between 15 and 40 second-feet discharge. September 18 to 21 interpolated; no record before July 10.

Daily discharge, in second-feet, of Ophir Creek at Canyon ditch intake for 1909.

[Drainage area, 24 square miles.]

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	27	9	15	21	12	18	13
2	27	9	16	22	15	17	19
3	25	11	15	23	13	18	18
4	24	19	15	24	12	17	19
5	23	13	16	25	11	16	16
6	23	13	15	26	10	17	....
7	25	12	15	27	10	16	....
8	21	13	14	28	11	16	....
9	24	25	14	29	9	16	....
10	26	38	14	30	9	16	....
				31	9	16	....
11	23	21	14				
12	26	19	14		532	548	388
13	23	24	14	Mean	17.2	17.7	15.5
14	19	18	19	Mean per square mile	.717	.738	.646
15	19	20	16	Run-off (depth in inches on drainage area)	.83	.85	.60
16	18	23	16				
17	17	21	19				
18	16	19	13				
19	15	19	15				
20	14	19	14				

NOTE.—These discharges were obtained by subtracting the discharge of the Pargon ditch below Helen Creek from that of Canyon ditch at the intake, and adding 3 second-feet, the approximate amount of water lost by seepage from the Pargon ditch below Helen Creek.

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, 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.

One station has been maintained in this basin to obtain data for comparative purposes and for possible power development, that on Solomon River below East Fork, during July and August, 1908, and August and September, 1909.

A list of miscellaneous measurements made in this basin is given on page 408.

Daily discharge, in second-feet, of Solomon River below East Fork for 1908 and 1909.

[Elevation, 140 feet; drainage area, 66 square miles.]

Day.	1908.		1909.	
	July.	Aug.	Aug.	Sept.
1		162		37
2		115		36
3		95		35
4	81	224		37
5	79	682		37
6	77	280		37
7	77	150		37
8	65	112		36
9	68			35
10	63			34
11	61			33
12	68			32
13	54			32
14	55			53
15	52			34
16	48		66	35
17	48		56	56
18	40		52	46
19	36		50	46
20	40		46	46
21	37		46	46
22	34		43	46
23	33		42	58
24	34		40	63
25	33		39	
26	31		39	
27	30		39	
28	33		39	
29	33		39	
30	375		37	
31	692		37	
Mean	84.9	228	44.4	41.1
Mean of East Fork ditch	6.5	10	3.7	4.5
Mean total	91.4	238	48.1	45.6
Mean per square mile	1.38	3.61	.729	.691
Run-off (depth in inches on drainage area)	1.44	1.07	.43	.62

NOTE.—The above daily discharges are based on rating curves which are applicable as follows:
July 4 to 30, 1908 (fairly well defined).
July 31 to August 8, 1908 (fairly well defined).
August 16 to September 24, 1909 (well defined).
September 7 to 12 and 19 to 22 (estimated).
The values for 1908 are based on additional data and supersede those published in Bulletin 379, p. 383.

NOME RIVER DRAINAGE BASIN.

Nome River is formed by the junction of Buffalo and Deep Canyon creeks, which have their sources in the Kigluaik Range. The principal tributaries are David, Alfield, Christian, Darling, Buster, and Osborn creeks from the east and Divide, Dorothy, Clara, Hobson, and Banner creeks from the west. Hobson Creek, the most important of these tributaries, is a short stream but receives a large flow from limestone springs.

Four ditches have been built to divert water for mining purposes, and 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.

The Miocene ditch has its intake on Nome River just below the mouth of Buffalo Creek and extends along the right bank of Nome River to the Ex. Here it forks, one branch delivering water to Glacier and Anvil creeks, the other to Dexter Creek and its tributaries. The ditch crosses and diverts the flow of Hobson Creek and several other small creeks. The David Creek lateral delivers water to Nome River above the intake, the Grouse Creek branch comes in at the flume, and the Glacier Creek branch enters at the Ex.

The Campion ditch has its intake on Buffalo Creek, about half a mile above the mouth, and extends 4 miles to Dorothy Creek, into which its water is dropped. The Seward ditch has its intake just below the mouth of Dorothy Creek and receives much of its water supply from the Campion ditch. The Pioneer Nome River ditch takes its water about 3 miles below the Seward. Both of the latter ditches have laterals to Hobson Creek.

The total amount of water that can be made available for these ditches includes not only the discharge of Nome River itself, but also that of Grand Central River and some of its tributaries, which can be diverted over the Nugget divide. (See p. 383.) These discharges have been summarized by weekly periods in the accompanying table. The amount available for use at elevation 400 to 450 feet includes all above the level of the Miocene ditch; that for use at elevation 220 to 280 feet includes all additional water down to the level of the Pioneer ditch. Sinuk River and its tributaries, Windy and North Star creeks, could also be made to furnish some water, but only by a rather long ditch line and at considerable expense. Their discharge at elevation 800 feet may be estimated at one-half that of upper Grand Central River, Thompson Creek, and Gold Run.

The monthly discharge of Nome River above the Miocene intake, for 1906 to 1909, is given in order to show the relation between the discharges of different years.

Records of discharge have been kept on Nome River and the ditches since 1906, and the basin has been covered more thoroughly than any other in Seward Peninsula. The following stations have been maintained.

Nome River above Miocene intake, 1906–1908.
Nome River below Pioneer intake, August 21 to 31, 1907, 1908–9.
Hobson Creek below Manila Creek, 1907–1909.
Campion ditch at Black Point, 1906–1909.
Miocene ditch at Black Point, 1906–1909.
Miocene ditch at Clara Creek, 1907 and 1909.
Miocene ditch above Hobson Creek, 1907–1909.
Miocene ditch below Hobson Creek, 1907–1909.
Miocene ditch at the flume, 1906–1909.
David Creek ditch opposite Black Point, August, 1906, 1907–1909.
Seward ditch at intake, 1907–1909.
Seward ditch below Hobson Branch, 1909.
Seward ditch at Dexter Creek, 1909.
Seward ditch above Newton Gulch, 1909.
Hobson Branch above Seward ditch, 1909.
Pioneer ditch at intake, August 21 to 31, 1907, 1908–9.

Mean weekly water supply, in second-feet, available for Nome River ditches in 1909.

Date.	For use at elevation 220 to 280 feet: Nome River, low-level flow.	For use at elevation 400 to 450 feet.			Total.
		Nome River, high-level flow.	Upper Grand Central River, Thompson Creek, and Gold Run.	Nugget, Copper, and Jett creeks.	
June 17–23	152	140			292
June 24–30	117	119			236
July 1–7	142	95.8	258	9.7	506
July 8–14	68.7	62.1	175	8.7	314
July 15–21	34.4	42.6	105	4.4	186
July 22–28	26.8	28.8	75.1	3.2	134
July 29–August 4	23.3	24.1	72.8	1.9	122
August 5–11	25.8	32.1	101	6.3	165
August 12–18	23.3	31.9	92.5	6.0	154
August 19–25	20.1	25.8	69.4	4.2	120
August 26–September 1	19.2	24.0	55.9	3.1	102
September 2–8	15.6	22.1	50.4	2.5	90.6
September 9–15	17.5	20.2	42.6	1.8	82.1
September 16–22	16.9	22.2	37.9	1.4	78.4
September 23–30	22.7	26.7			49.4
Mean	48.4	47.8	94.6	4.4	175
Maximum	152	140	258	9.7	506
Minimum	16.9	20.2	37.9	1.4	49.4

NOTE.—Discharges are those for the streams at the ditch intakes, except for Nugget, Copper, and Jett creeks, for which the values given are the approximate quantities of water delivered over the Nugget divide. Discharges for Grand Central River and for Nugget, Copper, and Jett creeks are omitted for June and the last week in September, as the records do not cover these periods, and no water could have been diverted from these streams on account of snow and ice conditions.

Monthly discharge of Nome River above Miocene intake for 1906 to 1909.

[Drainage area, 15 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1906.					
July	314	23	57.8	3.85	4.44
August	191	20	50.5	3.37	3.88
September	230	29	65.6	4.37	4.88
The period, 92 days	314	20	57.9	3.86	13.20
1907.					
June 15-30	460	125	212	14.1	8.39
July	132	25	66.5	4.43	5.11
August	71	19.2	33.8	2.25	2.59
September	349	25	66.0	4.40	4.91
The period, 108 days	460	192	78.6	5.24	21.00
1908.					
June 20-30	86	26	59.5	3.97	1.62
July	88	6.1	15.5	1.03	1.19
August	146	22	43.6	2.91	3.36
September 1-22	39	15.0	23.8	1.59	1.30
The period, 94 days	146	6.1	32.0	2.13	7.64
1909.					
June 15-30	271	26	99.2	6.61	3.93
July	74	8.8	28.1	1.87	2.16
August	39	7.4	15.5	1.03	1.19
September	30	9.2	12.4	.827	.92
The period, 108 days	271	7.4	30.8	2 05	8.20

NOTE.—Values for 1906, 1907, and 1908 have been recomputed and supersede those published in previous reports. These discharges represent the natural flow of the river.

Daily discharge, in second-feet, of Nome River and Hobson Creek for 1909.

Day.	Nome River at Miocene intake.[a] Elevation, 572 feet; drainage area, 15 square miles.				Nome River at Pioneer intake.[b] Elevation, 320 feet; drainage area, 37 square miles.				Hobson Creek at Miocene intake.[c] Elevation, 500 feet; drainage area, 2.6 square miles.				
	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	May.	June.	July.	Aug.	Sept.
1	......	52	7.4	10.9	......	241	27	30	......	40	21	9.5	7.6
2	......	50	8.2	11.4	......	211	28	28	......	35	20	9.0	6.9
3	......	74	13.0	11.1	......	222	41	27	......	39	22	8.3	6.8
4	......	58	19.1	12.2	......	228	42	26	......	31	18.1	6.2	6.4
5	......	57	12.6	13.3	......	196	33	29	......	44	17.7	5.7	6.6
6	......	51	10.4	13.8	......	186	35	29	......	42	17.4	8.0	6.2
7	......	41	10.1	12.8	......	169	30	26	......	30	17.0	8.2	6.4
8	......	45	8.2	10.4	......	147	37	26	......	22	16.4	8.2	6.4
9	......	43	39	10.3	......	130	64	27	......	29	16.4	8.0	6.5
10	......	33	37	10.4	430	117	74	26	......	35	16.1	8.3	6.1
11	......	24	16.3	9.9	424	96	44	26	0.12	60	16.1	9.2	6.4
12	......	27	9.9	9.2	415	99	41	26	.12	35	16.1	6.2	6.4
13	......	29	24	9.4	364	81	48	28	.12	39	16.1	6.2	6.3
14	......	25	27	13.3	334	67	52	30	.12	34	15.5	7.2	7.2
15	238	22	23	11.9	310	58	47	28	.19	27	15.9	6.3	6.3
16	271	24	17.8	13.2	355	60	44	29	.26	39	15.0	6.3	6.4
17	11[illegible]	22	14.8	12.8	316	58	40	27	.26	25	15.1	7.1	7.1
18	99	23	13.9	12.5	298	52	38	27	.54	23	12.0	8.4	6.1
19	93	22	14.5	11.7	316	54	36	26	1.3	25	13.4	8.4	6.0
20	80	20	13.6	11.6	268	52	37	29	5.8	21	12.4	7.5	6.8
21	73	17.8	14.1	12.8	236	46	35	32	7.1	18.8	15.7	6.9	6.8
22	66	16.0	13.7	12.8	219	43	34	32	5.3	17.4	13.6	7.1	5.9
23	72	13.7	13.1	17.2	162	40	32	43	6.7	14.9	11.5	7.6	5.9
24	45	11.0	12.5	30	174	38	32	76	6.7	14.6	12.4	7.4	6.4
25	26	10.7	11.7	16.0	138	36	31	40	6.1	14.6	13.7	7.6	5.9
26	27	10.5	12.3	13.2	120	35	33	33	5.0	15.1	10.7	7.6	6.4
27	27	10.4	13.1	13.2	168	34	33	33	4.7	15.4	11.3	7.7	6.4
28	89	11.4	13.7	12.4	192	30	31	31	5.8	18.8	10.6	7.6	6.4
29	184	10.0	13.1	12.0	338	29	30	30	6.4	27	11.0	8.0	6.0
30	86	8.8	11.9	12.0	303	30	31	30	9.7	24	10.2	8.1	6.0
31	......	9.5	12.1	......	......	32	29	......	36	......	9.9	7.0	......
Mean	99.2	28.1	15.5	12.4	280	94.1	38.4	31.0	5.16	28.5	14.8	7.57	6.43
Mean per square mile	6.61	1.87	1.03	.827	7.57	2.54	1.04	.838	1.98	11.0	5.69	2.91	2.47
Run-off (depth in inches on drainage area)	3.93	2.16	1.19	.92	5.91	2.93	1.20	.94	1.55	12.27	6.56	3.36	2.76

[a] These values were found by adding the discharges of Nome River below the Miocene intake and of Miocene and Campion ditches at Black Point, and subtracting the discharges of the David Creek, Nugget Creek, and Jett Creek ditches. Values for September 20 to 30 were estimated as 40 per cent of the discharge at the Pioneer intake.

[b] These values were found by adding the discharges of Nome River below the Pioneer intake, Pioneer ditch at the intake, Seward ditch at the intake, and Miocene ditch at Clara Creek, and subtracting the discharges of the Nugget Creek and Jett Creek ditches.

[c] These values up to June 17 were obtained from gage heights below the Miocene diversion dam, using a rating table which is well defined below 40 second-feet discharge. Those from June 18 to September 19, while the Miocene ditch was diverting water, were obtained by subtracting the discharge of the ditch above the dam from that below the dam and adding the amount spilled over the wasteway, as computed from gage readings. September 20 to 28 the Hobson branch of Seward ditch diverted the total flow of the creek above its intake and the discharges were obtained by subtracting from the flow of the ditch the amount it had been carrying for the days just previous; for September 29 and 30 these figures are estimated.

Discharge measurements of Hobson Creek below Manila Creek in 1909.

[Drainage area, 5.1 square miles.]

Point of measurement.	June 14.	July 15.	Aug. 1.	Aug. 10.	Sept. 12.
	Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
Miocene intake	[a] 21.0	15.9	9.5	8.3	6.4
Seward lateral	0	5.5	3.2	3.8	2.5
Pioneer lateral	0	4.3	2.3	1.7	.85
Deschamps ditch	0	.2	3.3	0	0
Hobson Creek below Manila Creek	34.8	7.5	2.9	4.2	4.9
	34.8	33.4	21.2	18.0	14.6
Per square mile	6.82	6.55	4.16	3.53	2.86
Ratio of total to discharge at Miocene intake	1.66	2.10	2.23	2.17	2.28

[a] Discharge at 10 a. m., when measurement was made below, no water diverted.

Daily discharge, in second-feet, of Miocene ditch for 1909.

Day.	Miocene ditch at Black Point.				Miocene ditch above Hobson Creek.				Miocene ditch at the flume.			
	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1	......	33.3	7.5	8.2	......	27.2	3.2	2.4	......	43.6	10.7	8.9
2	......	33.3	7.2	8.2	......	26.6	2.8	2.4	......	42.8	9.5	8.9
3	......	33.3	11.6	7.9	......	26.6	2.8	1.8	......	43.9	11.3	8.3
4	......	33.3	18.2	7.9	......	25.7	16.8	1.8	......	44.3	20.8	8.0
5	......	33.3	11.4	9.3	......	25.4	9.5	3.0	......	43.2	15.3	9.2
6	......	40.4	9.5	10.0	......	29.0	6.2	2.0	......	45.8	12.5	7.8
7	......	40.4	9.3	8.9	......	29.0	1.8	1.8	......	45.1	9.5	7.8
8	......	42.2	8.6	7.4	......	29.6	0	1.8	......	44.7	6.4	7.7
9	......	44.0	40.8	7.2	......	29.6	17.4	1.5	......	44.7	21.7	7.6
10	......	44.0	44.0	7.2	......	29.9	33.8	1.8	......	44.7	36.1	7.1
11	......	44.0	28.4	7.0	......	29.9	24.5	1.5	......	44.7	31.1	6.6
12	......	44.0	21.1	6.5	......	29.9	17.4	1.2	......	43.9	22.4	6.4
13	......	42.2	28.4	6.5	......	29.9	17.4	.8	......	42.4	22.1	6.2
14	......	36.1	29.5	7.9	......	26.9	24.2	.8	......	40.5	26.5	7.6
15	......	31.6	25.0	7.0	......	24.8	18.2	.8	......	37.6	22.8	6.2
16	......	34.0	18.7	7.4	......	25.7	16.2	.8	......	38.3	20.4	9.0
17	......	31.2	15.4	7.4	......	23.6	10.9	.8	......	36.1	17.9	11.3
18	......	34.0	14.3	7.4	......	21.0	9.0	.8	......	34.3	16.3	7.5
19	......	29.8	13.8	6.5	......	23.9	9.0	.8	6.2	34.3	15.6	7.2
20	......	25.7	12.9	......	......	21.6	8.5	......	16.9	31.8	14.7	......
21	......	23.7	12.5	......	......	14.8	7.8	......	21.1	28.6	14.1	......
22	......	21.8	12.2	......	......	14.0	7.6	......	21.1	26.2	13.4	......
23	12.0	19.3	11.8	......	12.7	15.1	6.6	......	27.5	25.1	12.8	......
24	18.4	16.5	11.0	......	19.6	13.0	5.0	......	31.4	22.4	11.6	......
25	26.4	15.9	10.0	......	21.0	11.4	4.6	......	35.4	20.8	11.6	......
26	29.8	15.6	10.4	......	23.9	10.9	4.6	......	39.0	20.1	11.0	......
27	29.8	15.1	10.8	......	23.9	9.5	4.3	......	40.5	19.2	10.7	......
28	29.8	12.7	11.0	......	23.9	9.0	4.6	......	41.7	18.5	11.6	......
29	15.6	11.0	9.6	......	22.4	6.4	3.8	......	41.7	15.6	11.0	......
30	33.3	8.6	9.1	......	22.1	5.8	3.0	......	37.9	13.1	9.5	......
31	......	7.9	9.5	......	......	4.3	3.0	......	......	11.9	9.2	......
Mean	24.4	29.0	15.9	7.66	20.6	21.0	9.84	1.51	30.0	33.8	15.8	7.86

NOTE.—Discharges for all three stations are based on well-defined rating curves. Records at Black Point show the amount of water diverted from Nome River; those above Hobson show the amount delivered 12 miles below. The discharge below Hobson can be obtained by adding the flow of the creek to that of the ditch above, except for June 18 to 20 and June 28 to July 3, when there was some waste from the spillway. The records at the flume show the amount delivered about 4 miles below Hobson Creek.

Daily discharge, in second-feet, of Campion, Seward, and Pioneer ditches near their intakes for 1909.

Day.	Campion ditch at Black Point.			Seward ditch at intake.				Pioneer ditch at intake.			
	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1		2.8	6.7		20.2	9.5	16.3		20.2	12.7	10.3
2		3.4	7.1		20.2	11.7	15.7		23.2	12.7	9.7
3		4.2	7.1		23.2	17.0	15.3		27.0	14.7	9.7
4		4.9	8.0		28.0	12.8	15.0		26.2	16.4	9.7
5		4.9	7.5		22.9	13.4	15.7		25.1	12.7	10.0
6		4.5	7.1		26.8	17.6	16.6		26.6	12.4	10.0
7		4.5	7.1		32.8	18.3	15.0		27.0	11.5	9.7
8		4.9	6.0		32.8	16.6	15.0		27.0	12.7	9.7
9		4.9	6.0		32.0	27.8	15.7		27.0	23.2	9.7
10		5.2	6.0		28.0	25.8	15.0		26.2	24.0	9.7
11		2.2	5.6		29.2	15.7	15.0		27.0	15.3	9.7
12		2.2	5.2		28.0	18.3	15.0		25.1	15.0	9.4
13		7.1	5.2		19.5	17.6	16.6		26.6	16.7	9.7
14		8.0	7.5		14.4	15.7	16.6		24.0	16.0	11.5
15		7.5	7.1		13.1	16.6	17.0		21.7	16.0	9.7
16		7.1	8.0		12.2	16.6	15.0		22.1	15.3	11.8
17		7.1	7.5		12.2	16.6	15.0		20.2	15.0	9.7
18		7.1	7.1		11.1	17.0	15.0		19.5	14.0	9.7
19		8.0	7.1		10.5	15.7	14.4		19.5	14.0	9.7
20		7.5			10.5	17.6	18.3		18.8	13.4	9.4
21		8.0			10.5	16.6	19.7	10.9	18.1	13.4	11.2
22		7.5			10.5	15.7	18.3	14.0	17.4	13.4	12.7
23		7.1			9.5	15.3	29.8	12.7	16.4	12.7	12.1
24		7.1		16.7	9.5	15.7	25.8	25.9	15.7	12.7	24.0
25		7.1		15.0	9.5	15.3	23.8	22.1	14.4	12.7	15.7
26		7.1		16.7	9.5	17.0	19.0	16.7	14.4	12.4	13.4
27		7.3		16.7	10.0	16.6	17.6	18.1	14.0	12.7	14.4
28	3.2	7.5		16.7	10.0	15.7	17.2	25.1	14.0	11.5	12.7
29	3.2	8.0		16.7	10.0	15.0		25.1	13.4	11.5	
30	4.0	7.1		19.2	10.8	16.6		25.5	13.4	10.9	
31	4.9	6.7			10.8	15.0			17.4	10.3	
Mean	3.82	6.08	6.78	16.8	17.4	16.5	17.3	19.6	20.9	14.1	11.2

NOTE.—Discharges for all three stations are based on well-defined rating curves. Two were used for the Seward ditch station, covering the periods June 24 to August 5 and August 6 to September 28. These records show the amount of water diverted by the ditches.

Daily discharge, in second-feet, of Seward ditch for 1909.

Day.	Seward ditch below Hobson branch.				Seward ditch at Dexter Creek.				Seward ditch above Newton Gulch.			
	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1		22.6	10.4	14.2		12.9	4.5	9.2		8.7	2.1	5.2
2		16.2	10.4	14.2		11.8	4.5	9.2		8.7	.4	5.2
3		22.6	10.4	14.2		11.8	4.2	8.6		8.9	3.4	4.8
4		22.6	18.2	14.2		12.2	10.0	8.6		8.9	6.9	3.2
5		22.6	13.6	14.2		11.8	8.6	10.0		8.9	5.8	2.8
6		27.2	11.0	14.2		11.8	7.6	9.2		8.9	3.8	3.0
7		37.0	17.4	14.2		11.8	6.2	8.6		8.9	3.4	2.7
8		37.0	18.2	13.9		12.9	9.2	8.1		11.4	5.8	2.7
9		37.0	18.2	13.6		15.2	9.6	7.6		13.0	6.4	2.5
10		42.0	27.2	14.2	4.2	18.8	9.6	9.2		14.0	11.8	3.5
11		34.5	14.6	13.6	3.9	17.6	9.2	9.2		15.1	11.2	4.8
12		18.2	17.4	13.6	3.6	17.6	9.2	8.6		12.4	5.9	4.4
13		29.6	18.2	13.6	3.0	17.8	10.7	8.6		13.4	6.7	4.2
14		18.2	16.2	15.0	3.0	11.8	10.9	9.2		9.9	6.4	5.2
15		16.2	17.4	14.2	1.4	10.7	10.0	9.2		8.2	4.8	5.0

Daily discharge, in second-feet, of Seward ditch for 1909—Continued.

Day.	Seward ditch below Hobson branch.				Seward ditch at Dexter Creek.				Seward ditch above Newton Gulch.			
	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
16	....	18.2	17.4	14.2	1.0	9.2	8.4	9.6	....	6.9	4.7	4 8
17	....	16.2	15.0	14.2	6.7	8.8	8.0	11.8	....	6.6	4.4	6.6
18	....	16.2	14.2	14.2	6.7	7.6	8.0	10.7	....	5.7	3.6	5.3
19	....	12.6	14.2	14.2	6.7	7.8	8.6	12.2	....	4.4	3.8	4.7
20	....	12.6	14.2	24.9	6.7	6.7	8.6	11.4	....	3.2	3.5	7.1
21	....	12.6	15.0	27.2	9.6	7.2	8.6	16.4	....	2.9	4.2	10.3
22	....	12.6	14.2	27.2	12.9	6.2	8.6	18.8	....	2.9	2.8	13.0
23	....	11.6	14.2	27.2	11.8	6.0	9.2	19.3	....	2.9	2.3	13.4
24	16.2	11.6	14.2	27.2	9.6	5.5	9.2	20.8	8.5	2.2	4.7	15.0
25	18.2	11.6	14.2	32.0	11.8	5.5	8.6	20.8	8.5	1.6	2.7	15.2
26	18.2	11.0	14.2	27.2	11.8	4.8	8.0	16.4	8.7	1.2	3.8	10.7
27	27.2	11.0	14.2	24.9	10.7	4.5	9.6	16.4	9.2	1.1	4.7	13.0
28	18.2	10.4	14.2	29.6	23.8	4.5	10.0	....	10.7	1.4	5.0	......
29	24.9	11.0	14.2	....	9.6	4.8	10.0	....	12.4	.6	6.4	......
30	18.2	11.0	14.2	....	9.6	4.9	9.6	....	8.7	.1	5.8	......
31	....	11.0	14.2	....	....	5.0	9.6	....	....	.1	5.2	......
Mean	20.2	19.5	15.2	18.4	8.00	9.85	8.60	11.8	9.53	6.56	4.91	6.60

NOTE.—Discharges for all three stations are based on fairly well defined rating curves. There is practically no inflow between these stations, and the differences between upper and lower points show the loss by seepage from the ditch. The Hobson branch enters just above the first station, and its mean discharge was as follows: June 24 to 30, 5.77 second-feet; July, 5.00 second-feet; August, 3.18 second-feet; September 1 to 28, 4.58 second-feet. The discharge at Dexter Creek prior to June 24 came from melting snow, and no record was kept of the amount delivered to Newton Gulch.

GRAND CENTRAL RIVER DRAINAGE BASIN.

Grand Central River rises in the heart of the Kigluaik Mountains, where the peaks reach an elevation of 3,000 to 4,500 feet. The river and its tributaries head in glacial cirques and flow through U-shaped valleys over broad gravel beds. North Fork rises on the east side of Mount Osborn, the highest peak of the range; West Fork rises to the south of the same mountain, and the two forks join at elevation 690 feet. West Fork receives the waters of Crater Lake, a glacial lake having an area of 43 acres, through a short tributary from the south. About 3 miles below the junction of the forks the river is joined by the two principal tributaries, Thompson Creek from the west and Gold Run from the east. From this point the river flows southeastward into Salmon Lake.

In order to make the waters of Grand Central River available for use near Nome, they must be carried over the Nugget divide, which has an elevation of 785 feet. The diversion must be made about a mile above the forks, and 8 or 9 miles of ditch will be required. There are two waterways being built to divert this water—a 42-inch wood-pipe line, starting at Crater Lake, with laterals taking water from North Fork at about elevation 1,030 feet and from West Fork at elevation 1,010 feet, and a ditch 8 feet wide on the bottom with a 5-foot bank, having its intake on the forks at an elevation of about 850 feet.

The following stations have been maintained on Grand Central River and its tributaries:

West Fork at pipe intake, 1906, 1907, and 1909.
West Fork at ditch intake, 1906–7.
West Fork at the forks, 1907–1909.
Grand Central River below the forks, 1906–1908 and 1909.
Crater Lake outlet, 1906–1909.
North Fork at pipe intake, 1906–1909.
North Fork at ditch intake, 1906.
North Fork at the forks, 1907.
Gold Run below ditch intake, 1906–7.
Thompson Creek below ditch intake, 1906–1909.
Grand Central branch of Miocene ditch, 1907 and 1909.
Jett Creek branch of Miocene ditch, 1907 and 1909.

The daily discharge of four of the most important stations is given below, and a list of miscellaneous measurements made in the basin may be found on page 409. A table of monthly discharge of Grand Central River below the forks for 1906 to 1909 is given for comparative purposes.

Monthly discharge of Grand Central River below the forks for 1906 to 1909.

[Drainage area, 14.6 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1906.					
June 24-30	150	75	112	7.67	2.00
July	1,160	56	185	12.7	14.64
August	210	53	85.2	5.84	6.73
September	510	47	121	8.29	9.25
The period, 99 days	1,160	47	129	8.84	32.62
1907.					
July 8-31	220	74	133	9.11	8.13
August	463	72	142	9.73	11.22
September 1-23	770	55	174	11.9	10.18
The period, 78 days	770	55	149	10.2	29.53
1908.					
July	180	29	62.7	4.29	4.95
August	225	71	123	8.42	9.71
September	146	33	52.6	3.60	4.02
The period, 92 days	225	33	79.6	5.46	18.68
1909.					
July	200	37	101	6.92	7.98
August	122	36	53	3.63	4.18
September 1-21	36	28	31.9	2.18	1.70
The period, 83 days	200	28	65.8	4.51	13.86

NOTE.—Discharges for 1906 have been revised and missing periods estimated; for 1907 they are the combined dicharges at the stations on West and North forks.

Daily discharge, in second-feet, of Grand Central River and tributaries for 1909.

Day.	Grand Central River below the forks. Elevation, 680 feet; drainage area, 14.6 square miles.			West Fork of Grand Central River at the forks. Elevation, 690 feet; drainage area, 7.7 square miles.			Crater Lake outlet. Elevation, 925 feet; drainage area, 1.8 square miles.			Thompson Creek below ditch intake. Elevation, 720 feet; drainage area, 2.5 square miles.		
	July.	Aug.	Sept.	July.	Aug.	Sept.	July.	Aug.	Sept.	July.	Aug.	Sept.
1	200	41	34	122	25	19.0	24	4.6	2.7	36	5.5	4.0
2	195	44	33	118	28	19.0	23	5.2	2.4	36	7.6	3.7
3	195	55	32	118	36	18.1	23	7.5	2.3	36	9.9	3.6
4	185	65	33	112	39	19.0	22	6.5	2.2	34	14.5	3.5
5	175	58	36	106	33	20	22	5.5	2.8	32	8.5	4.0
6	180	46	35	110	31	19.0	22	7.5	3.0	34	7.4	3.5
7	170	42	35	107	28	19.0	22	5.7	2.7	32	6.2	3.2
8	160	40	34	104	25	18.1	21	4.6	2.5	30	6.2	2.8
9	145	122	32	101	50	18.1	21	10.4	2.4	28	21	2.8
10	134	97	31	98	60	18.1	20.9	10.2	2.3	27	16	2.8
11	123	70	31	94	39	17.2	20.0	10.0	2.3	57	10.8	2.8
12	116	57	30	90	31	17.2	19.2	9.0	2.2	21	8.5	2.9
13	110	63	32	81	37	18.1	17.0	10.4	2.3	15	9.9	3.0
14	88	71	32	72	34	17.2	12.2	10.6	2.2	7.1	13.0	3.0
15	75	64	32	60	33	17	11.1	9.3	2.2	14	12.2	2.8
16	64	57	31	52	31	16	10.0	7.2	2.1	15	11.5	2.7
17	62	54	31	50	30	16	10.0	6.8	2.0	15.8	10.8	2.6
18	71	52	30	50	29	16	10.4	6.5	2.0	25	10.0	2.5
19	74	50	29	50	28	15	11.6	6.1	1.9	21	9.3	2.4
20	72	48	29	50	28	15	10.8	5.8	1.8	15.8	8.5	2.3
21	62	47	28	46	27	14.5	8.3	5.6	1.6	13.3	7.8	2.3
22	60	45	......	41	26	......	8.3	5.3	......	12.0	7.0	......
23	60	43	......	36	26	......	8.2	5.0	......	11.4	6.2	......
24	51	42	......	31	25	......	6.2	4.7	......	7.1	5.5	......
25	50	40	......	33	24	......	5.6	4.5	......	10.8	4.8	......
26	49	40	......	31	24	......	5.0	4.5	......	10.0	4.0	......
27	48	36	......	31	21	......	5.0	3.5	......	8.5	3.8	......
28	50	36	......	28	20	......	5.0	3.0	......	7.1	3.5	......
29	43	38	......	30	20	......	5.5	3.0	......	7.6	3.5	......
30	41	42	......	28	22	......	5.0	3.5	......	7.0	4.5	......
31	37	39	......	27	20	......	4.2	3.0	......	6.2	4.2	......
Mean	101	53.0	31.9	68.0	30.0	17.5	13.5	6.29	2.28	20.4	8.45	3.01
Run-off per square mile	6.92	3.63	2.18	8.83	3.90	2.27	7.50	3.49	1.27	8.16	3.38	1.20
Run-off (depth in inches on drainage area)	7.98	4.18	1.70	10.18	4.50	1.77	8.65	4.02	.99	9.41	3.90	.94

NOTE.—The rating tables used in computing these daily discharges are all well defined. There were no gage readings before July 10, from August 18 to 31, and from September 15 to 20, and discharges for these periods have been estimated, largely on the basis of the rate of rise and fall of Kruzgamepa River at Salmon Lake. Records for the low-water periods are believed to be very reliable, but for the first half of July they are only approximate on account of diurnal fluctuations.

KRUZGAMEPA RIVER DRAINAGE BASIN.

Kruzgamepa or Pilgrim River rises in Salmon Lake and, after traversing a valley filled with glacial débris, flows around the east end of the Kigluaik Mountains and through broad flats to Imuruk Basin. Its principal tributaries are Iron and Sherrette creeks from the south; Crater, Big, and Homestake creeks from the southern slope of the Kigluaik Mountains; and Goldengate, Pass, Smith, Grand Union, Osborn, Westend, and several unnamed creeks from the northern slope of the mountains. The Kruzgamepa and its tributaries offer excellent opportunities for power development. Salmon Lake has an area of 1,865 acres and a good dam site at its outlet and offers good facilities for storing the spring flood waters for use later in the season. The streams on the north side of the mountains have a prodigious fall, amounting in places to over 1,000 feet in 2 or 3 miles, and the amount of power which they can be made to furnish is very great. Records of stream discharge in the basin have been kept largely to obtain data on power available, as mining is confined almost wholly to Iron Creek and its tributaries.

The following gaging stations have been maintained on Kruzgamepa River and its tributaries:

Kruzgamepa River at Salmon Lake, 1906–1909.
Kruzgamepa River above Iron Creek, 1908.
Dome Creek below Telegram Creek, August 1 to 17, 1907.
Iron Creek below Canyon Creek, August 1 to 17, 1907.
Iron Creek near mouth, 1908-1909.
Pass Creek below lower lake, parts of 1908 and 1909.
Smith Creek below Swift Creek, parts of 1908 and 1909.

For Kruzgamepa River at Salmon Lake the total run-off is sought as the spring flood water can be stored and held until later in the season. The discharge at the station for the periods not covered by observation has been estimated on the basis of the best available data and the yearly values are given below. They are believed to be sufficiently accurate for general comparative purposes.

Monthly discharge of Kruzgamepa River at Salmon Lake for 1906 to 1909.

[Drainage area, 84 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1906.						
January			80	0.95	1.10	4,920
February			60	.71	.74	3,330
March			50	.60	.69	3,070
April			50	.60	.67	2,980
May	3,450	50	888	10.6	12.22	54,600
June	3,360	308	1,110	13.2	14.73	66,000
July	2,130	235	575	6.85	7.90	35,400
August	475	175	266	3.17	3.66	16,400
September	1,460	175	466	5.55	6.19	27,700
October	390		210	2.50	2.88	12,900
November			110	1.31	1.46	6,540
December			90	1.07	1.23	5,530
The year	3,360		330	3.92	53.47	239,000
1907.						
January			70	.83	.96	4,300
February			60	.71	.74	3,330
March			50	.60	.69	3,070
April			40	.48	.54	2,380
May	2,500	40	507	6.04	6.96	31,200
June	2,600	935	1,870	22.3	24.88	111,000
July	875	295	555	6.61	7.62	34,100
August	555	229	347	4.13	4.76	21,300
September	1,560	217	489	5.82	6.49	29,100
October	205		150	1.79	2.06	9,220
November			90	1.07	1.19	5,360
December			70	.83	.96	4,300
The year	2,600		358	4.27	57.85	259,000
1908.						
January			60	.71	.82	3,690
February			50	.60	.65	2,880
March			50	.60	.69	3,070
April			40	.48	.54	2,380
May	1,100	40	413	4.92	5.67	25,400
June	1,100	395	732	8.71	9.72	43,600
July	375	92	188	2.24	2.58	11,600
August	465	210	299	3.56	4.10	18,400
September	210	92	161	1.92	2.14	9,580
October	103	72	80.0	.95	1.10	4,920
November	70	67	68.1	.81	.90	4,050
December	67		65	.77	.89	4,000
The year	1.100		184	2.19	29.80	134,000
1909.						
January			60	.71	.82	3,690
February			50	.60	.62	2,780
March			40	.48	.55	2,460
April			40	.48	.54	2,380
May	1,100	40	348	4.14	4.77	21,400
June	1,000	590	874	10.4	11.60	52,000
July	674	125	349	4.15	4.78	21,500
August	184	113	149	1.77	2.04	9,160
September	123	91	108	1.29	1.44	6,430
October	87	52	70.0	.83	.96	4,300
November	71	53	60.6	.72	.80	3,610
December	53		50	.60	.69	3,070
The year	1,100		183	2.18	29.61	133,000

NOTE.—Yearly values for 1906 and 1909 are believed to be within 10 or 15 per cent of the true values as only 30 and 25 per cent respectively of the totals have been estimated. Yearly values for 1907 and 1908 are liable to greater error, as over 50 per cent of the totals had to be estimated. The time when the river broke each year is known within a few days, and the maximum flood can be approximated. Values for February to April are uncertain, but they have little bearing on the yearly totals.

Daily discharge, in second-feet, of Kruzgamepa River and Iron Creek for 1909.

Day.	Kruzgamepa River at Salmon Lake.[a] Elevation, 442 feet; drainage area, 84 square miles.								Iron Creek above tunnel.[b] Elevation, 280 feet; drainage area, 50 square miles.			
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	June.	July.	Aug.	Sept.
1	......	1,000	674	127	123	87	71	53	......	194	19	19
2	......	980	656	125	117	87	68	52	......	129	19	17
3	......	980	650	117	115	84	67	52	......	149	24	18
4	......	917	614	130	113	82	65	52	......	138	30	17
5	......	938	579	134	119	81	64	52	......	123	24	17
6	......	910	590	139	119	79	64	52	......	122	23	16
7	......	966	568	127	117	77	63	51	......	121	25	17
8	......	924	530	113	115	77	63	51	......	94	22	17
9	......	896	491	121	111	79	61	51	......	89	50	17
10	......	903	475	184	111	65	63	51	......	83	50	17
11	......	910	430	179	111	64	63	51	......	84	36	17
12	......	917	412	173	111	64	64	51	......	66	34	18
13	......	924	385	173	111	64	64	51	......	63	42	25
14	......	931	340	170	111	63	63	51	......	50	37	23
15	......	917	296	173	107	64	61	51	......	45	29	23
16	......	924	272	153	107	64	61	51	1,160	40	29	23
17	......	931	255	156	101	57	60	51	516	35	28	28
18	......	966	235	160	96	60	60	......	509	32	27	25
19	......	938	226	158	94	57	60	......	514	28	26	20
20	100	924	226	160	96	57	60	......	418	24	26	21
21	300	875	198	156	101	57	57	......	283	24	27	19
22	500	840	187	150	105	55	57	......	347	23	26	18
23	700	833	168	143	113	52	56	......	240	26	25	......
24	900	875	160	139	105	55	56	......	162	24	27	......
25	1,100	784	163	134	103	64	55	......	153	23	26	......
26	1,100	650	160	132	100	71	55	......	181	23	22	......
27	1,100	590	160	121	98	79	55	......	223	27	23	......
28	1,100	590	150	121	96	87	54	......	311	26	20	......
29	1,000	758	136	127	92	87	54	......	641	24	23	......
30	1,000	710	127	139	91	79	53	......	180	20	19	......
31	1,000	......	125	130	......	71	......	......	......	22	19	......
Mean	825	873	343	144	107	70.0	60.6	51.4	389	63.6	27.6	19.6
Mean per square mile	9.82	10.4	4.08	1.71	1.27	.833	.721	.612	7.78	1.27	.552	.392
Run-off (depth in inches on drainage area)	4.38	11.60	4.70	1.97	1.42	.96	.80	.39	4.34	1.46	.64	.32

[a] Discharges are based on a defined rating curve; those up to June 2 are uncertain, as the gage was covered with snow and the maximum was estimated from a high-water mark. The river began to break up about May 20; the water had been flowing over the ice for a few days previous. The river became blocked with ice December 18, and the discharge probably continued to diminish gradually.

[b] Discharges for June 16 to July 14 were found by adding the discharge of Iron Creek at the railroad bridge near its mouth and that of the Iron Creek tunnel flume; from July 15 to 19 they are interpolated. Beginning July 20 records were obtained above the tunnel. Discharges for the latter station were obtained by the indirect method for shifting channels. For the other two stations a well-defined rating curve was obtained.

Daily discharge, in second-feet, of Smith and Pass creeks for 1908 and 1909.

Day.	Smith Creek below Swift Creek. Elevation, about 960 feet.					Pass Creek below lower lake. Elevation, 1,010 feet.				
	1908.		1909.			1908.		1909.		
	July.	Aug.	July.	Aug.	Sept.	July.	Aug.	July.	Aug.	Sept.
1	....	77	....	20	28	....	60	....	10	17
2	....	64	....	24	24	....	39	....	15	15
3	....	64	....	32	20	....	22	....	20	13
4	....	77	....	48	20	....	33	....	32	13
5	....	124	....	42	37	....	101	....	29	15
6	....	108	....	37	32	....	53	....	26	15
7	....	64	....	32	32	....	39	....	21	15
8	....	51	....	28	24	....	33	....	17	15
9	....	48	....	231	23	....	31	....	41	15
10	27	48	....	140	22	22	31	....	38	14
11	58	48	....	120	22	30	31	....	34	14
12	80	140	....	104	20	38	76	....	30	13
13	36	92	....	88	19	28	46	....	32	13
14	36	64	....	56	18	26	28	....	34	12
15	36	77	....	48	18	26	39	....	30	12
16	34	64	....	37	16	25	33	....	26	11
17	35	51	....	32	14	25	28	....	22	10
18	36	40	....	34	9.4	22	30	....	21	8
19	38	....	....	34	....	22	....	....	20	7.7
20	47	....	....	32	....	22	....	....	20	....
21	36	....	....	32	....	20	....	....	20	....
22	27	....	....	34	....	18	....	....	20	....
23	27	....	28	28	....	18	....	....	19	....
24	19	....	26	24	....	12	....	17	18	....
25	19	....	25	20	....	14	....	16	15	....
26	23	....	25	18	....	13	....	15	15	....
27	16	....	24	18	....	13	....	14	16	....
28	16	....	23	28	....	13	....	13	16	....
29	16	....	22	48	....	13	....	12	22	....
30	171	....	21	48	....	101	....	11	28	....
31	137	....	20	32	....	101	....	10	25	....
Mean	44.1	72.3	23.8	50.0	22.1	28.3	41.8	10.8	23.6	13.0

NOTE.—Discharges for both stations are somewhat uncertain, owing to poor measuring conditions and lack of measurements except at low stages. Those for July 11 to 19, 1908, July 24 to 30, 1909, and shorter periods at other times have been estimated with the aid of a hydrograph.

CENTRAL SEWARD PENINSULA

DESCRIPTION.

The central portion of Seward Peninsula, lying north of the Kigluaik and Bendeleben mountains, shows two types of topography—(1) a lowland area 10 to 15 miles wide, lying at the foot of the mountains, and (2) an upland, with flat-topped ridges rising to an elevation of 1,000 to 1,600 feet, representing a former level of erosion. Several mountain masses rise above the level of the plateau, notably Kougarok, Midnight, and Baldy mountains. The streams have cut their channels deep into this plateau, and one or more levels of benches can usually be traced above the present streams. The principal streams are Kuzitrin River and its tributaries Kougarok and Noxapaga rivers.

This region is an area of low precipitation, especially in the early summer, and as there is no unfrozen ground the discharge is very small at low water.

Investigations of flow were made of the following streams and their tributaries in central Seward Peninsula in 1909

Kuzitrin River.
Kougarok River.
Noxapaga River (miscellaneous measurements only).

KUZITRIN RIVER DRAINAGE BASIN.

Kuzitrin River is formed by the junction of North and South forks, which rise in the lava beds in the central portion of Seward Peninsula. Below their junction the river crosses the Kuzitrin Flats, a lowland area 20 miles long and averaging over 10 miles in width, lying north of the Bendeleben Mountains. The valley narrows to less than half a mile just above Lanes Landing, but widens as the river enters the lowland lying around Imuruk Basin. In the lower 10 miles of its course the Kuzitrin mingles its waters with those of the Kruzgamepa in an intricate network of channels and sloughs. The principal tributaries are Minnie, Ella, Bonanza, Birch, and Belt creeks from the Bendeleben Mountains on the south and Noxapaga River, Garfield Creek, and Kougarok River from the plateau region to the north.

One gaging station has been maintained on Kuzitrin River for comparative purposes, that at Lanes Landing, 1908 and 1909.

Daily discharge, in second-feet, of Kuzitrin River at Lanes Landing for 1908 and 1909.

[Elevation, 40 feet; drainage area, 1,750 square miles.]

Day.	1908.				1909.				
	June.	July.	Aug.	Sept.	May.	June.	July.	Aug.	Sept.
1	6,000	830	1,040	448		6,120	1,930	235	285
2	6,000	745	802	474		7,200	1,460	235	285
3	6,020	628	722	448		6,660	1,400	235	285
4	6,620	590	425	474		6,300	1,200	257	285
5	6,280	665	722	500		5,490	1,200	325	317
6	6,960	465	1,140	448		5,760	1,240	325	325
7	6,440	440	1,240	474		5,220	1,430	305	305
8	5,000	365	1,190	474		4,260	976	305	293
9	4,490	365	895	424		3,920	905	334	293
10	3,980	365	850	424		4,180	855	505	285
11	3,810	360	590	400		4,780	718	955	278
12	3,900	380	560	378		5,490	692	836	285
13	3,900	420	560	357		5,310	587	675	285
14	3,810	410	560	378		4,950	535	535	293
15	3,810	400	500	357		5,080	487	475	348
16	3,900	357	474	357		5,220	464	410	361
17	3,230	357	448	424		5,440	431	361	380
18	3,150	357	448	530		5,150	410	334	395
19	2,910	357	357	560	4,000	4,520	380	317	380
20	2,670	336	424	530	5,000	3,760	370	293	361
21	1,640	315	400	500	6,000	3,760	348	285	334
22	1,510	336	400	448	7,000	3,420	325	285	325
23	1,280	315	400	448	8,000	2,670	317	285	305
24	1,450	336	448	378	8,100	2,320	305	268	305
25	1,510	296	474	337	7,200	1,930	293	268	305
26	1,570	296	474	280	6,480	1,500	268	268	305
27	1,450	278	448		5,940	1,430	268	268	285
28	1,280	278	424		5,670	1,720	257	268	285
29	1,060	262	400		5,490	1,990	250	268	278
30	875	278	400		5,670	2,320	250	268	257
31		722	400		6,120		250	268	
Mean	3,550	416	600	433	6,210	4,260	671	363	310
Mean per square mile	2.03	.238	.343	.247	3.55	2.43	.383	.207	.177
Run-off (depth in inches on drainage area)	2.26	.27	.40	.24	1.72	2.71	.44	.24	.20

NOTE.—Discharges for both years are based on well-defined rating curves Those for June 1 to 2, 1908, and May 19 to 23, 1909, are estimated on account of backwater. Some days after this may have been slightly affected. Values for 1908 are based on additional data and supersede those published in Bulletin 379, page 386.

KOUGAROK RIVER DRAINAGE 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, 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, and its tributaries, Coffee, Dahl, Checkers, Carrie, and Independence creeks, have been among the most important gold producers of the region, but have a very small run-off except at times of heavy rain.

Several ditches have been built to divert the water of the river and its tributaries for hydraulicking. The largest are the Homestake ditch, on the upper Kougarok; the North Star and Cascade ditches, on Taylor Creek; and the Henry Creek and Coarse Gold Creek ditches. There are smaller ditches on Arizona Creek, North Fork, and Windy Creek.

The following gaging stations have been maintained on Kougarok River and the tributaries:

Kougarok River at Homestake intake and Homestake ditch at intake, 1907–1909.
Kougarok River below Henry Creek, 1909.
Kougarok River above Coarse Gold Creek, 1907–8 and June and July, 1909.
Taylor Creek at Cascade intake, 1907.
Henry Creek at mouth, 1908–9.
North Fork above Eureka Creek, 1908–9.
Homestake ditch above penstock, August and September, 1907.
North Star ditch above siphon, August and September, 1907.

The monthly discharge of Kougarok River above the Homestake intake for 1907 to 1909 is given for purposes of comparison:

Monthly discharge of Kougarok River above Homestake intake for 1907 to 1909.

[Drainage area, 44 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1907.					
July 15-31	29	6.3	12.4	0.282	0.18
August	110	3.2	22.8	.518	.60
September 1-20	351	26	79.1	1.80	1.34
The period, 68 days	351	3.2	36.8	.836	2.12
1908.					
June 27-30	50	32	39.9	.907	.13
July	18.7	2.7	5.72	.130	.15
August	13.9	2.0	5.51	.125	.14
September 1-10	19.9	1.2	10.2	.232	.09
The period, 76 days	50	1.2	8.01	.182	.51
1909.					
June 20-30	150	36	65.1	1.48	.61
July	45	2.9	9.47	.215	.24
August	112	2.9	12.2	.277	.32
September 1-16	12.9	2.9	5.57	.127	.08
The period, 89 days	150	2.9	16.6	.377	1.25

NOTE.—Discharges for June 20 to July 8, 1909, have been estimated from the records at other stations in order to complete the season.

Daily discharge, in second-feet, of Kougarok River and tributaries for 1909.

Day.	Kougarok River above Homestake intake.[a] Elevation, 635 feet; drainage area, 44 square miles.			Kougarok River below Henry Creek.[b] Elevation, 410 feet; drainage area, 225 square miles.			Henry Creek at mouth.[c] Elevation, 410 feet; drainage area, 51 square miles.				North Fork above Eureka Creek.[d] Elevation, 370 feet; drainage area, 66 square miles.			
	July.	Aug.	Sept.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1	......	2.9	9.2	125	9	24	......	46	2.2	3.0	......	21	8.4	9.5
2	......	2.9	12.9	130	9	33	......	38	2.2	3.0	......	17.1	8.4	9.5
3	......	2.9	9.0	91	9	32	......	30	3.0	3.0	......	17.7	8.6	9.5
4	......	40	6.2	111	18	27	......	33	7.9	2.8	......	15.9	8.6	9.5
5	......	16.0	6.6	91	48	20	......	27	9.3	2.8	......	14.6	8.4	9.7
6	......	6.5	5.3	84	27	24	......	27	5.5	3.0	......	13.4	8.4	9.5
7	......	2.9	3.2	76	20	18	......	19.8	3.6	2.6	......	12.5	8.4	9.2
8	......	2.9	3.0	56	12	17	......	15.0	2.8	2.2	......	11.9	8.6	9.2
9	10.7	112	2.9	53	40	17	......	18.2	19.8	2.2	......	11.4	9.9	9.0
10	7.7	61	2.9	66	113	17	......	16.6	31	2.2	......	12.2	47	9.0
11	7.0	26	3.0	49	83	16	......	13.9	17.4	2.0	......	11.4	78	9.0
12	6.0	12.7	3.1	44	35	16	......	12.7	12.7	1.7	......	11.4	15.4	9.0
13	5.0	7.8	3.2	36	33	14	......	9.0	7.9	1.7	......	10.8	14.5	8.8
14	5.0	6.2	3.3	26	28	21	......	8.6	5.8	3.0	......	9.8	13.2	......
15	5.0	4.8	7.9	26	18	54	......	7.9	4.7	3.6	......	9.8	11.9	......
16	4.0	4.8	7.5	21	16	61	......	5.8	4.1	3.6	......	9.4	11.3	......
17	4.0	4.8	......	17	16	47	......	5.8	3.6	3.3	......	9.4	11.3	......
18	4.0	4.8	......	17	14	49	......	5.8	3.0	3.0	......	9.4	10.8	......
19	4.0	3.9	......	16	13	......	......	5.5	2.6	......	......	9.3	10.6	......
20	3.5	3.9	......	14	10	......	......	5.2	2.6	......	120	9.2	10.2	......
21	3.5	3.9	......	10	8	......	188	4.4	2.4	......	115	9.1	10.4	......
22	3.5	3.9	......	9	8	......	109	3.8	2.2	......	55	9.0	9.9	......
23	3.4	3.9	......	10	7	......	84	4.4	2.2	......	36	9.0	9.5	......
24	2.9	3.9	......	10	7	......	59	4.4	2.0	......	32	8.8	9.2	......
25	2.9	3.9	......	9	7	......	46	3.0	2.0	......	25	9.0	9.2	......
26	2.9	3.9	......	8	6	......	46	2.6	1.7	......	24	9.0	9.2	......
27	2.9	3.9	......	8	7	......	52	3.0	1.7	......	24	9.0	9.2	......
28	2.9	3.9	......	9	7	......	56	3.0	1.7	......	24	8.8	9.7	......
29	2.9	5.7	......	9	10	......	46	2.6	2.2	......	25	8.6	9.7	......
30	2.9	5.7	......	9	16	......	46	2.6	2.8	......	21	8.4	9.5	......
31	2.9	5.7	......	9	21	......	......	2.4	2.6	......	......	8.4	9.2	......
Mean	4.32	12.2	5.57	40.3	21.8	28.2	73.2	12.5	5.65	2.71	45.5	11.1	13.4	9.26
Mean per square mile	.098	.277	.127	.179	.097	.125	1.44	.245	.111	.053	.690	.168	.203	.140
Run-off (depth in inches on drainage area)	.08	.32	.08	.21	.11	.08	.54	.28	.13	.04	.28	.19	.23	.07

[a] These discharges are the sums of those at the stations on Kougarok River below the intake and of the ditch. On account of changes in channel and lack of measurements they are liable to error, especially during the latter part of August. The water was turned into the ditch for only nineteen days.

[b] These discharges are not of the best; the rating curve used up to July 28 is based on float measurements at the higher stages. From July 29 to August 13 the gage was affected by backwater from a small mining dam. The gage was reset August 14; the curve used after that date is well defined above 15 second-feet, but uncertain below.

[c] Discharges for Henry Creek are based on a well-defined rating curve and are believed to be thoroughly reliable.

[d] Discharges for North Fork are from gage readings at two points; the first gage was affected by backwater after July 18 and was moved upstream July 22; the values for July 19 to 21 are estimated. The rating curves are fairly well defined.

FAIRHAVEN PRECINCT.

DESCRIPTION.

The Fairhaven precinct comprises all of Seward Peninsula that drains northward into Kotzebue Sound, except the flat area near Devil Mountain, west of Goodhope Bay. It is an area of relatively low relief, none of the mountains having an elevation of more than half a mile. There is no dominant mountain range like the Kigluaik and Bendeleben mountains to the south. The principal rivers, in order from west to east, are the Goodhope, Immachuk, Kugruk, Kiwalik, and Buckland. The southwestern portion of the precinct, together with parts of the adjacent Kougarok and Koyuk precincts, is covered with a recent lava flow, which has caused a considerable readjustment of drainage. The most notable effect of this flow is the formation of Imuruk Lake, the largest body of fresh water in Seward Peninsula. An area of older eruptive rocks east of Kiwalik River forms a rugged, dissected mass which reaches an altitude of 2,000 to 2,500 feet. In general the country is underlain by frozen muck and ground ice, in some places to a depth of 30 or 40 feet or more.

The climatic and other conditions affecting the run-off from the Fairhaven precinct are very similar to those prevailing in the Kougarok region. The run-off during the summer comes mostly from the rain, aided somewhat by melting snow and ice, ground water, and springs. The rainfall is relatively small, even in a rainy season, and runs off quickly. Most of the streams have a large drainage area, however, and in a wet season yield a good volume of water.

There are springs in limestone on Glacier Creek, in the Kiwalik River basin, and on the upper Inmachuk, and in the lava on Kugruk, Pinnell, and Goodhope rivers. These springs give the streams a steady flow during the summer, and the melting of the ice banks formed by their overflows during the winter yields a large amount of water during the early part of the open season.

Investigations of flow were made of the following streams and their tributaries in 1909:

Goodhope River.
Inmachuk River.
Kugruk River.
Kiwalik River.

GOODHOPE RIVER DRAINAGE BASIN.

Goodhope River is formed by the junction of Right Fork and Cottonwood Creek and flows in a general northwesterly course to Goodhope Bay. Right Fork, the true source of the river, rises in the lava near Imuruk Lake, the source of Kugruk River, and flows through most of its course in a rather narrow canyon, in places 600 feet deep. There are springs in the lava which contribute a large portion of the low-water flow of the river. Cottonwood and Eagle creeks enter from the east and Esperanza, Placer, and Humboldt creeks from the west and south. The larger portions of the basins of these tributaries lie outside the area of lava.

Esperanza Creek is the only tributary on which any systematic mining has been done. Gold in paying quantity was discovered in

1908 and the creek was worked in 1909 as far as the scanty supply of water permitted.

A gaging station was maintained during the season of 1909 below the mouth of Esperanza Creek, to determine the discharge available for diversion at points above for use on Esperanza Creek.

Daily discharge, in second-feet, of Goodhope River below Esperanza Creek for 1909.

[Drainage area, 194 square miles.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	....	63	20	14.0	20	....	26	15.0	14.0
2	....	63	21	14.0	21	....	24	17.0	12.5
3	....	72	17.5	13.5	22	....	23	17.5	13.0
4	....	63	26	13.0	23	....	26	17.0	18.0
5	....	63	25	13.0	24	91	26	17.0	13.0
					25	72	22	15.0	12.5
6	....	58	23	13.0					
7	....	68	18.0	13.0	26	72	21	13.0	12.1
8	....	54	20	12.5	27	81	20	15.0	....
9	....	41	22	12.5	28	91	18.0	15.0	....
10	....	58	30	12.1	29	72	17.5	15.0	....
					30	58	18.0	14.0	....
11	....	58	34	12.1	31	....	22	16.0	....
12	....	50	26	11.7					
13	....	41	24	10.4	Mean	76.7	39.0	19.7	13.4
14	....	37	22	12.5	Mean per square mile	.395	.201	.102	.069
15	....	34	22	15.0					
16	....	34	20	17.5	Run-off (depth in inches on drainage area)	.10	.23	.12	.07
17	....	30	18.0	18.0					
18	....	34	17.5	16.5					
19	....	30	17.5	15.0					

NOTE.—These discharges are based on a well-defined rating curve. There may be some seepage through the gravel, but the amount is probably not large.

INMACHUK RIVER DRAINAGE BASIN.

Inmachuk River rises against the head of Trail Creek, a tributary of the Goodhope, flows northwestward, and empties into Kotzebue Sound at Deering. Its principal tributaries are Hannum Creek, from the northwest, and Pinnell River, from the south, each of which has a larger drainage area than the main stream above the junction. Arizona, Fink, Washington, West, Cue, and Mystic creeks are small tributaries below the mouth of Pinnell River.

Hannum Creek occupies a deep and rather narrow valley. Its principal tributaries are Cunningham, Milroy, and Collins creeks. Pinnell River rises in a broad, flat swamp, or "goose pasture," formed by the lava flow. About 6 or 8 miles from its source the river has cut down through the lava, forming a deep, narrow canyon, in which it drops 250 to 300 feet in about half a mile. Its principal tributaries are Magnet, June, Perry, and Old Glory creeks and Snow Gulch.

A striking feature of the Inmachuk Valley is the lava rim which extends down the Pinnell from the canyon, following the left side of the valley for several miles, then crossing to the right side and extending down the Inmachuk to the coastal plain and up Hannum

Creek nearly to its head. Its elevation is generally 300 to 400 feet above the stream.

A limestone spring issuing from the hillside about 3 miles above Hannum Creek furnishes the only well-sustained water supply available for hydraulicking to be found in the basin. A ditch to divert this water for mining was begun in 1909. Two other short ditches receive their supply from tributaries of the Inmachuk, one from Hannum Creek below Cunningham Creek and one from a spring near the head of Old Glory Creek. The Fairhaven ditch brings water from Imuruk Lake at the head of Kugruk River for use on mining claims on the Inmachuk.

A gaging station was maintained on Inmachuk River below Logan Gulch during the summer of 1909.

Daily discharge, in second-feet, of Inmachuk River below Logan Gulch for 1909.

[Elevation, 130 feet; drainage area, 145 square miles.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		72	18	22	21		31	19	
2		74	16	22	22		34	19	
3		68	16	22	23		34	30	
4		70	15	22	24		22	26	
5		68	34	22	25		18	24	
6		66	25	22	26	93	16	19	
7		58	32	22	27	93	15	19	
8		50	23	22	28	82	13	24	
9		77	35	24	29	80	14	19	
10		65	48	24	30	74	15	22	
11		56	44	22	31		17	22	
12		70	24	22	Mean	84.4	43.9	24.2	22.4
13		56	30	22					
14		47	27	24	Mean per square mile	.582	.303	.167	.154
15		48	24	24					
16		42	24	22	Run-off (depth in inches on drainage area).	.11	.35	.19	.11
17		43	22	22					
18		34	19	24					
19		37	19	22					
20		32	15	19					

NOTE.—Water was wasted into Logan Gulch from the Fairhaven ditch in amounts varying from 0.5 to 6 or 8 second-feet and averaging, roughly, 2 second-feet; this water is included in the discharges given above. This water carried a large amount of sediment, which filled up the channel near the gage to such an extent that discharges up to August 10 were obtained by the indirect method for shifting channels and are only approximate. The gage used after August 12 was not materially affected and the results obtained are good.

FAIRHAVEN DITCH.

The Fairhaven ditch takes water from Imuruk Lake, which lies at an elevation of about 960 feet above sea level and is the source of Kugruk River. A dam 500 feet long and 5 feet high has been built to form a storage reservoir, and this will hold the total inflow at the lake for two years if necessary. The ditch is in three sections. The upper section, 17 miles long, lies on top of the lava and extends from the lake around the head of Wade Creek to a point near the Pinnell River divide, where the water is dropped into a channel emptying into Wade Creek. It is diverted from this channel into

Pinnell River by the middle section of the ditch, which is 850 yards long. The water runs about 6½ miles between the upper and lower ditches and the drop is estimated at 150 feet. The lower section of the ditch extends from the intake on Pinnell River along the left side of the valley to a point a few hundred feet below Logan Gulch, a small tributary of the Inmachuk above Arizona Creek, and has a length of about 19 miles, making a total of 36½ miles of ditch.

Practically the whole of the upper ditch and at least three-fourths of the lower ditch, including all the upper 6 or 8 miles, is built in frozen muck with only a small percentage of solid matter. Along the upper ditch lava bowlders are present in the muck from the surface to bed rock. At some places the material encountered was composed of angular fragments of lava with little soil between them. Above and below Snow Gulch, the lowest tributary of Pinnell River which the ditch crosses, there are short pieces of rock work.

The ditch was built under contract; construction was begun early in 1906 and was completed in July, 1907. Water was run through the ditch for a short time in September, 1907, from July 1 to September 21, 1908, and from June 14 to September 21, 1909, except when it was turned out on account of breaks. The ultimate capacity of the ditch when some low parts of the bank are raised will be about 100 second-feet. The pressure-pipe leading from the penstock below Logan Gulch to the mine has a total length of 10,600 feet, and gives a total head on bed rock of 530 feet.

Measurements were made of the ditch in 1908 to determine its discharge and the loss by seepage, which was shown to be very small. In 1909 three regular gaging stations were maintained on the ditch for the whole or part of the season, located at the intake and Camp 2, of the upper section, and at Snow Gulch, about 5 miles above the outlet.

Daily discharge, in second-feet, of Fairhaven ditch for 1909.

Day.	At intake of upper ditch.[a]			At Camp 2 of upper ditch.[b]		At Snow Gulch.[c]			
	July.	Aug.	Sept.	July.	Aug.	June.	July.	Aug.	Sept.
1	....	40.0	50.6	....	43.0	....	25.1	37.9	35.8
2	....	46.0	46.0	....	46.2	....	24.9	40.0	37.2
3	....	50.6	50.6	....	[d] 42.3	....	23.9	37.9	32.2
4	....	54.9	50.6	....	46.2	....	26.4	36.5	32.8
5	....	52.8	50.6	....	45.6	....	25.1	41.5	40.0
6	....	52.8	50.6	....	46.7	....	26.2	41.5	42.3
7	....	50.6	50.6	....	46.7	....	27.2	42.3	43.0
8	....	52.8	50.6	....	46.7	....	27.8	41.9	43.8
9	....	40.0	50.6	....	[d] 33.8	....	5.0	42.7	43.8
10	....	61.8	50.6	....	[d] 35.2	....	27.8	36.8	39.3

[a] These discharges are based on a rating curve which is well defined above 20 second-feet discharge.
[b] These discharges are based on several rating curves, as the ditch bed is constantly changing. Gage heights observed in September are of no value, as no measurements were made during the month.
[c] These discharges are based on a rating curve which is well defined above 18 second-feet discharge. Records at this point show practically the amount delivered at the penstocks, about 5 miles below, by ditch.
[d] Water turned out part of the day to make repairs on ditch.

Daily discharge, in second-feet, of Fairhaven ditch for 1909—Continued.

Day.	At intake of upper ditch.			At Camp 2 of upper ditch.		At Snow Gulch.			
	July.	Aug.	Sept.	July.	Aug.	June.	July.	Aug.	Sept.
11	....	52.8	48.6	....	45.6	....	27.2	36.2	32.2
12	....	48.6	48.6	....	46.7	....	29.2	41.9	44.6
13	....	57.0	54.9	30.8	41.5	....	29.2	42.3	43.0
14	31.9	57.0	50.6	30.3	*a* 38.0	22.8	29.7	41.1	45.7
15	28.3	44.0	61.8	*a* 23.3	*a* 29.2	0	30.3	31.6	42.3
16	36.1	44.0	57.0	33.2	0	22.8	26.7	23.2	33.4
17	36.1	46.0	50.6	33.2	0	18.8	30.3	14.4	38.6
18	40.0	52.8	50.6	34.2	*a* 32.6	17.7	30.9	11.6	43.0
19	44.0	52.8	54.9	39.2	21.8	18.4	34.5	19.5	42.3
20	46.0	48.6	54.9	42.3	27.3	21.0	37.2	0	41.5
21	46.0	44.0	....	43.3	29.7	18.8	39.3	25.1	43.0
22	46.0	44.0	....	43.3	*a* 30.3	16.4	39.0	27.8	....
23	44.0	50.6	....	*a* 24.8	42.3	15.0	40.0	32.2	....
24	9.7	50.6	....	7.2	*a* 37.0	13.1	17.2	40.8	....
25	9.7	50.6	....	0	44.4	12.0	13.7	41.5	....
26	0	48.6	....	0	45.5	14.5	10.0	40.0	....
27	13.3	48.6	....	11.8	*a* 41.6	18.2	3.0	41.5	....
28	30.1	48.6	....	26.9	*a* 41.6	20.2	0	37.2	....
29	40.0	50.6	....	38.0	*a* 46.5	21.4	26.7	37.2	....
30	30.1	50.6	....	35.0	46.5	23.7	34.8	41.5	....
31	38.0	50.6	....	39.0	*a* 42.5	....	36.5	42.3	....
Mean	31.6	49.8	51.7	28.2	37.4	17.[illegible]	26.0	34.4	40.0

a Water turned out part of the day to make repairs on ditch.

KUGRUK RIVER DRAINAGE BASIN.

Kugruk River rises in Imuruk Lake and flows northwestward for about 20 miles and thence northward for the remainder of its 60 miles of length, emptying into Kotzebue Sound near Deering. Imuruk Lake, with an area of 31 square miles and a drainage basin of 102 square miles, lies on top of the lava plateau in the central part of Seward Peninsula. About 4 miles below the lake the river has cut into the edge of the lava, forming a canyon about 300 feet deep and 1,000 feet wide at its deepest point. At the mouth of the canyon the river is about 500 feet below the level of the lake and is probably at about the elevation it had before the invasion of the lava flow. This canyon affords a favorable location for a plant to develop electric power. Water from the lake can be diverted through a ditch for about 4½ miles and then through a pipe line to the bottom of the canyon, developing a pressure of nearly 500 feet. Below the canyon the grade of the river is relatively flat. The principal tributaries in this section are Holtz, Mina, Montana, Reindeer, and Chicago creeks from the east and Ruby and Gold Bug creeks and Wade Creek, locally known as Burnt River, from the west. The Kugruk basin is relatively unimportant economically, as its gold production has been small. Chicago Creek is of interest on account of the coal mine which lies near its mouth.

The following gaging stations have been maintained in this basin:

Kugruk River below Fairhaven ditch intake, 1909.
Kugruk River below Reindeer Creek, 1909.
Chicago Creek at coal mine, August and September, 1908.

Daily discharge, in second-feet, of Kugruk River for 1909.

Day.	Below Fairhaven ditch intake.[a] Elevation, 960 feet; drainage area, 102 square miles.			Above Reindeer Creek.[b] Drainage area, 556 square miles.			
	July.	Aug.	Sept.	June.	July.	Aug.	Sept.
1		3.7	1.0		158	38	46
2		4.7	1.0		114	34	46
3		4.7	1.0		114	53	46
4		5.7	1.0		114	56	65
5		5.7	1.4		114	59	46
6		5.7	1.4		93	62	29
7		5.7	1.0		114	65	29
8		5.7	1.0		114	46	29
9		1.0	1.0		93	46	29
10		1.0	1.0		116	65	29
11		1.0	1.0		114	50	29
12		1.0	1.0		114	50	29
13		1.0	1.0		114	46	29
14	1.0	1.0	1.0		93	46	29
15	1.0	1.0	1.0		93	46	46
16	1.0	1.0	1.0		93	46	46
17	1.0	1.0	1.0		93	46	29
18	1.4	1.0	1.0		73	85	29
19	1.4	1.0	1.0		73	105	29
20	1.4	1.0	1.0		53	105	29
21	2.0	1.0			53	85	29
22	2.0	1.0			34	75	29
23	1.0	1.4			40	57	29
24	1.0	1.4			45	46	29
25	1.4	1.4			73	46	29
26	1.4	1.8			53	46	19
27	2.0	1.4			53	29	19
28	2.0	1.4		180	34	29	23
29	2.0	1.4		158	34	29	17
30	3.7	1.4		180	34	46	16
31	3.7	1.4			34	46	
Mean	1.69	2.21	1.04	173	82.1	543	31.9
Mean per square mile				.311	.148	.098	.057
Run-off (depth in inches on drainage area)				.03	.17	.11	.06

[a] These discharges represent merely the quantity of water wasted from the lake. They are only approximate, on account of the poor measuring conditions in the rocky stream bed.

[b] These discharges are based on two well-defined rating curves used up to and after August 4. The drainage area has been taken as including the Imuruk Lake basin. To obtain the natural flow from the area below the lake, deduct the discharge below the ditch intake and the water spilled from the ditch from the measured discharge at this station.

KIWALIK RIVER DRAINAGE BASIN.

Kiwalik River, the longest river on the north side of Seward Peninsula, rises in a low ridge which separates its drainage basin from that of the Koyuk and flows northward for nearly 70 miles to Kotzebue Sound, at Kiwalik. The river traverses a flat lowland area, several miles wide in places, which narrows a few miles above Candle to less than half a mile. Near its mouth the river widens into a lagoon.

The tributaries from the west drain rather narrow basins, roughly parallel and separated by long, low ridges. The principal streams from this side are Canoe Creek, Gold Run, and Glacier, Dome, Bonanza, Eldorado, Candle, and Minnehaha creeks. The largest tributaries from the east are Quartz and Hunter creeks, which rise in the mountainous mass separating the Kiwalik basin from that of Buckland River.

The Candle ditch, built in 1907, has its intake on Glacier Creek and extends for 33½ miles along the left side of Kiwalik River to John Bull Hill, opposite the mouth of Candle Creek. Of this length nearly 3 miles is made up of three siphons—2,250 feet of 28-inch pipe across Dome Creek, 912 feet of 30-inch pipe across Bonanza Creek, and the big 12,300-foot siphon across Eldorado and Burnside creeks, composed of equal lengths of 35½, 37½, and 39½ inch pipes. The lateral to Dome Creek consists of 3½ miles of 4-foot ditch, making a total of 37 miles. The ditch is 6 feet wide at the intake, increasing to 9 feet at the lower end. It has a capacity of 20 to 30 second-feet and an elevation at the penstock of 249 feet above Kiwalik River. An extension of the ditch to Gold Run will require about 8 miles of ditch and a siphon. The mining operations in 1908 and 1909 were confined to stripping the overburden from the bench on John Bull Hill. A line has been surveyed for a second ditch to Candle Creek which will take its water from Quartz and Hunter creeks. It will have its intakes on the forks of Quartz Creek about 2 miles above the junction, and the flow of Hunter Creek will be diverted by a lateral. The proposed system will require a total of about 65 miles of ditch and 14,000 feet of pipe and will give a pressure of 303 feet above the mouth of Candle Creek.

Mining in the basin has been mostly confined to Candle Creek and its tributaries, but in 1909 a little work was done on Glacier Creek and Gold Run.

The following gaging stations have been maintained in this basin:

Kiwalik River below Candle Creek, 1909.
Quartz Creek below the forks, 1909.
Glacier Creek above Candle ditch intake, 1908–9.
Dome Creek at siphon crossing, July, 1909.
Hunter Creek near proposed intake, 1908–9.

Monthly discharge of Glacier Creek above Candle ditch intake for 1908 and 1909.

[Drainage area, 10 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1908.					
July	14.0	2.0	4.67	0.467	0.54
August	4.0	1.7	2.15	.215	.25
September 1–20	8.2	1.9	3.35	.335	.25
The period, 82 days	14.0	1.7	3.40	.340	1.03
1909.					
June	76	6	35.3	3.53	3.94
July	7 0	2.3	3.01	.301	.35
August	5.0	1.5	2.13	.213	.25
September	1.8	1.3	1.43	.143	.16
The period, 122 days	76	1.3	10.6	1.06	4.70

Daily discharge, in second-feet, of Kiwalik River and tributaries for 1909.

Day.	Kiwalik River below Candle Creek.[a] Elevation, about 2 feet; drainage area, 800 square miles.			Quartz Creek below forks.[b] Elevation, 570 feet; drainage area, 56 square miles.			Glacier Creek above Candle ditch intake.[c] Elevation, 409 feet; drainage area, 10 square miles.				Dome Creek at siphon crossing.[d]	Hunter Creek near proposed intake.[e] Elevation, 500 feet; drainage area, 32 square miles.		
	July.	Aug.	Sept.	July.	Aug.	Sept.	June.	July.	Aug.	Sept.	July.	July.	Aug.	Sept.
1	239	41	47	80	8.8	14.1	50	7.0	2.2	1.6	4.2	14.0	2.5	3.3
2	254	39	47	80	8.0	13.0	60	5.7	2.2	1.6	4.4	14.0	2.5	3.3
3	217	36	45	70	8.2	12.5	64	3.8	2.2	1.6	3.6	13.0	2.9	3.0
4	207	38	47	55	11.4	11.4	60	3.0	2.5	1.6	2.9	12.9	5.5	3.0
5	147	39	47	45	19.9	11.1	60	3.0	3.0	1.6	2.8	12.9	7.5	3.0
6	130	47	52	199	15.2	10.8	60	2.9	2.4	1.6	2.7	12.9	5.8	2.8
7	298	48	54	150	14.6	10.4	50	2.8	2.4	1.5	2.6	11.6	5.0	2.8
8	275	63	47	100	13.6	10.1	35	2.9	2.4	1.5	2.5	12.0	4.4	2.8
9	208	80	45	70	36	9.8	25	3.0	3.5	1.5	2.3	16.6	10.4	2.6
10	175	51	45	120	242	9.8	20	3.3	5.0	1.5	2.2	14.3	18.7	2.6
11	238	362	45	110	96	9.5	36	3.2	4.0	1.5	1.7	12.0	13.8	2.5
12	225	409	57	100	79	9.5	52	3.1	3.0	1.5	1.7	11.2	10.4	2.4
13	188	286	62	85	61	9.5	63	2.9	2.9	1.6	1.5	9.7	8.5	2.6
14	169	212	67	75	44	13.6	68	2.8	2.0	1.7	1.3	8.1	6.9	3.6
15	172	165	50	80	26	16.8	63	2.9	1.8	1.8	1.1	7.5	6.4	4.2
16	126	137	47	70	25	14.6	76	2.8	1.6	1.6	.9	6.6	5.2	3.7
17	121	110	52	55	19.9	15.2	33	2.8	1.6	1.4	.7	5.8	5.2	3.6
18	109	84	51	45	19.3	15.2	26	2.9	1.5	1.4	.7	5.8	4.4	3.5
19	123	78	51	35	18.7	11.4	39	2.8	1.5	1.4	.7	5.2	3.6	3.2
20	110	76	50	30	16.8	9.5	34	2.8	1.5	1.4	.7	4.8	3.6	2.8
21	68	63	35	25	16.3	8.8	16	2.7	1.5	1.4	.6	4.2	3.6	2.6
22	67	65	36	20	16.0	9.8	16	2.6	1.5	1.4	.6	3.6	3.5	2.4
23	62	58	35	15	15.7	10.1	15	2.6	1.5	1.4	.6	5.8	3.5	2.4
24	56	50	24	12	15.7	10.8	16	2.4	1.6	1.4	.6	4.8	3.2	2.4
25	51	44	21	12	15.2	10.1	10	2.5	1.6	1.3	.6	4.2	3.0	2.2
26	52	45	20	12	14.6	6.0	8	2.4	1.5	1.3	.6	3.4	3.2	2.0
27	54	48	17	12.2	14.6	5.2	11	2.4	1.5	1.3	.5	3.6	3.2	1.8
28	52	60	16	10.1	16.8	5.0	13	2.4	1.5	1.3	.5	3.2	3.3	1.6
29	52	52	15	9.8	16.8	5.0	10	2.4	1.5	1.3	.5	3.2	3.5	1.6
30	51	51	14	9.8	16.8	5.0	6	2.3	1.5	1.3	.5	3.2	3.5	1.6
31	43	52	......	9.8	15.2	......	......	2.3	1.5	......	.5	2.9	3.3	1.6
Mean	140	96.4	41.4	58.1	30.9	10.5	35.3	3.01	2.13	1.43	1.30	8.16	5.48	2.73
Mean per square mile	.175	.120	.052	1.04	.552	.188	3.53	.301	.213	.143	.081	.255	.171	.085
Run-off (depth in inches on drainage area)	.20	.14	.06	1.20	.64	.21	3.94	.35	.25	.16	.09	.29	.20	.09

[a] Discharges for July 1 to 24 were obtained by the indirect method for shifting channels, on account of the large amount of fine material washed into the river from the cut on John Bull Hill. The mining had practically ceased by July 25, and after that date one rating curve was used, which is well defined between 40 and 300 second-feet discharge.

[b] Discharges for July 27 to September 27 were obtained from a rating curve which is well defined between 10 and 200 second-feet discharge. Those for July 1 to 26 have been estimated with the aid of a hydrograph, following the rate of rise and fall of Kiwalik River below Candle Creek. Most of the increase in the Kiwalik the second week in July came from Quartz Creek. A measurement was made July 6 near the crest of the flood.

[c] Discharges for June are based on float measurements by H. M. Long and R. S. Dimmock. These measurements were made in the afternoon, when the water was highest, and have been reduced by 20 to 40 per cent to give an approximate mean for the day. The values for July, August, and September are based on readings from three gages at different locations and are fairly good except those for August 1 to 15 and September 13 to 30, which are estimated.

[d] Elevation, 230 feet; drainage area, about 16 square miles. These discharges are based on a fairly well-defined rating curve and for about half the days have been interpolated.

[e] Discharges for July 5 to August 21 are based on a rating curve which is well defined between 3 and 15 second-feet discharge; those for July 1 to 4 and after August 22 are estimated on the basis of a hydrograph.

BEAR CREEK DRAINAGE BASIN.

Bear Creek rises opposite the headwaters of Quartz and Hunter creeks and flows southeastward for about 20 miles into West Fork of Buckland River. Its principal tributaries are Eagle, Polar, Split, Bob, and Cub creeks from the west and May, Camp, and Sheridan creeks from the east. The Bear Creek ditch has its intake just below the mouth of May Creek and extends along the right bank nearly to Split Creek, diverting water from Eagle and Polar creeks. This ditch was not used in 1909 and no measurements were made in this drainage basin.

MISCELLANEOUS MEASUREMENTS.

Discharge measurements made at other points than regular gaging stations or at stations for which daily discharges are not given have been listed in the following table. For streams, the elevation of point of measurements, discharge, drainage area, and discharge per square mile are given; for ditches, the gage reading, if any, and discharge.

Miscellaneous measurements of streams in Seward Peninsula in 1909.

Fish River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. mi.*	*Sec.-ft.*
August 21	Boston Creek	Fish River	1 mile above edge of mountains.	[a] 350	102		
Do	Baker Creek	Boston Creek	½ mile above edge of mountains.	[a] 450	27		
Do	Oregon Creek	do	Edge of mountains.	[a] 700	11.1		
August 19	Pargon River	Fish River	Below Miocene intake.	610	[b] 26	36	
September 17	do	do	do	610	14.0	36	
August 19	Dillon Creek	Pargon River from west.	Above Pargon ditch crossing.	720	4.0		
Do	McKelvie Creek	do	Above Pargon ditch intake.	710	8.9		
September 5	do	do	do	710	6.4		
September 18	do	do	do	710	4.5		
August 19	Cawlfield Creek	Pargon River from east.	Miocene ditch level	600	2.3		
August 22	Lanagan Creek	do	Above Miocene level.	650	9.0		
September 18	do	do	Below Miocene level.	550	4.5		
August 19	Helen Creek	Pargon River from west.	In flume, at Pargon ditch intake.	700	6.1		
September 17	do	do	do	700	5.8		
September 19	do	do	do	700	5.6		
August 22	do	do	Miocene ditch crossing.	580	[c] 1.24		
September 15	Niukluk River	Fish River	Above Ophir Creek	[a] 100	296	644	0.46
August 29	Casadepaga River.	Niukluk River	½ mile above Whiskey Creek.	500	9.0	29	.31
Do	do	do	Below Moonlight Creek, including ditch.	400	20	47	.43
Do	Moonlight Creek	Casadepaga River.	Ditch intake	485	6.7	.81	([d])
Do	do	do	At mouth, including ditch.	400	8.9	1.0	([d])

[a] Approximate.
[b] Not including Pargon ditch.
[c] Inflow below Pargon ditch intake.
[d] The discharge of Moonlight Creek comes from large limestone springs, which probably receive much of their water from outside of the surface drainage area of Moonlight Creek.

Miscellaneous measurements of streams in Seward Peninsula in 1909—Continued.

Fish River drainage basin—Continued.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. mi.*	*Sec.-ft.*
August 28	Ruby Creek	Casadepaga River.	At mouth, including ditch.	310	1.8	6.0	0.30
Do	Lower Willow Creek.	do	Above Ridgeway Creek.	400	5.8	15.4	.38
Do	Canyon Creek	do	Above Canyon Creek Gold Mining Company's ditch intake.	510	1.2	4.6	.26
Do	do	do	Below Boulder Creek.	355	9.4	22	.43
Do	Spring	Canyon Creek.	At intake of McKay ditch.	395	6.4		
Do	Boulder Creek	do	At mouth	355	.53	5.0	.11
September 20	Ophir Creek	Niukluk River	Above intake of "22" ditch.	220	7.1		
September 14	Melsing Creek	do	At mouth	80	9.6	30	.32
Do	Fox River	Fish River	Dam site at Fox River road house.		11.7	15.2	.77

Solomon River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
August 27	Solomon River	Bering Sea	Above Coal Creek	250	2.1	10	0.21
Do	do	do	Below Johns Creek	245	22	40	.55
August 16	do	do	Above East Fork	146	52	49	1.06
August 26	do	do	do	146	26	49	.53
September 13	do	do	do	146	23	49	.47
August 27	Coal Creek	Solomon River	At mouth	250	16.3	27	.60
August 16	East Fork	do	At mouth, including ditch.	146	18.4	17.2	1.07
August 17	do	do	do	146	16.2	17.2	.94
September 13	do	do	do	146	13.5	17.2	.78
August 16	Big Hurrah Creek.	do	do	85	19.3	17.4	1.11

Nome River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
July 16	Nome River	Bering Sea	Above Miocene intake.	575	36	15	
August 3	do	do	do	575	9.4	15	
August 2	do	do	Below Seward intake; seepage through dam only.	408	3.3		
Do	Alfield Creek	Nome River	¼ mile above mouth	410	4.5	4.4	1.02
September 14	do	do	½ mile above mouth	500	3.3	4.4	.75
August 2	Christian Creek	do	Above railroad	380	2.1	2.1	1.00
September 14	do	do	do	410	1.4	2.1	.67

Sinuk River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
September 5	Sinuk River	Bering Sea	Below upper lake	770	12.4	6.2	2.00
Do	Windy Creek	Sinuk River	Between lower lakes.	670	20	12.0	1.67
September 15	do	do	do	670	[a]18	12.0	1.50
September 5	North Star Creek	Windy Creek	In canyon	900	1.93	2.3	.84

Cobblestone River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
September 16	Cobblestone River.	Imuruk Basin.	Below Oro Grande Creek.	500	126	58	217

[a] Computed from gage reading.

Miscellaneous measurements of streams in Seward Peninsula in 1909—Continued.

Grand Central River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. mi.*	*Sec.-ft.*
July 10	West Fork	Grand Central River.	Pipe intake	1,010	32	2.8	11.4
August 5	do	do	do	1,010	7.3	2.8	2.61
August 8	do	do	do	1,010	5.1	2.8	1.82
September 21	do	do	do	1,010	1.56	2.8	.56
July 11	North Fork	do	do	1,030	36	2.3	15.7
July 18	do	do	do	1,030	27	2.3	11.7
August 5	do	do	do	1,030	14.3	2.3	6.22
August 8	do	do	do	1,030	13.0	2.3	5.65
September 4	do	do	do	1,030	11.6	2.3	5.04
Do	Spring	North Fork	Near ditch intake	850	4.6		
July 19	Gold Run	Grand Central River.	Below ditch intake.	820	21		
August 4	do	do	do	820	47		
August 7	do	do	do	820	15.2		
September 21	do	do	do	820	5.4		
June 28	Thumit Creek	do	Near ditch intake	800	8.0	.73	11.0
July 15	do	do	do	800	3.1	.73	4.25

Kruzgamepa River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
July 28	Kruzgamepa River.	Imuruk Basin.	Sliscovitch road house, 1 mile below Crater Creek.	370	188	124	1.52
August 31	do	do	Above Iron Creek	248	239	153	1.56
July 19	Crater Creek	Kruzgamepa River.	Intake of proposed ditch to Salmon Lake.	550	95		
September 1	do	do	do	550	54		
August 30	Dome Creek	Iron Creek	Below Hardluck Creek.	630	4.5	12.3	.37
Do	Iron Creek	Kruzgamepa River.	Above Goldengate Mining Co.'s ditch intake.	425	[a]11.3	40	.28
Do	Spring	Iron Creek, from south.	In ditch	460	2.2		
August 6	Middle Creek	Kruzgamepa River, from north of mountains.	Edge of mountains.	400	10.0		
September 19	do	do	do		2.67		
September 2	Grand Union Creek.	do	Below springs	650	5.6		
August 6	Osborn Creek	do	In gorge, below cirque.	900	16.3		
September 20	do	do	do	900	6.11		
August 6	Westend Creek	do	Lower end of cirque	1,050	15.4		
September 20	do	do	do	1,050	6.2		

Noxapaga River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
August 29	Noxapaga River	Kuzitrin River	Above Goose Creek		31	340	0.091
August 27	Eldorado Creek.	Noxapaga River	Trail crossing		2.1	30	.070
August 29	Aurora Creek	do	Near mouth		2.0	28	.071
August 30	Turner Creek	do	Ditch intake		.5	13	.038
August 28	Boulder Creek	Turner Creek.	Claim No. 5		.5	6.5	.077

[a] Poor measuring section; results probably too small.

Miscellaneous measurements of streams in Seward Peninsula in 1909—Continued.

Kougarok River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. mi.*	*Sec.-ft.*
July 24	Kougarok River	Kuzitrin River	Above Taylor Creek.	433	4.0	81	0.049
August 30	Taylor Creek	Kougarok River.	At North Star ditch siphon, including ditch.	480	8.5	83	.10
July 24	do	do	At mouth, including ditch.	433	2.8	90	.031
August 9	do	do	do	433	6.6	90	.073
August 10	do	do	do	433	103	90	1.14
June 20	Coarse Gold Creek.	do	At mouth	341	50	34	1.47
Do	do	do	do	341	76	34	2.24
July 21	do	do	do	341	.9	34	.026
August 31	do	do	do	341	.8	.34	.024
August 30	North Fork	do	Northwestern intake.	540	.7	19.8	.035
June 20	Eureka Creek	North Fork	Near mouth, including ditch.	370	5.4	3.1	1.74
June 19	Windy Creek	Kougarok River.	Above Anderson Gulch, including ditch.		20	27	.74
July 26	do	do	do		1.2	27	.044
September 2	do	do	do		1.9	27	.070

Goodhope River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
June 25	Right Fork	Goodhope River.	At mouth	260	38	80	0.48
July 21	do	do	do	260	18.1	80	.23
August 26	do	do	do	260	12.4	80	.16
June 25	Cottonwood Creek.	do	Above Divide Creek.	330	[a] 10.4	38	.27
July 21	do	do	do	330	[a] 2.3	38	.061
August 26	do	do	do	330	[a] .78	38	.021
June 25	Divide Creek	Cottonwood Creek.	At mouth	330	4.9	10.6	.46
July 21	do	do	do	330	1.74	10.6	.16
August 26	do	do	do	330	.27	10.6	.025
June 24	Esperanza Creek	Goodhope River.	do	100	2.8	20	.14
July 21	do	do	do	100	[b] .25	.20	.012

Inmachuk River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
July 19	Inmachuk River	Kotzebue Sound.	Above Eureka Creek.	210	10.9	8.6	1.27
August 7	do	do	do	210	9.4	8.6	1.09
August 26	do	do	do	210	8.3	8.6	.97
August 8	do	do	Above Pinnell River.	140	9.8	46	.21
Do	do	do	Above Cue Creek	60	[c] 56	177	
July 19	Hannum Creek	Inmachuk River.	At mouth	175	3.5	34	.10
August 8	do	do	do	175	1.77	34	.052
August 25	do	do	do	175	2.0	34	.059
July 19	Pinnell River	do	do	140	6.6	96	.069
August 7	do	do	do	140	3.1	96	.032
August 25	do	do	do	140	3.2	96	.033

[a] Probably much underflow through gravel.
[b] Estimated.
[c] Includes about 42 second-feet from Fairhaven ditch.

Miscellaneous measurements of streams in Seward Peninsula in 1909—Continued.

Kugruk River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. mi.*	*Sec.-ft.*
July 15	Kugruk River	Kotzebue Sound.	At mouth of canyon	470	36	152	....
August 4	....do	....do	....do	470	[a]34	....	....
June 27	Wade Creek (Burnt River).	Kugruk River.	Near mouth	....	26	177	0.15
July 11	....do	....do	....do	....	12	177	.068
July 23	....do	....do	....do	....	3.1	177	.018
August 2	....do	....do	....do	....	1.31	177	.007
August 11	....do	....do	....do	....	1.44	177	.008
August 24	....do	....do	....do	....	.72	177	.004

Kiwalik River drainage basin.

Date.	Stream.	Tributary to—	Locality.	Elevation.	Discharge.	Drainage area.	Discharge per square mile.
July 2	Gold Run	Kiwalik River	Proposed ditch intake.	....	3.2	9.0	0.36
July 28	....do	....do	....do	....	1.04	9.0	.12
August 16	....do	....do	....do	....	1.20	9.0	.13
July 2	Boulder Creek	Gold Run	....do	....	.47	4.0	.12
July 29	Dome Creek	Kiwalik River	Candle ditch intake	383	.39	9.0	.043
June 30	Eldorado Creek	....do	Siphon crossing	....	2.4	....	....
June 29	Candle Creek	....do	At mouth	2	6.3	60	.105
July 6	....do	....do	....do	2	.72	60	.012
July 8	....do	....do	....do	2	.86	60	.014
July 10	....do	....do	....do	2	7.2	60	.12
July 30	....do	....do	....do	2	0	60	.00
August 4	....do	....do	....do	2	.30	60	.005

[a] Includes 14 second-feet from Fairhaven ditch and Imuruk Lake.

Miscellaneous measurements of ditches in Seward Peninsula in 1909.

Fish River drainage basin.

Date.	Ditch.	Diverts from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
September 5	Pargon	Pargon River	Above Dillon Creek		14.2
Do	do	do	Below Dillon Creek		15.3
August 19	do	do	1½ miles below Helen Creek.	[a] 1.56	29.2
July 17	do	do	2 miles below Helen Creek	[a] 1.50	27.5
September 5	do	do	Outlet into Ophir Creek	[a] 1.33	19.7
August 19	McKelvie Creek lateral.	McKelvie Creek	Near outlet		7.4
September 5	do	do	do		3.9
September 18	do	do	do		3.0
August 19	Helen Creek lateral.	Helen Creek	do	[a] 1.56	6.1
September 17	do	do	do	[a] 1.27	5.8
September 19	do	do	do	[a] 1.19	5.6
August 23	Canyon	Ophir Creek	Below Crooked Creek flume.		40.6
July 10	do	do	Below claim 10	1.80	29.7
July 14	do	do	do	1.50	21.5
August 13	do	do	do	1.74	33.4
August 24	do	do	do	1.64	28.7
September 15	do	do	do	1.58	25.1
July 14	do	do	Above claim 6	1.83	20.9
August 1	do	do	do	1.54	10.3
August 18	do	do	do	2.03	30.4
September 15	do	do	do	1.90	26.7
September 16	do	do	do	1.84	24.6
July 10	do	do	Below claim 6	1.80	25.5
September 15	do	do	do		14.0
July 10	do	do	Below claim 4	.96	6.8
July 14	do	do	do	.71	2.19
August 13	do	do	do	.37	.0
August 18	Twenty-two	Ophir Creek, on claim 22.	At intake		3.3
August 24	do	do	do		3.3
September 20	do	do	do		2.3
August 18	Nineteen	Ophir Creek, on claim 19.	do		5.7
August 24	do	do	do		5.8
September 20	do	do	do		4.3
August 25	Hot Air	Ophir Creek, on claim 10.	On claim 4		11.3
August 23	Stitch	Portland Gulch, tributary of Oxide Creek.	At outlet		1.38

Solomon River drainage basin.

Date.	Ditch.	Diverts from—	Locality.	Gage height.	Discharge.
August 17	East Fork	East Fork of Solomon River.	At intake	0.84	9.6
August 27	do	do	do	.78	[b] 8.4
September 13	do	do	do	.79	[b] 8.6
August 17	do	do	Near mouth of East Fork	.64	4.6
August 26	do	do	do	.53	2.9
September 14	do	do	do		.0
September 24	do	do	do	1.01	[b] 12.5
August 16	do	do	Above penstock near Big Hurrah Creek.		2.4
Do	Midnight Sun	Big Hurrah Creek	Near mouth of Big Hurrah Creek.		6.7

[a] Gage at Helen Creek.

[b] Computed from gage reading.

Miscellaneous measurements of ditches in Seward Peninsula in 1909—Continued.

Nome River drainage basin.

Date.	Ditch.	Diverts from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
July 16	Miocene	Nome River	At Clara Creek	1.34	29.0
August 2	do	do	do	.50	4.14
August 10	do	do	do	1.45	34.6
September 13	do	do	do	.35	1.97
July 15	do	Nome River and Hobson Creek.	Below Hobson Creek	2.12	39.0
Do	do	do	do	2.11	38.3
August 1	do	do	do	1.22	13.2
September 13	do	do	do	.93	6.95
July 14	Glacier branch of Miocene.	do	Below the Ex		26.6
July 31	do	do	do		2.7
August 11	do	do	do		18.8
July 14	Dexter branch of Miocene.	do	do		13.0
July 31	do	do	do		6.8
August 11	do	do	do		12.8
Do	do	do	Above Grass Gulch	1.00	11.4
August 12	do	do	do	.85	10.0
September 11	do	do	do	.51	3.1
July 16	David Creek branch of Miocene.	David Creek	Opposite Black Point	.55	7.69
August 2	do	do	do	.28	2.95
August 9	do	do	do	.49	6.48
July 15	Grouse Creek branch of Miocene.	Grouse and Cold creeks.	Outlet		2.5
June 10	Seward	Nome River	Above Banner Creek	.40	.58
July 14	do	do	do	1.18	14.4
July 31	do	do	do	.88	7.61
August 11	do	do	do	1.12	13.2
August 12	do	do	Extra Dry Creek	1.09	9.3
September 10	do	do	do	1.03	8.3
August 12	do	do	Lost Creek		7.8
June 4	do	do	Dog Creek	1.20	16.0
June 6	do	do	do	.75	6.1
July 15	Hobson branch of Seward.	Hobson Creek	Near outlet	.68	5.2
August 1	do	do	do	.56	3.13
August 10	do	do	do	.60	3.82
September 14	do	do	do	.50	2.52
August 1	Pioneer	Nome River	Above Hobson branch		11.0
August 12	do	do	Extra Dry Creek	.70	11.8
September 10	do	do	do	.48	7.4
July 14	do	do	Little Creek	1.17	20.7
July 30	do	do	do	.70	6.5
Do	do	do	do	.71	6.3
September 10	do	do	do	.60	4.2
July 15	Hobson branch of Pioneer.	Hobson Creek	Near outlet		4.3
August 1	do	do	do		2.3
August 10	do	do	do		1.7
September 12	do	do	do		.85

Grand Central River drainage basin.

July 17	Grand Central branch of Miocene.	Nugget Creek	Below Nugget Creek	0.80	1.85
August 3	do	do	do	.73	1.05
July 17	Jett Creek branch of Miocene.	Jett Creek	Above Copper Creek siphon.		1.3
Do	do	do	Below siphon	1.00	2.72
August 3	do	do	do	.75	.52
July 17	Copper Creek branch of Miocene.	Copper Creek	Above junction with Jett Creek branch.		1.2

Miscellaneous measurements of ditches in Seward Peninsula in 1909—Continued.

Kruzgamepa River drainage basin.

Date.	Ditch.	Diverts from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
June 17	Iron Creek tunnel flume.	Iron Creek	Intake	0.45	9.7
July 20	do	do	do	1.05	22.6
July 27	do	do	do	.80	17.2

Kougarok River drainage basin.

Date.	Ditch.	Diverts from—	Locality.	Gage height.	Discharge.
September 1	Homestake	Kougarok River	Intake	0.29	5.3
August 30	North Star	Taylor Creek	Below siphon		7.4
September 3	do	do	do		4.5
September 15	do	do	do		8.7
June 20	Galvin	Coarse Gold Creek	Above penstock		5.8
Do	do	do	do		7.6
July 26	Windy Creek	Windy Creek	Above Anderson Gulch		1.0
September 2	do	do	do		.4

Inmachuk River drainage basin.

Date.	Ditch.	Diverts from—	Locality.	Gage height.	Discharge.
July 13	Fairhaven	Imuruk Lake	Camp 1, lower section		29.0
August 3	do	do	do		39.8
June 26	do	do	Penstock, below Logan Gulch.		14.5
July 12	do	do	do		29.8
August 6	do	do	do		41.0
August 10	do	do	do		16.8
Do	do	do	do		33.7

RAINFALL RECORDS.

Records of precipitation were obtained at six stations in Seward Peninsula for a part or the whole of the season of 1909. It has been the object, as far as possible, to obtain the records near the drainage basin on which records of discharge were kept. The stations have therefore been placed in the interior, at mining and ditch camps, where it is hard to obtain records for an entire season. The location, elevation, etc., of these stations are given in the following table.

Rainfall stations in Seward Peninsula, 1909.

Station.	Latitude.	Longitude.	Elevation—Above sea level.	Elevation—Above ground.	Observer.	Date established.
	° ′	° ′	*Feet.*	*Feet.*		
Nome	64 30	165 24	40	20	Arthur Gibson	June 14, 1906
Black Point	64 51	165 16	575	2	F. F. Miller	June 23, 1906
Grand Central	64 58	165 14	690	2	P. B. Chapman and others.	July 10, 1907
Iron Creek	64 58	164 38	350	2	George Lorimer	June 22, 1907
Ophir Creek, claim 4	64 56	163 42	160	2	H. Leland	July 1, 1908
Dahl	65 22	164 41	230	2	John A. White	Aug. 1, 1909
Candle	65 55	161 56	25	15	Ward Estey	Aug. 11, 1909

The records obtained show, as in previous years, that the precipitation is high in the Kigluaik Mountains, moderate in the area south of them, and very low in the northern half of the peninsula. The daily rainfall for 1909 at all stations and the monthly total for the years 1906 to 1909 at Nome are given below.

Monthly precipitation, in inches, at Nome, Alaska, for 1906 to 1909.

Year.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Period.
1906									Trace.	2.38	2.50	1.02	
1906-7	0.93	0.32	1.91	2.64	1.46	3.37	0.10	1.12	1.31	2.08	2.68	1.41	19.33
			20.8	25.2	13.9	28.8							88.7
1907-8	.16	.06	.30	.43	.76	1.19	.02	.19	.90	2.10	2.92	.52	9.55
			6.75	8.9	11.95	13.1	.3						41.0
1908-9	1.13	.26	.75	.37	.13	.21	.45	.15	.88	.82	1.66	.96	7.77
	10.5	3.5	11.75	3.0	2.0	2.75	5.0	Trace.					38.5
1909	1.45	1.16	1.22										
	1.5	14.0	16.0										

Daily rainfall and snowfall, in inches, at Nome for 1908-9.

Day.	October.		November.		December.		January.		February.		March.	
	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.
1										Trace.		
2									0.06	1.0		
3	0.05					Trace.				Trace.		
4	.05					Trace.						
5						Trace.	0.08	1.0				
6						Trace.	.12	(a)				
7						Trace.						Trace.
8											0.16	2.0
9					0.13	2.0		Trace.				
10												
11						Trace.						
12	Trace.	Trace.			.04	.75						
13						Trace.						
14						Trace.						
15	.25	3.0	0.04	1.0								
16					.11	2.0					.05	.75
17						Trace.						
18	.02	Trace.										
19	.11	2.0				Trace.						
20			.07	1.0						Trace.		
21												
22			Trace.	Trace.								
23							.17	2.0	.07	1.0		
24					.08	2.0						
25	.45	3.0	.10	1.0								
26	.04	.5										Trace.
27	.16	2.0										
28												
29			Trace.	Trace.	.17	3.0						
30			.05	.5	.22	2.0						
31												
	1.13	10.5	.26	3.5	.75	11.75	.37	3.0	.13	2.0	.21	2.75

[a] Snow and sleet.

Daily rainfall and snowfall, in inches, at stations in Seward Peninsula in 1909.

Day.	April.				May.					
	Nome.		Candle.		Nome.		Iron Creek.		Candle.	
	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.
1		Trace.					0.04			
2	0.11	2.0					.01	Trace.	0.07	Trace.
3							.01	Trace.		
4										Trace.
5							.01	Trace.		
6										
7		Trace.								Trace.
8	.05	1.0				Trace.				Trace.
9						Trace.				
10										Trace.
11	.14	2.0								
12										
13					0.06	Trace.	.01	Trace.		
14			0.08	Trace.			.03	Trace.		
15					.09		.09	Trace.		
16							.03			
17							.03			
18			.03	Trace.			Trace.			
19										
20										
21			.15							
22										
23										
24										
25										
26		Trace.								
27										
28										
29	.08									
30	.07		.02							
31										
	.45	5.0	.28	Trace.	.15	Trace.	.26	Trace.	.07	Trace.

Daily rainfall and snowfall, in inches, at stations in Seward Peninsula for 1909—Cont'd.

Day.	June.				July.			
	Nome. [a]	Black Point.	Iron Creek.	Candle.	Nome. [a]	Black Point.	Ophir Creek.	Candle.
1								
2				Trace.				
3								
4								
5			Trace.	0.03				Trace.
6								
7								
8					0.42	0.09		0.11
9			Trace.			.16		.42
10				.05				
11				.11				
12						.18		.12
13			Trace.	Trace.		.05		
14	0.08			.03				
15		Trace.	Trace.	.08		.04		
16				.32		.03		.04
17					.02	.02		
18					.02			
19								
20		0.05		.03				
21								
22								
23			.02					.05
24		Trace.						
25		.03						
26		.02						
27	.02	.07	.04			.07		.07
28	.02	.13		.12	.04			
29	.18	.75		.05				
30	.57	.01		.02				
31								
	.88	1.06		.84	.82	.64	.00	.81

[a] The daily values for June and July at Nome are incomplete, but the monthly totals are correct.

Daily rainfall and snowfall, in inches, at stations in Seward Peninsula for 1909—Cont'd.

Day.	August.					September.					
	Nome.	Black Point.	Ophir.	Dahl.	Candle.	Nome.	Black Point.	Grand Central.	Ophir.	Dahl.	Candle.
1											
2					Trace.						
3	0.33	0.42	0.40	0.10							
4	.28	.22		.01	0.36	0.04	0.02	0.01		0.01	
5		Trace.			.02	.04	.14	.14			
6					Trace.						
7			.09		Trace.						
8	.11	.07	.40	.05							
9	.38	.72	.58	.04	.40						
10	.13	.22									
11											
12											
13	.24	.02	.20			.11	Trace.	.02	0.49	.05	0.12
14	.03	.10				.05	.17	.10			.11
15								(b)			[c] .07
16						.28	[a] .14		[a] .38	.03	[c] .07
17		.02				.06					[c] .05
18							.01				
19											
20											
21						.05	.24		.14		
22					Trace.	.02	(b)		.25		.02
23						.16			Trace.		Trace.
24						.15					.01
25											.02
26											
27	.11	.08	.12	.01							
28	.05		.02		.05						
29											
30											
31					Trace.						
	1.66	1.87	1.81	.21	.83	.96			1.26	.09	.47

[a] Water equivalent of snow. [b] No record. [c] Rain and snow.