MINING DEVELOPMENTS IN THE KETCHIKAN AND WRANGELL MINING DISTRICTS.

By Theodore Chapin.

KETCHIKAN DISTRICT.

INTRODUCTION.

Mining operations in the Ketchikan district were conducted on a much larger scale during 1916 than in the preceding year, as is evident by the large increase in production.

Seven copper mines were in operation, and the output of the larger mines was materially increased. Only two gold-lode mines were operated during a part of the year, but development work was continued on other gold-lode properties and a large quantity of gold was won from ores mined primarily for copper. Items of more than ordinary interest are the recent discovery of a lode of stibnite (antimony) ore, a mineral not known previously to occur in this region in commercial quantity, of lodes in which zinc appears to be the predominant metal, and of platinum and palladium in certain of the copper deposits.

Interest in marble continues. At present production is confined to the quarries of the Vermont Marble Co. at Tokeen, but the district contains large bodies of high-grade marble, whose development awaits the capital necessary for their exploitation. Development work was continued on the barite claims on Lime Point, on Prince of Wales Island, and work was started on the construction of a treatment mill. The location of the known mineral deposits is shown on Plate V.

LODE MINING.

PRODUCTION.

The increase in the production of 1916 over that of 1915 is shown in the subjoined table. The gold and silver produced were derived from both the gold lodes and the gold and silver bearing copper lodes. This increased production was due to the continued demand and high price of copper, which made possible the operation of a number of low-grade properties.

Copper, gold, and silver produced in the Ketchikan mining district in 1915 and 1916.

Year.	Ore mined.	Copper.		Gold.		Silver.		Total value.
		Quantity.	Value.[a]	Quantity.	Value.	Quantity.	Value.[b]	
	Tons.	*Pounds.*		*Fine oz.*		*Fine oz.*		
1915	50,997	1,728,182	$302,431	1,727.38	$35,708	11,666	$5,914	$344,053
1916	76,111	3,526,703	867,569	2,769.61	57,253	19,361	12,640	937,462

[a] Computations based on average price of copper in 1915 ($0.175) and 1916 ($0.246).
[b] Computations based on average price of silver in 1915 ($0.507) and 1916 ($0.658).

PRINCE OF WALES ISLAND.

KASAAN BAY AND VICINITY.

Kasaan Peninsula was again the center of the copper-mining activity of the Ketchikan district, owing in large part to the operations of the Granby Consolidated Mining, Smelting & Power Co. (Ltd.), which operates the Mamie and It mines. The Mamie mine was taken over by the Granby Co. in 1913, and development and improvements were started to put the mine into working condition. The aerial tram, which originally extended to the old smelter only, was rebuilt and extended to the dock in the harbor, where the ore is loaded on barges for shipment to the Granby smelter at Anyox, B. C.

Mining operations consist of stoping the irregular-shaped ore bodies composed of chalcopyrite-bearing magnetite, associated with garnet, epidote, and other contact-metamorphic minerals, formed along the border of intrusive dioritic masses that invade limestone and arenaceous sediments. The Mamie continued operations throughout 1916, employing 55 to 85 men. Underground development work has been carried forward on all the levels, and on the lowest level ore bodies formed along porphyry dikes that cut the magnetite have been located. Considerable surface development work has also been done, with a view to locating new ore bodies. A topographic and geologic map has been completed, a magnetic survey has been made to determine the position of the magnetite bodies, and diamond-drill holes have been put down.

The It mine was worked on about the usual scale, employing 25 men. The ore bodies occur along the contact of intrusive diorite and limestone, and are composed of chalcopyrite, pyrite, and associated metamorphic lime-silicate minerals but contain little magnetite. Development work in 1916 consisted in 5,000 feet of diamond drilling and the extension of drifts and raises on the 275-foot and 350-foot levels, from both of which ore was extracted.

Operations at the Mount Andrew mine were started early in the year and carried forward on a larger scale than usual. The ore

Base from U.S. Coast and Geodetic Survey charts bodies here are composed of very large masses of copper-bearing magnetite.

The Goodro mine, near the head of Kasaan Bay, was operated, and a number of shipments of ore were made. The ore bodies are in gabbro, and the ore minerals are essentially bornite and chalcocite with lesser amounts of other copper sulphides. The ore also carries considerable gold and traces of platinum and palladium. The ore is sorted by hand and trammed to the wharf, where it is loaded on barges for shipment to the smelter.

The Rush & Brown mine, at the head of Kasaan Bay, was operated throughout the year, and shipments of ore were made. The mine is developed on two lodes, a contact deposit of copper-bearing magnetite and a shear-zone deposit carrying copper sulphides. Both of these deposits have been explored to the 250-foot level by various underground workings. Besides these ore bodies of proved persistence and depth there are also a number of surface outcrops that have not yet been cut by the underground workings. A drift is now being driven along an underground slip on the 200-foot level to cut one of these ore bodies, and surface showings near the ore bins are to be prospected by a stope now being opened from the glory hole on the sublevel above the 100-foot level. An incline now being sunk on the sulphide ore body will be used for a working shaft.

South of Karta Bay and northwest of Twelvemile Arm, including the vicinity of Hollis, is a mineralized area in which gold lodes predominate. The country rock is a complex assemblage of sedimentary and igneous rocks whose relations have not been worked out in detail. The bedded rocks include tuff, breccia, schist, thin beds of limestone, black slate, argillite, and graywacke and are cut by a large boss of quartz diorite and associated porphyritic dikes. The lodes are quartz veins and occur in the intrusive and the bedded volcanic rocks as well as in the sediments.

A number of claims have been located on Granite Mountain, in the quartz diorite. On the Last Chance group development was continued during the summer preparatory to putting in a stamp mill. The Ready Bullion mine and mill, near Hollis, were operated with good success. The mine is developed by three adits driven along the vein and connecting stopes. Development work was continued on the Crackerjack group of claims, adjoining the Ready Bullion, but no production was made. The Dunton mine, on Harris Creek, was not operated in 1916, but some prospecting and ore testing were done.

The Burke and Lang claims were recently located on the north bank of Hollis Cove, about a mile northeast of Hollis. The lode as here exposed by surface stripping is a quartz vein about 20 feet wide, trending N. 70° W., parallel to the strike of the inclosing greenstone tuff country rock. Assessment work consisting of surface stripping was done on the Copper Hill claim, about a mile northwest of Hollis, a short distance from the Ready Bullion tram. The lode occupies a shear zone in greenstone tuff and is composed of a network of chalcopyrite veinlets inclosing sheared rock impregnated with particles of chalcopyrite and stained in places with copper carbonates. Both country rock and lode strike N. 70° W.; the greenstone tuff dips steeply northeast, and the lode apparently dips in the opposite direction.

McLEAN ARM AND MALLARD BAY.

Prospecting and assessment work is being continued on a number of claims on McLean Arm and Mallard Bay. The country rock north of McLean Arm and part of that south of the arm is a medium-grained dioritic rock, evidently a part of the batholith that occupies a large area in the south end of Prince of Wales Island. South of the diorite is a narrow strip of greenstone with associated porphyritic alaskite. The diorite is intrusive into the greenstone. The light-colored porphyries are believed to be intrusive into both greenstone and diorite.

The principal work has been done by Polson & Ickis on a group of claims extending from McLean Arm to Mallard Bay, including mineral claims and a mill site. On the Veta a short adit with drifts and crosscuts has been run, and on the Apex and Adit about 200 feet of underground work has been done, besides a number of surface openings.

The ore deposits occupy shear zones in both the greenstone and its associated porphyritic intrusives. Chalcopyrite is the principal ore mineral, with a little secondary malachite and in places a black coating that is probably chalcocite. The Apex, Adit, and Astor claims cover a mineralized zone that has been traced by surface cuts and underground workings for a distance of 300 feet across its strike. Within this zone are a number of well-defined lodes with intermediate parts which are more or less mineralized.

On the Adit claim an adit has been driven for about 200 feet, exposing two well-defined parallel lodes and an intermediate area with disseminated chalcopyrite. The ore appears to follow very prominent fracture planes with a general trend of N. 20° E. and a southeasterly dip. The mineralization was not confined within these walls but extended into the wall rock. The adit follows one of the lodes for about 50 feet and cuts across to another lode. Above the adit, at an elevation of 550 feet, an open cut has been made on a quartz vein which appears to be the hanging wall of the lode.

On the Veta claim the ore body occurs in the greenstone adjoining the diorite that forms the hanging wall of the lode. The lode strikes N. 45° W. and dips 70° NE. A short tunnel crosscuts the lode and drifts along it for about 20 feet. Adjoining the diorite is about 15 feet of greenstone mineralized with disseminated chalcopyrite.

Below this low-grade ore is about 8 feet of high-grade chalcopyrite ore, which occurs in masses and irregular veins in the greenstone and also associated with quartz veins.

The Spik claim is about a mile west of the Polson & Ickis claims and 2 miles south of the head of McLean Arm. It can be reached by a good trail from a point on McLean Arm half a mile west of the Polson & Ickis mill site. The developments consist of a few open cuts and a short adit. The country rock is greenstone with much intrusive granite. The ore exposed by the open cuts is of very high grade. It consists of bornite, chalcopyrite, and pyrrhotite, occurring in irregular masses in the greenstone.

NICHOLS BAY.

The rocks along the shore line of Nichols Bay are mineralized at a number of places, and several prospects have been located, but little work has been done on them.

Near the mouth of the bay the Feickert claim has been located recently and a little surface stripping done. The country rock is red granite and quartz diorite. The lode is a chalcopyrite-bearing quartz vein about a foot wide. It strikes N. 50° E. and stands about vertical. Development work in 1916 consisted of surface stripping and the construction of a temporary shelter and blacksmith shop.

Another Feickert claim has been located on the east side of the bay a short distance from the head. A trail leads from the cabins on the shore half a mile to the workings. The ore is chalcopyrite-bearing quartz, and the country rock is andesitic greenstone. The lode has been prospected by a shaft and other openings and traced on the surface by open cuts.

The Alice claim, on the east shore of Nichols Bay, was recently relocated by Thornton & Kilpatrick. The country rock is andesitic greenstone with intercalated beds of limestone. The ore is chalcopyrite and occurs in the limestone in irregular bunches and veinlets. Two old shafts on the lode were filled with water at the time of visit and were not accessible for examination.

A short distance north of the Alice claim is another property on which a little work has been done. The country rock is quartzite and siliceous slate interbedded with andesitic greenstone. The beds strike N. 20° E. and stand about vertical. The ore bodies consist of irregular masses of rock strongly impregnated with pyrite. No underground exposures were accessible when the property was visited.

TAH BAY.

Several claims, including the Ranger 1 and 2, have been located recently in a mineralized area on the ridge southwest of Tah Bay, a small cove on the north shore of Hessa Peninsula, on the west coast of Prince of Wales Island. The claims, which are on a low ridge about 200 feet above sea level and a quarter of a mile from the beach, may be reached easily by trail. The country rock consists of greenstone tuff and red and green volcanic breccias and associated graywacke and green grits, which are well exposed along the southwest shore of Tah Bay. In the vicinity of the ore deposits the greenstone is cut by many granite dikes with associated quartz veins. The developments to date consist of one prospect adit about 10 feet long and a number of surface clearings to expose the outcrops. The largest outcrop noted is about 25 feet across and is concealed on all sides by vegetation. It is essentially magnetite, but in places carries considerable chalcopyrite. The numerous outcrops of magnetite cover a larger area, but the workings are as yet too meager to show the size of the ore bodies or the nature and extent of the copper-bearing rock.

HETTA INLET AND CORDOVA BAY.

The principal producer on Hetta Inlet was the Jumbo mine, which was operated throughout the year on a large scale. The mine was leased from the Alaska Industrial Co. in November, 1915, by Charles A. Sulzer and since that time has been operated on this lease. A small sawmill has been erected on the beach south of the ore bunkers and supplies timber for mining and building. It is planned to move the town of Sulzer to the vicinity of the mine wharf.

The Rex and Idela claims, recently located by Jack Smith and William Fox, are on the south slope of Green Monster Mountain at an elevation of 1,700 feet and may be reached by trail from the head of Cholmondeley Sound, a distance of about 5 miles. The developments consist of a number of open cuts and short adits which have exposed a mineralized zone for several hundred feet in an easterly direction. The ore bodies are lenses of chalcopyrite-bearing magnetite associated with masses of garnet-epidote-diopside rock along the contact of the limestone and intrusive quartz diorite. A little malachite also occurs.

On the Rex claim a short adit has been driven into a body of magnetite-chalcopyrite rock inclosed between quartz diorite and limestone. The ore bodies, so far as could be judged by the few surface workings, are contact-metamorphic deposits similar in general character to the deposits on Copper Mountain.

Deposits of zinc ore occur on the ridge about 1½ miles northeast of Sulzer. These deposits were not visited by the writer, and information regarding them was obtained from Mr. W. C. Waters. They occur at an elevation of about 2,000 feet on top of a low ridge that extends westward from Beaver Mountain and divides the drainage of Portage Bay from that of Polk Inlet and Twelvemile Arm. The country rock consists of crystalline limestone, black slate, and quartzite, which strike N. 70° W. and dip 70° NE. The limestone caps the ridge and appears to overlie the other rocks but is stratigraphically lower, its steep dip carrying it below the slate and quartzite. The ore deposits occur in limestone. Specimens of the ore examined by the writer consist essentially of zinc blende with a little galena in a limy matrix.

The Lakeside claim, on the extreme south end of Sukkwan Island, is being developed by P. A. Tucker and Hal Gould. Underground developments in September, 1916, consisted of a vertical shaft 51 feet deep and a crosscut at this level 41 feet in length. The country rock is altered pyroxenite, a basic rock which is intrusive into the greenstone schists and associated schistose sediments. The greenstone schists are bedded tuffs and lava flows of andesitic composition with considerable secondary chlorite, epidote, and calcite. The pyroxenite, a rock originally composed essentially of pyroxene and olivine, has been altered to epidote, calcite, and serpentine. The greenstone schists, the sediments, and the altered pyroxenite are all cut by quartz diorite, a large boss of which occupies the rugged hills of the interior of the island. The schists and sediments strike N. 30° W. and dip southwest at steep angles. The ore deposits occur in strongly mineralized shear zones along the contact of the pyroxenite and the greenstone, for the most part in the altered contact zone of the pyroxenite. Two such shear zones have been cut in the crosscut. One of these, in the southwest end of the crosscut, strikes N. 20° W. parallel to the strike of the country rock, but dips northeasterly. For a width of about 5 feet the pyroxenite is mineralized with disseminated chalcopyrite. The other shear zone is in the northeast end of the crosscut and lies along a vertical fault striking N. 20° W. It incloses about 2 feet of good chalcopyrite ore.

No other development is in progress on Sukkwan Island, but at several places the schists show considerable pyrite mineralization.

Harry Wills, representing the Alaska Tidewater Co., of Seattle, has located copper claims on the long peninsula east of Sukkwan Island, a mile north of Lime Point, and plans active development in the near future. The claims are known as the Teresa and Florence.

WEST COAST.

Developments were continued at the Big Harbor mine, on Trocadero Bay, and a test shipment of ore was made. No notable production has ever been made from this mine, but development work has been in progress since 1908 and several shipments of ore have been made. The property was acquired in 1916 by W. W. Sweet, R. W. Sweet, and N. P. Olson, who have incorporated under the name Southeastern Alaska Copper Corporation.

The ore body is a wide zone of silicified greenstone, within which are shear zones carrying lenses of rich chalcopyrite ore and stringer lodes. The country rock on the footwall of the lode is composed of altered calcareous and arenaceous sediments; on the hanging-wall side it is albite-bearing schist. The lode strikes N. 60° E. and dips 60° NW.

The principal developments to date have been on three claims on the chalcopyrite lenses along the hanging wall of the lode. The ore bodies exposed in the workings on the Northland No. 1 claim were described in detail in a previous report.[1] The developments on the Northland Nos. 2 and 3 claims consist of an adit and a connecting vertical shaft 120 feet deep, from which crosscuts have been extended at 28, 48, and 120 feet below the surface. The shaft for its entire depth is in ore consisting of pyrite and chalcopyrite. An adit 64 feet long connects with the shaft 28 feet below its mouth. This adit and a 10-foot crosscut beyond are all in ore, the lode material consisting of silicified greenstone strongly mineralized with pyrite and chalcopyrite. A 20-foot crosscut on the 48-foot level was for 17 feet in pyrite-chalcopyrite ore and 3 feet in barren rock. On the 120-foot level an 18-foot crosscut shows 11 feet of pyrite-chalcopyrite rock and 7 feet of slightly mineralized rocks, but a drill hole in the face penetrates another body of sulphide rock. The workings at this place, known as the upper workings, appear to be on the same lode as the lower workings, for the ore bodies have been traced more or less continuously from the lower to the upper workings by outcrops of chalcopyrite-bearing rocks. The crosscuts at the upper workings, however, have not cut the hanging wall of the lode, so it would appear that the rich chalcopyrite lenses occurring along the hanging wall have not yet been opened and that the present workings are in the leaner part of the lode. It is planned to continue sinking at the upper workings to a depth of 500 feet and to crosscut every 50 feet. At the lower workings a raise to the surface will be completed and sinking continued to a depth of 250 feet, with crosscuts every 50 feet.

DALL ISLAND.

McLEOD BAY.

A number of claims have been located on McLeod Bay, near the south end of Dall Island. Considerable development work has been done, including three adits and a number of open cuts and shafts besides several substantial buildings. The claims comprise several groups and include the Golden Chariot, Elks Pup, Elk, Daykoo, Delaware, No Name, Virginia, West Virginia, and others. The

[1] Chapin, Theodore, Mining developments in southeastern Alaska: U. S. Geol. Survey Bull. 642, pp. 92-93, 1916.

principal development work has been done on the Golden Chariot, West Virginia, and New York. This property is now controlled by W. D. McLeod and others.

The footwall of the lode is massive crystalline limestone; the hanging wall is crystalline schist. Two well-defined ore bodies occur—a strong vein of quartz ranging in thickness from 40 to 60 feet, and a parallel stringer lode, the two lodes with the intervening impregnated rock forming a mineralized zone from 200 to 600 feet wide. The country rock is crystalline limestone and siliceous schist and quartzite with a little greenstone schist. The beds strike N. 45° W. and dip 30°–45° NE. The quartz vein is the most conspicuous of the ore bodies. It has a general northwest strike, dips northeast, about parallel to the beds, and occupies the contact between the limestone and schist. It has been traced by workings and surface cuts for a number of claim lengths but is best exposed on the Elk claim by two adits and an open cut, which crosscut the vein in three places. Along the hanging wall there is a gouge seam about 3 feet thick, and a number of parallel seams of gouge occur on the hanging wall side of the vein. Gouge also occurs along the footwall. The quartz is rusty and brecciated and breaks down easily under the hammer. The vein is being developed for its gold content. The principal metallic mineral is chalcopyrite, with lesser amounts of pyrite and galena. The very little gold that is visible is believed to occur in association with the sulphides. The stringer lode has not been extensively exploited. Several attempts have been made to open some of the rich stringers within it, but no systematic development of the lode as a whole has been made. On the beach claims on the southwest side of McLeod Bay this lode from the beach to the moss-covered area has a surface width of 400 feet and an actual width of 260 feet. This is a minimum width of the lode at this place, as it probably extends beneath the moss-covered area between the exposed part and the vein. At this place the lode is composed of quartzose schist, carrying several strong veins of quartz and innumerable stringers and gash veins. Both quartz and schist are metallized with chalcopyrite, pyrite, and galena. Particles of free gold occur sparingly, and individual stringers appear to be very rich. The schist is uniformly metallized with particles and tiny stringers of the sulphides.

Attempts have been made to open some of the richer of the individual veins, but this method of mining will not prove satisfactory, for the veins are lenticular in habit and tend to pinch out both laterally and vertically. The lode, owing to its diffused mineralization over so great a width, lends itself much more readily to exploitation on a large scale and should be further investigated with this in view.

The Lucky Strike claim is on the crest of Dall Island, at an elevation of 1,300 feet. It is 3 miles east of the head of Gooseneck Harbor, on the west coast, and 4 or 5 miles west of Sawmill Cove and may be reached by a trail starting from a point about 1¼ miles south of the entrance to Grace Harbor.

The country rock consists of metamorphic schist, limestone schist and thin beds of limestone. The lode where not covered by vegetation appears to be a shear zone in the schist, mineralized with chalcopyrite, pyrite, and much limonitic material. It is cut by stringers of bluish quartz carrying bunches of pure chalcopyrite. The schist strikes east and is nearly vertical; the quartz stringers strike N. 20° E. and dip 60° SE.

COCO HARBOR.

The Silver Star claim is about three-quarters of a mile from the head of Coco Harbor, at an elevation of 1,700 feet. The dominant rocks between the prospect and the beach are crystalline limestone, greenstone schist, and black blocky schists. There are two parallel lodes having a general strike of N. 55° W. and a steep northeast dip, about parallel to the strike and dip of the inclosing limestone beds. The larger lode pinches and swells, ranging in width from a few inches to 2½ feet, and veinlets of the sulphides penetrate the wall rock, increasing in places the width of mineralized rock The visible contents are essentially sphalerite, chalcopyrite, and galena, with a relatively small amount of gangue. The other lode, about 30 feet northeast of this one, is of similar appearance and is composed of sphalerite, chalcopyrite, and galena. Assays made on a sample of this ore body showed notable amounts of gold, silver, zinc, lead. and copper.

The underground workings consist of a 50-foot adit and two drifts. The adit was started on the outcrop of the main lode but apparently drifted away from it. Cabins have been built both at the claim and on the beach, and a good trail leads from the beach to the claim.

The Shellhouse claims are half a mile northwest of the head of Coco Harbor, at an elevation of 350 feet. A good trail leads from the cabin on the beach to the workings, which consist of an adit and a number of open cuts. The principal showings of ore are found in a large open cut above the adit. Samples taken from this open cut consist essentially of pyrrhotite and chalcopyrite.

ANTIMONY LODE ON CAAMANO POINT.

A lode of antimony ore was recently discovered on Caamano Point, the southern extremity of Cleveland Peninsula. The country rock is blue limestone intricately veined with calcite and quartz stringers and apparently interbedded with greenstone. The limestone beds strike N. 60° W. and dip 45° NE. The developments to date consist of a 12-foot shaft, a crosscut, and several open pits besides a blacksmith shop and a short trail to the beach. The principal ore body exposed by the workings is a lode of solid stibnite ore about 3½ feet wide, trending N. 60° W., parallel to the strike of the limestone beds, and standing nearly vertical. Its length is not evident, but parallel to it are smaller bunches of stibnite ore, all occurring in a brown-stained limestone ledge. The ore is composed of bunches of solid stibnite (antimony sulphide) with yellow alteration products along the fractures.

NONMETALLIC PRODUCTS.

MARBLE.

The marble quarry of the Vermont Marble Co. at Tokeen, on Marble Island, was operated on about the usual scale, employing 50 men. Assessment work was continued on the property of the Mission Marble Co., on Orr Island; on the Dickinson and Bell claims, on Carroll Inlet; and on the Marble Heart and associated groups, on the west coast of Dall Island, but no production was made. The marble deposits of southeastern Alaska are described in detail in a forthcoming Survey bulletin.[1]

BARITE.

Development work on the barite deposit on Lime Point, Prince of Wales Island, was continued in 1916 by a small crew of men, and a crushing plant near the Jumbo wharf was in process of construction.

WRANGELL DISTRICT.

WOEWODSKI ISLAND.

The only productive mining in the Wrangell district in 1916 was at the Maid of Mexico mine, on Woewodski Island (fig. 1), from which a small test shipment of ore was made.

The property consists of six claims, comprising the Maid of Mexico, Maid of Mexico South Extension, and Maid of Mexico North Extension Nos. 1, 2, and 3, situated on the border of Spear Lake, about 1¼ miles from the coast, at an elevation of 400 feet. This property is being developed on a vein of quartz carrying metallic sulphides and free gold. The country rock is greenstone schist with interbedded black slate cut by dikes of porphyry. The dominant strike is about east, with a steep dip to the south. The vein is about parallel to the inclosing country rock. It strikes from east to N. 60° E. and dips 60°–80° to the south and southeast. It follows the porphyry, in places lying between porphyry and black slate and in places penetrating the porphyry. The vein averages 4½ feet in width in

[1] Burchard, E. F., Marble resources of southeastern Alaska: U. S. Geol. Survey Bull. 682 (in preparation).

the underground workings, but in the open cuts on the Maid of Mexico North Extension No. 1 it is much larger. Where the vein cuts the porphyry dikes it is wider and more irregular than where it lies between slate and porphyry. The quartz carries sphalerite, galena, pyrite, and chalcopyrite, and in places considerable visible gold. The walls are very clean, and the ore breaks away easily. A small parallel stringer occurs about 50 feet north of the main lode. South of the Maid of Mexico another lode has been cut on the adjoining Maid of Texas group of claims but has not been opened.

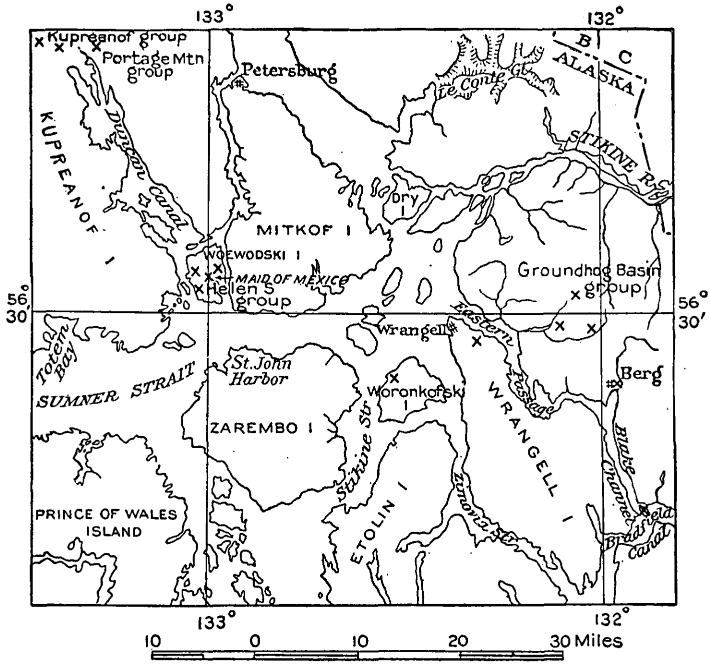


FIGURE 1.—Map showing location of prospects in the vicinity of Wrangell.

The principal work has been done on the Maid of Mexico claim. A crosscut adit 130 feet long cuts the vein 82 feet below the surface, and from this point a drift has been extended 20 feet to the west and 150 feet to the east along the vein. The vein has also been exposed by surface trenching above the adit and drift and also by open pits on the Maid of Mexico North Extension No. 1 and a short adit on the boundary line between the two claims.

MAINLAND.

Assessment work was continued in 1916 at the properties in Ground Hog and Glacier basins. These properties are located 12 miles east of Wrangell, on the mainland, and may be reached by trail from the cabin at the mouth of Mill Creek to the foot of Mill

Lake, by boat across the lake a distance of 3 miles, and by trails from the head of the lake—one trail leading to Glacier Basin and another along Porterfield Creek to Ground Hog Basin—a distance of about 4½ miles from the head of Mill Lake.

The workings are at elevations of about 1,500 to 2,100 feet on the eastern branch of Porterfield Creek. Two ore bodies are being developed, one on each side of the creek. The country rock is argillite and crystalline schist composed essentially of quartz, feldspar, biotite, and hornblende, with accessory garnet, rutile, and pyrite. The general strike is northwest with steep dips northeast. The schist is cut by bodies of porphyritic quartz diorite and dikes of alaskite porphyry, a light-colored rock composed of quartz, orthoclase, and microcline with a little biotite and garnet as accessory minerals.

South of the creek a 15-foot adit crosscuts a lode about 10 feet wide with a hanging wall of schist and a footwall of argillite. The lode carries galena and sphalerite. Along the hanging wall occurs about 20 inches of nearly solid galena. The remainder of the vein contains disseminated galena and sphalerite. Mineralization was less pronounced toward the footwall, where the mineralized rock passes gradually into the slate country rock.

Other workings are on the north side of the creek at an elevation of 2,100 feet and consist of open cuts and two adits, one 12 and one 160 feet in length. The ore bodies are inclosed in dense green crystalline schist cut by many porphyry dikes, along which the lodes have been formed. Both country rock and lodes strike N. 45° W. and dip 63° NE. The best exposures are found in the ong adit, which trends N. 55° E., almost perpendicular to the strike of the country rock and the lode, and which cuts the lode about 70 feet from the portal. The lode as exposed in this opening has a stope length of 30 feet and a width nearly as great. It is diffusely mineralized with sphalerite, galena, and pyrite and contains lenses of nearly solid sulphide ore. Sulphide minerals with accompanying quartz stringers occur in the green schist near the face of the adit. About 100 feet above this opening there are a number of surface cuts and a short adit in the outcrop of the lode, which may be traced along the side of the gulch for a long distance by the wide zone of oxidized rocks.

Development work was continued on the Berg property, on the mainland about 20 miles southeast of Wrangell. It is reported that an adit has been driven for 300 feet, and that work will be resumed in the spring.

LODE MINING IN THE JUNEAU GOLD BELT.

By Henry M. Eakin.

GENERAL SUMMARY.

The progress of the mining industry in the Juneau gold belt (Pls. VI and VII) in 1916 was marked by the continued large-scale operation of most of the established plants, by the construction of larger reduction plants on properties of advanced development, and by the consolidation and enlargement of enterprise in the exploitation of properties hitherto but little developed. Advance was made in determining the extent and character of reserves in the several mines, in more specifically delineating mining difficulties that threaten safety or economy of operation, and in adapting systems of exploration and mining to overcome these difficulties.

The Treadwell group of mines, on Douglas Island, carried on normal operations until August 1, when part of the stamp-mills were shut down to avoid further drawing of ore from beneath settling ground that threatened the safety of the Treadwell, Seven Hundred Foot, and Mexican mines. The other properties continued operating as usual. Other activities on Douglas Island included assessment work on a number of different properties south of the Treadwell group and diamond-drill prospecting on the Tyee, Jersey, and Holman claims, north of Treadwell.

On the mainland near Juneau the Alaska Gastineau and Alaska Juneau properties were in active operation, and development work was in progress on the Alaska Ebner property. Prospecting equivalent to the required assessment work was done on several other properties.

North of Juneau along the gold belt the Eagle River, Jualin, and Kensington enterprises represented the chief activity. The Eagle River and Yankee Basin properties were consolidated early in the year, but no development work beyond the annual assessment work was done. The Jualin mine operated on a moderate scale throughout the year. The new project of developing and equipping the Kensington mine on a 500-ton daily basis was being rapidly executed in 1916, with a view to completion by the spring of 1917.

South of Juneau only small-scale operations were carried on in 1916. The Alaska Gold Belt Co. did a little open-cut prospecting on its claims at the head of Grindstone Creek. At Taku Harbor several claims are still held. At Limestone Inlet Williams & Leak installed a 5-stamp mill and tramway on their property and are reported to have milled some ore. Small operations at Snettisham are also reported. At Windham Bay a consolidation of properties with a view to larger enterprise in development had been made, and engineers were on the ground during the summer making examinations in the interests of prospective investors.

West of Juneau, at Funter Bay, on Admiralty Island, four different properties are held, and assessment work for 1916 is reported to have been done on each. The ground of the Funter Bay Gold Mining Co. has passed into the ownership of a new concern, the Admiralty Alaska Gold Mining Co. The 10-stamp mill on this property, which had been run for several months testing ores, was shut down early in 1916, and development work was suspended pending financial arrangements for enlarged operations.

DOUGLAS ISLAND.

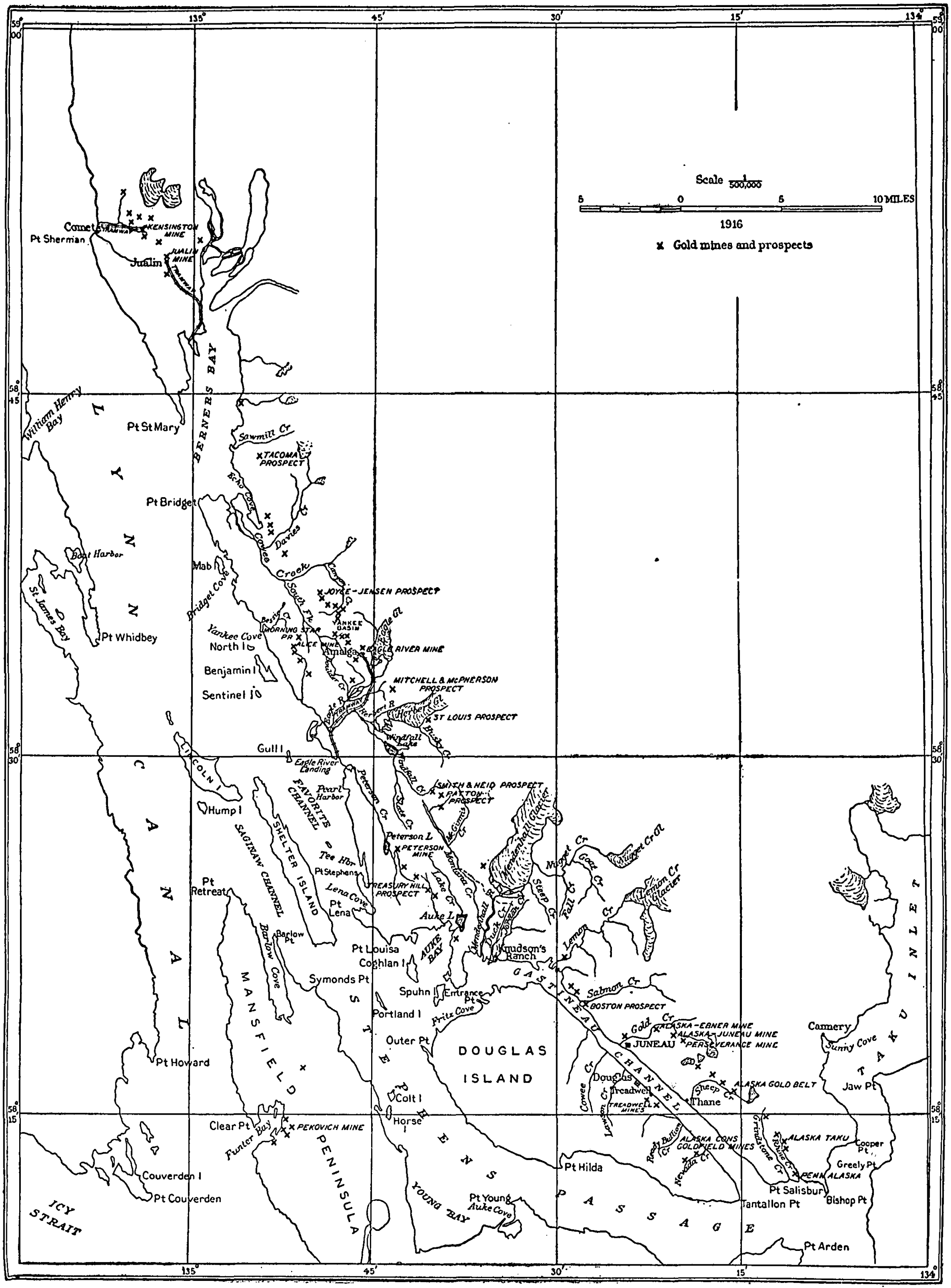
TREADWELL GROUP.

The Treadwell group of mining companies, operating on Douglas Island, carried on mining and milling operations as usual for the first seven months of the year, treating 972,765 tons of ore, an average of 138,966 tons a month. Late in July signs of a subsidence of the hanging wall appeared at the surface near the boundary between the Treadwell and Seven-Hundred Foot claims, over the workings from which the main supply of ore was being drawn. To protect the mines from the dangers of further subsidence the heavy removal of this ore was discontinued August 1 and the 240-stamp mill and half the 300-stamp mill were shut down. The remaining 550 stamps continued normal operations for the rest of the year, treating 422,215 tons, or an average of 84,443 tons monthly, a deficiency of 54,523 tons a month compared with previous operations.

The ore treated during the whole year aggregated 1,394,980 tons, with a total production of $2,466,936 worth of bullion. The following table gives the yearly gold production of the mines from the commencement of operations:

Value of gold produced by Treadwell group of mines, Douglas Island.

1882–1884	$10,902	1896	$1,028,691	1908	$3,124,047
1885	280,479	1897	1,011,693	1909	3,534,871
1886	366,180	1898	1,010,235	1910	3,737,498
1887	476,934	1899	1,611,857	1911	4,983,474
1888	429,889	1900	2,081,840	1912	4,080,300
1889	652,490	1901	1,665,373	1913	3,904,066
1890	160,681	1902	2,223,373	1914	3,743,945
1891	769,765	1903	2,667,914	1915	3,228,066
1892	707,017	1904	2,845,994	1916	2,466,936
1893	694,658	1905	3,146,715		
1894	909,990	1906	3,085,324		64,013,782
1895	852,585	1907	2,520,000		



MAP OF THE NORTHERN PART OF THE JUNEAU GOLD BELT.

The subsidence of the surface mentioned above has followed a series of cavings in the upper workings, which began as early as 1913. It has been accompanied by fissuring in the hanging wall and the appearance of a moderate flow of salt water on the 1,600-foot level. These phenomena constitute a menace that must be taken into account in further operations.[1] They affect the rate at which the broken and caved pillar ore can be safely drawn from the upper levels, and perhaps also the amount of this stock that can be finally utilized.

Shrinkage in assay values of the material in the intermediate levels down almost to the 2,100-foot level has caused the abandonment of stopes that otherwise might have supplied the requisite ore for normal milling operations at the present time. As the levels below the 2,100-foot level, where the ore is of higher value, are not yet developed to the productive stage, the mill supply is curtailed to the point indicated by the operations after July 1.

Consideration of the advantage of a unified system of operation of the Treadwell group of mines led to the appointment of a committee to determine a basis of consolidation. The report of this committee, which was submitted July 31, 1916, is in large part reproduced in the Mining and Scientific Press of August 26, 1916. It presents an exhaustive analysis of the past and possible future showing of the different properties, discusses geologic and mining conditions, gives the committee's findings with respect to an equitable basis for consolidation, and proposes a program for future development work. The plan of consolidation appears especially fortunate in view of the difficulties that have arisen to make the expensive work of deeper exploration and development imperative.

The deeper development work was carried on rapidly during the year. The central shaft was completed for the 2,500 and 2,700 foot levels, and the combination shaft was being sunk to the 2,100-foot level. An incline was being sunk in the Mexican mine below the 2,100-foot level. These improvements will combine to give a complete service and ventilating outlet for the stopes on the 2,300, 2,500, and 2,700 foot levels. Diamond drilling below the 2,300-foot level was carried on in the Seven Hundred Foot mine, testing the ore body at least to the 2,700-foot level.

A total of 14,383 feet of development work was done during the year on the entire group. By far the greater amount was done in the Seven Hundred Foot and Ready Bullion mines in developing the ore bodies in the lower levels. In both mines the reserves of ore in sight and broken ore were increased materially. The development work done in the Mexican mine during the first eight months of the year

[1] Further caving and surface subsidence occurred Apr. 21, 1917, resulting in the complete flooding of the Treadwell, Seven Hundred Foot, and Mexican mines with sea water.

was mainly on the 2,100-foot level. The later work was chiefly on the 2,300-foot level, where preparations for stoping are in progress. In the Treadwell mine development work was practically suspended after August. Earlier in the year considerable work had been done in opening prospective ore bodies on the 2,100 and 2,300 foot levels.

MAINLAND.

ALASKA GASTINEAU MINING CO.

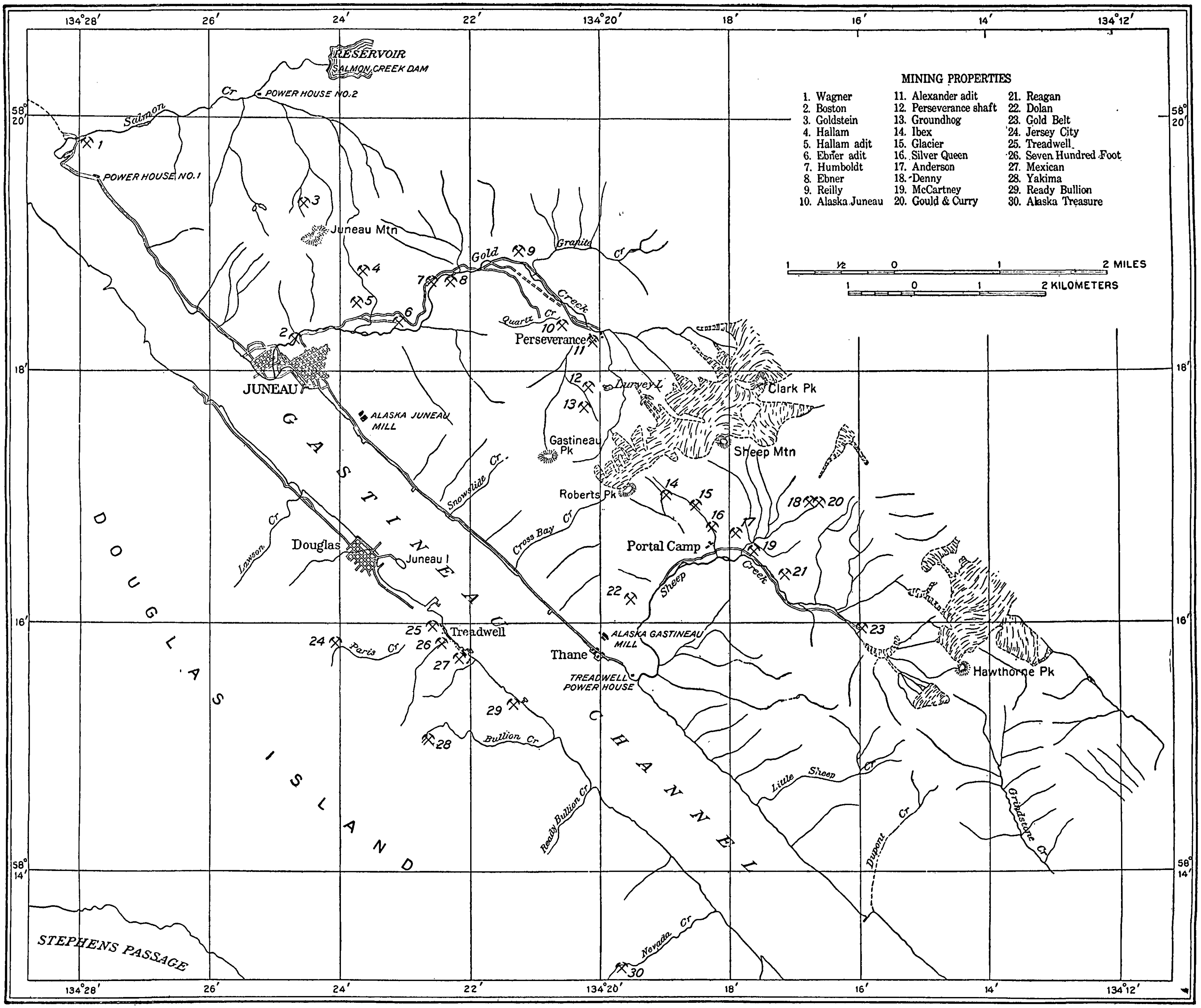
The Alaska Gastineau Mining Co. is the operating company for the Alaska Gold Mines Co., whose properties comprise mineral lands in the Sheep and Gold creek basins, a mill site at the mouth of Sheep Creek, and water-power sites on Salmon and Annex creeks. The development of all these properties was completed in 1915, and operations were carried on throughout 1916 on a 6,000-ton daily basis. The advantages of abundant water power, modern facilities, and simplified methods of extraction have afforded the lowest cost of operation yet achieved in the region.

Owing to the addition of waste from the hanging wall of stopes on the higher levels the average tenor of the ores milled fell below the original estimate, and this has caused misgiving in some quarters regarding the ultimate success of the enterprise. However, the difficulties in the way of selective stoping were being overcome and the tenor of ores showed a gradual improvement month by month, promising soon to reach the desired grade. Smaller stopes than those originally opened are necessary to the production of cleaner ore from the mine. The expense of mining by this method will be greater, but it will be offset by the higher tenor of the ore supplied to the mill. As the levels in the 1,600-foot backing above the main adit are developed to the productive stage the capacity of the mine for producing a proper grade of ore will increase, and without doubt it can be kept equal to that of the present mill for a long period before resort to the reserves below the main adit level must be had.

ALASKA JUNEAU GOLD MINING CO.

The Alaska Juneau Gold Mining Co. proceeded energetically throughout the year with the enlarged development of the mine and the construction of the new 8,000-ton mill.

The main haulageway from mine to mill was widened and equipped throughout with double tracks of 50-pound rails suitable for the traction of 10-ton ore cars, which are to be used exclusively in the enlarged plan of operations. The development of the north ore body was advanced by the completion of undercutting the great stope, 250 feet wide and 700 feet long, with the necessary ore ways, chambers, and gates, for drawing ore along both sides. Work pro-



MAP SHOWING LOCATION OF MINING PROPERTIES IN THE JUNEAU DISTRICT.

ceeded also in driving raises and powder tunnels in the north ore body above the cut-out area, preparatory to the enforced caving of ore into the stope chamber as drawing proceeds. The south ore body was developed further by driving on working and prospect tunnels and by preparations for stoping selected bodies of proved ore. Although it is expected that the north body can furnish enough ore to supply the rated capacity of the mill, the development achieved on the south ore body makes it possible to supplement the output from this source whenever necessary.

The construction of the mill went ahead steadily during the year. Late in autumn the housing had been completed and the installation of machinery and power plant was well advanced, with the expectation that all would be in readiness for operation early in the spring of 1917. The new mill uses jaw crushers to reduce the ore to 6-inch size, gyratory crushers for reduction to 3-inch size, and ball mills for the first phase of further reduction. Suitable grizzlies are provided so that all undersize is removed ahead of each crushing operation. That part of the ball-mill product going through 10-mesh screens is passed to roughing concentrators; the oversize from these screens is returned to tube mills for regrinding. Classifiers follow the roughers, the fines passing to the finishing tables and the oversize to tube mills for regrinding. Crushing and concentrating are the only operations in the process of ore reduction. The ball-mill practice is patterned closely after that of the Inspiration mill of Arizona.

The 50-stamp pilot mill was run at full capacity most of the year, treating a share of the ore produced in enlarging the mine. Its operation not only served to utilize the ore necessarily produced in drifting and opening stopes but gave practical tests of ores from the different workings and of methods of treatment.

JUALIN MINE.

Operations at the Jualin mine were continued during 1916 on the reduced scale that was adopted at the beginning of the European war, owing to its foreign financial backing. However, there was a gradual increase in the extent of operations during the year, the force of 20 men employed at the start being increased to 65 by the latter part of the summer. The work is progressing on the plan of milling only the ore produced in developing the mine. No stoping is done, as the 10-stamp mill is fully supplied by the ore that is taken from the shafts and drifts that are being driven on the lodes. Although the mine is being developed into a larger producer more slowly than was originally planned, the present operations have the advantage of being self-supporting.

According to Knopf[1] the work done prior to 1910 had developed three parallel veins, 75 feet apart, trending N. 40° W. and dipping 60° NE. to 90°. At that time the workings had reached a depth of 200 feet below the adit level, which is 750 feet above the sea.

The later development work has been directed mainly to the two outside veins. The workings have reached a depth of 310 feet below the adit level, and it is planned to extend them as rapidly as possible to 1,000 feet below the adit.

The northeast vein has an average width of about 7½ feet, and the southwest vein of 5 feet, in the developed areas. The horizontal extent of the ore bodies in each vein is about 400 feet.

The mine waters, which were formerly a hindrance to operations, are now fully controlled. They are collected on the 300-foot level and pumped to the surface at the rate of about 500 gallons a minute. The deeper development is planned so that the mine below the 300-foot level will be entirely dry. Control of the water has been achieved by additions to the pumping and power facilities. About 1,200 horsepower is developed by the hydroelectric plant on Johnson Creek in summer. In winter this is reduced to about 100 horsepower, and additional power is developed by internal-combustion engines as required.

The plans for a larger mill are in abeyance pending a fuller development of the mine in depth. The ores in the upper workings are free-milling, so that ordinary amalgamating methods give a high recovery. In neighboring mines the ores change in character with depth, and a high extraction from the deeper ores is best obtained by flotation methods. The continued development of the mine on a moderate scale will give excellent opportunity for investigating the ores and designing the best equipment for their treatment.

KENSINGTON MINE.

After the consolidation of the Kensington, Bear, and Comet properties by the Hayden-Stone interests the combined development of the Kensington, Eureka, and Johnson lodes by a single adit tunnel was undertaken. This tunnel, known as the Kensington crosscut, was completed for a length of over 5,000 feet in 1914, and additional work was done in drifting on the different lodes. In 1915 only the necessary assessment work was done on the properties, but the reserves that had been developed were investigated further, and plans were matured for future development. These plans contemplated the exploitation of the known reserves with the least practicable expense for equipment and operation. The lodes were to be developed from the Kensington crosscut only; the mill was to be adapted to the use of flotation methods of extraction, with a daily

[1] Knopf, Adolph, Geology of the Berners Bay region, Alaska: U. S. Geol. Survey Bull. 446, p. 45, 1911.

capacity of 500 tons; power was to be developed from streams without artificial water storage, and the scale of operations at different seasons was to be adjusted to the power available from this source—at or above the rated capacity of the plant in summer and at a standstill for a part of the winter. The quarters and other housings on the properties were to be rehabilitated and enlarged as required, and proper rail connections between mine and mill were to be constructed.

Active work on the execution of these plans was deferred until 1916, when it was begun with the expectation of completion early in the spring of 1917. The time schedule adopted for different phases of the work permitted the constant employment of a fairly uniform force of workmen. The wharves, buildings, railways, and trams, hydroelectric plant, milling plant, and concentrate storage and loading plant were to be completed in the order named, and productive operation was to begin May 1, 1917, on the completion of the mill. The progress that was reported late in 1916 indicated that this time schedule was being met.

The Kensington lode, which is fully developed above the adit level, is to furnish the main supply of ore for the first milling operations. The reserves in this part of the lode are said to exceed 500,000 tons. This plan will permit a gradual further exploration and development of the Johnson and Eureka lodes.

The ore is to be stoped by the shrinkage method from levels 200 feet apart, and delivered to the main haulageway in the Kensington crosscut through an ore-way raise in the footwall. Tramways are to deliver the ore from stopes to the ore-way on each level. From the bottom of the ore-way the ore is to be drawn into cars and hauled by storage-battery locomotives to a 250-ton crib outside the portal of the Kensington crosscut. The ore is to be drawn from the crib into 6-ton skips operating on a 3-rail automatic reversible inclined tramway, delivering at a 150-ton hopper at the mill. The hopper bin will feed the ore by gravity to a gyratory crusher, giving a 3-inch product to be elevated to a 500-ton storage bin. Belt conveyors are to carry the ore from the storage bin to ball mills, whose product first goes to equalizing tanks and then to flotation machines. The flotation product is then to be dewatered and loaded directly from the filter to 5-ton cars for haulage to the wharf tipple.

Experimental work in the flotation of the Kensington ores shows that this method of treatment is far superior to the amalgamation process that was formerly used. Extractions of 92 per cent to over 97 per cent have been made, about 4 pounds of oil being used to the ton of pulp. Further experiments with a view of reducing the consumption of oil and power were in progress during 1916.

FUNTER BAY, ADMIRALTY ISLAND.

GEOGRAPHIC FEATURES.

Funter Bay is formed by a reentrant in the east shore line of Chatham Strait about 10 miles south of Point Retreat, the north extremity of Admiralty Island. It is 18 miles directly west of Juneau, but by water routes the distance is over 50 miles. The bay is about a mile wide and 2 miles long. The shore line is irregular, and the bay contains a number of small islands and reefs. There is a clear steamboat passage well into the head of the bay, and it forms an excellent harbor, with favorable sites for docks in many places.

The shore of the bay is marked in most of its extent by low sea cliffs, reaching 10 to 30 feet above sea level, back of which lie broad terraced tracts 50 to 200 feet above the sea. Half a mile from the shore line in most places the bay is encircled by mountains that rise very abruptly to various altitudes up to 3,500 feet. The mountains approach nearer the shore line on both sides of the entrance. The lowlands at the head of the bay extend northeastward for several miles.

The terraced lowlands and the mountain slopes are heavily timbered up to an altitude of 2,500 feet. The ground in the timbered areas is generally covered with moss and underbrush and above timber line with a heavy matted growth of shrubs and grasses, so that natural bedrock exposures are exceedingly rare away from the coast. Geologic study is therefore greatly assisted by the numerous open cuts, strippings, and tunnels that have been made on the mining properties during the 30 years that have elapsed since gold was first discovered here in 1887. The timber is largely of excellent quality spruce and cedar and far exceeds in amount any probable future requirements for mining purposes.

The region has an abundant rainfall, so that the run-off is copious and fairly constant. The low elevation of the streams that gather on the terraced lowlands permits only a small amount of water power to be developed from them. There is, however, in the mountains south of the bay, a high hanging valley whose stream is said to be well adapted to large power development.

GENERAL GEOLOGY.

The rocks of the Funter Bay district include a highly altered bedded series, dominantly greenstone schist and subordinately limestone or marble, and a few small dikes of diabase, andesite, and diorite, which cut the bedded rocks at wide intervals. The schistose cleavage of the metamorphic rocks is generally parallel with the bedding planes. Locally intense crumpling and close folding on a small scale are apparent, but in general the bedded rocks lie in broad and gentle folds. Over considerable areas both schistosity and bedding are near the horizontal. Joint systems on both large and small scales cut the bedded rocks at high angles with the schistosity and bedding or near the vertical. The major joint planes in places persist for hundreds and even for a thousand feet or more with great regularity in strike and dip. Such large fractures were probably accompanied by some differential movement between the blocks which they separate, but there is no definite indication of the maximum displacement. These planes are generally marked by quartz veins, which range in thickness, in the different individuals observed, from mere films to nearly 60 feet. At one locality four approximately parallel veins were measured in a section 330 feet across, whose thickness aggregated 90 feet. Obviously the introduction of this amount of quartz in a narrow section involved displacement of masses of the rock. T-shaped and L-shaped bends in some of the veins indicate differential movements amounting at least to the thickness of the veins. Other veins, which gradually thin out to their ends, do not have this significance. Faults later than the veins and offsetting them occur only here and there, according to present evidence.

The metamorphism of the bedded rocks is for the most part of regional character and of earlier age than the igneous dikes or the quartz veins which are unsheared. Later metamorphic agencies have affected the bedded rocks locally, adjacent to the quartz veins, resulting in silicification and bleaching of the greenstone schists, accompanied by the introduction of sulphide minerals and in places of gold. Such minerals also occur in bands of greenstone schist without associated quartz veins at two localities, but they are not believed to represent a distinct period of mineralization.

ECONOMIC GEOLOGY.

The quartz veins and mineralized schists of the Funter Bay district are generally more or less auriferous, and since the time of the original discovery in 1887 several tracts have been held for mining purposes. The history of location, abandonment, and relocation of claims in the district is too tedious to narrate. The salient facts are that a great deal of prospecting and a little mining has been done, and at present four groups of claims are held, on only one of which development has advanced beyond the prospecting stage. These properties are the Portage group, the Seattle group, the Admiralty Alaska Gold Mining Co.'s holdings, and the Otterson claims.

PORTAGE GROUP.

The Portage group of claims are about 2 miles northeast of the head of Funter Bay, in a low, rolling timbered area. These claims are said to have been located about 1894, but little development work had been done prior to 1904, when Wright [1] visited the district. He describes the mineral deposits of the claims as follows:

At the lower workings is an irregular vein apparently composed of a succession of lenticular quartz masses inclosed in slate. The strike of the lead corresponds with the northwest strike of the slaty structure, the dips being nearly vertical. The vein carries considerable pyrite and chalcopyrite with small amounts of galena, but assays are said to show that the ore is of low grade. A small shaft and open cuts expose the quartz at several points. Up the hill above these workings prospecting has been done on a belt of mineralized schist. This is exposed across a width of 30 feet and has a N. 10° W. strike and dip NE. 65°, the footwall being defined by an unmineralized and massive greenstone, the hanging wall by a gradual decrease in mineralization.

Additional prospecting has been done on the property year by year up to the present time, measured by the amount of assessment work required to hold title.

SEATTLE GROUP.

A number of claims, known as the Seattle group, about 2 miles southeast of the Portage group, have been held for the last five or six years, and it is reported that considerable work has been done in prospecting them. The geology is similar to that of the Portage group, the prospects being mainly in mineralized schists. These rocks are apparently similar to the mineralized schists near Youngs Bay, about 15 miles southeast of Funter Bay, and also to schists on Douglas Island, on the Yakima and Alaska Treasure properties.

ADMIRALTY ALASKA GOLD MINING CO.

LOCATION OF PROPERTY.

The holdings of the Admiralty Alaska Gold Mining Co. comprise two groups of claims, including the earliest locations made in the district. The lower group is on the south shore of the bay halfway to its head and includes the Tellurium, Uncle Sam, King Bee, Lone Star, and other less important claims. The upper group is on the north slope of the mountains half a mile to a mile southeast of the shore claims. It includes the Patterson, Heckler, Washington, Mountain Queen, and other claims. (See Pl. VI.)

HISTORY OF DEVELOPMENT.

The earlier history of this property is given by Wright [2] as follows:

The first discoveries at Funter Bay were the Tellurium group, made in 1887 by R. Willoughby and C. Wier, of Juneau, but development in excess of the minimum

[1] Wright, C. W., A reconnaissance of Admiralty Island: U. S. Geol. Survey Bull. 287, p. 150, 1906.
[2] Idem, p. 149.

legal requirements was not begun until 1894. In that year a Huntington revolving mill and a Frue vanner were installed at the Tellurium mine in order to thoroughly sample the ore, and favorable returns were reported from this experiment. In the following year the Alaska Willoughby Mining Co. bonded the property and installed a 10-stamp mill with four Frue vanners. They continued operations in 1895–96 and later sold their properties to the Funter Bay Mining Co., which continued developments on many claims.

The Funter Bay Mining Co. held the property until 1904, when it was acquired through the courts by J. W. Hunter, who had done the assessment work, to satisfy his claims for wages. The property was bonded early in 1915 by W. S. Pekovich, who later incorporated the Admiralty Alaska Gold Mining Co., to which he assigned his interests.

The mill installed by the Alaska Willoughby Mining Co. was used in 1895–96, when considerable ore from the Tellurium and Uncle Sam lodes was run. It was shut down before the Funter Bay Mining Co. acquired possession and remained idle until June, 1915, when Mr. Pekovich began operations. After a run of about eight months testing ores from the beach claims it was again shut down pending financial arrangements for enlarged operations. Except in these two short periods of productive operation little development in excess of the minimum legal requirements has been done on the property. The assessment work has consisted mainly in erratic prospecting, so that the properties are, on the whole, very poorly developed, considering that 30 years has passed since the original discovery was made.

The Tellurium, Uncle Sam, and King Bee lodes have supported practically all the productive mining and are therefore the best developed. The Tellurium lode is developed by a drift 123 feet long, driven from the beach just above tide level. For most of this distance it has been stoped out to the surface through a backing of 25 to 30 feet and with an average width of 5 feet.

The Uncle Sam lode is developed by a crosscut 98 feet long, leading from the mill to the vein, 228 feet of drifts, and about 1,000 feet of open-cut work. The vein is stoped out above the drift for 108 feet. A crosscut has been driven 70 feet on a fault plane about 200 feet from the mill crosscut, in the attempt to locate the offset portion of the vein underground. In the main drift 200 feet from the mill is a 30-foot winze sunk on a shoot of sulphide ore.

The King Bee lode is developed by an adit 200 feet long, open surface cuts 20 to 25 feet deep at short intervals for a distance of 1,000 feet, a shaft 110 feet deep, and crosscuts at the bottom of the shaft 30 feet toward the Uncle Sam vein and 132 feet toward the Tellurium vein. The shaft collar is on the beach below high-tide level. The cribbing employed to keep out the sea water has been destroyed, and it is now flooded. The vein has been stoped out to the surface above the adit for most of its length.

The other claims of the lower group are developed only by a few shallow surface pits.

The claims of the upper group have been prospected mainly by surface pits and strippings, but a little underground work has been done on some of them. There is an 85-foot shaft on the Patterson lode, a 51-foot tunnel on the Washington lode, a 40-foot tunnel on the Devil Club lode, and three tunnels aggregating about 650 feet on neighboring claims whose names could not be learned. About 50 exposures in all, a few of which were natural exposures, the others open cuts or strippings, were examined by the writer on the upper group of claims. Although some of the work done on these claims may have been overlooked, it is believed that the list given represents very closely the extent of development thus far accomplished.

Improvements on the property include the mill, bunk houses, shops, tramways, ditch lines, etc. The mill has its original equipment, consisting of ten 850-pound stamps, four Frue vanners, a 3½-inch Huntington revolving mill, a 9 by 14 inch Blake crusher, suitable boilers, engines, compressor, water wheels, ore elevator, etc. Quarters are available for about 30 men. The shops include a well-equipped assay laboratory.

Water is delivered to a penstock back of the mill by two ditches, one 5,000 feet long from the southwest and one 6,000 feet long from the northeast. A head of about 60 feet is developed.

THE LODES.

GENERAL FEATURES.

The lodes that occur on the property of the Admiralty Alaska Gold Mining Co. are all quartz veins. The cleavage and apparent bedding of the schistose country rock are near the horizontal over most of the area, and the veins occupy fissures that cut across these structural features at high angles. Many of the veins show great persistence in thickness and trend, and there is nowhere any suggestion of the bluntly lenticular form shown in the veins of the Portage group. Mineralization in the schists not directly associated with quartz veins is also lacking. It would appear that these differences are related to the structure of the bedrock encountered by the mineralizing solutions. In the Portage area the dips are high and the slaty and schistose structure afforded numerous channels for the upward passage of solutions, resulting in disseminated mineralization. In the Admiralty Alaska area, on the other hand, the only available channels were the stronger fissures cutting across the other features of the rock structure, along which the movement of solutions was definitely concentrated.

The introduction of the quartz veins was accompanied by local alteration of the adjacent schists. This action included silicification and the development of sericite and sulphide minerals. Some of the altered schists adjacent to the quartz veins are said to give substantial assays for gold.

The veins generally have a composite structure, as if they had gained their thickness by the addition of successive layers. The layers differ in color and mineral content in the same section and are generally separated in weathered exposures by a micaceous iron-stained gouge. Layers relatively rich in sulphide minerals and metallic gold may occur in the same vein with layers that are almost barren.

Pyrrhotite, pyrite, and galena are the most abundant sulphide minerals. Sphalerite occurs sparingly in places. Iron carbonate is abundant in some veins, especially in those that give the higher assays for gold. In these respects the mineralization in the Funter Bay district resembles that of lodes on the mainland near Juneau.

LODES OF LOWER GROUP.

There are three principal lodes on the lower group of claims whose characteristics have been revealed by development work. These are he Uncle Sam, King Bee, and Tellurium lodes, named in geographic order from southeast to northwest. The distance between the Uncle Sam and King Bee near the shore line is 100 feet, and between the King Bee and Tellurium about 700 feet. Near the beach the Uncle Sam vein strikes N. 55° E., the King Bee N. 60° E., and the Tellurium N. 65° E., so that their trends converge slightly to the northeast. A short distance from the beach the Uncle Sam vein turns to N. 65° E., and two parallel veins, not seen at the beach, appear southeast of the Uncle Sam at intervals of 10 and 20 feet.

The Uncle Sam vein has a width in the mined section of 6 to 10 feet. Farther northeast, where exposed in open cuts, it is only 1 to 3 feet wide. The parallel veins noted above are 6 and 10 feet wide. The quartz of the Uncle Sam vein is of the milky variety, but it generally has a reddish aspect due to iron staining. Sulphide minerals, chlorite, and iron carbonate occur irregularly through its mass, finely disseminated in some places and segregated into irregular patches in others. A shoot of sulphide ore occurred in the vein about 100 feet from the mill crosscut, standing nearly vertical, about 8 feet across at the drift level and pinching downward for 30 feet. A shipment of 22 tons of ore taken from the shoot and sent directly to the smelter is said to have yielded $134 a ton in gold. The gold occurs mainly with the sulphides throughout the vein, so that the tenor of the ore can be estimated from its appearance.

The King Bee vein is similar to the Uncle Sam in appearance and size but appears to hold its width more uniformly back from the beach. It is said to persist in size and gold tenor to the bottom of the 110-foot shaft. This lode supplied a large part of the ore milled by the Alaska Willoughby Mining Co. and is probably the most promising of all the lower lodes for future development.

The Tellurium lode is said to be 10 feet wide in the beach cropping, which is now covered by shingle. It pinches gradually back from the beach and at the face of the 123-foot drift is only a few inches wide. Sulphide minerals, chiefly pyrrhotite, are abundant in the vein matter and along the walls. Calcite and iron carbonate also occur as gangue minerals. The ore mined from this ledge is said to have had the highest average value found in all the workings.

The other veins exposed on these claims have been but little developed, a fact which may indicate that they are relatively lean. A white quartz vein about 6 feet wide near the Tellurium examined by the writer showed no sulphide minerals except a little sphalerite and on assay gave not even a trace of gold. The veins southeast of the Uncle Sam contain no visible sulphides in the surface croppings.

As the property now stands there is little ore in sight above tide level in the lodes of the lower group of claims. The backing of most of the drifts has been mined out, so that future development must look to the extension of the veins below tide level. Any project for their development must include plans for pumping not only the surface waters, which now enter through the long open cuts, but also more or less sea water that will seep in along the veins. Surface waters are known to sink along the veins in places and probably reach the sea through underground crevices. This flow would undoubtedly be reversed if lower levels were opened in the mines.

The extent and availability of the lodes below sea level will be known only after much systematic prospecting has been done. It would appear that diamond drilling could be used advantageously in testing veins adjacent to the one that may be chosen for the first development work at depth.

LODES OF UPPER GROUP.

A large number of distinct veins were examined by the writer in the area of the upper group of claims, which lie on the steep northerly mountain slope half a mile to a mile southeast of the lower group. It is likely that not all existing exposures were found and also that there are many veins that have no visible croppings. Enough was seen, however, to show that veins on these claims are more numerous and much larger than those nearer the coast.

In working without an adequate base map it was impossible to show the positions of the veins examined or to learn the names of the claims on which many of them were located.

The most development work has been done on the Patterson and Heckler claims. The Patterson claims are about a mile southeast of the mill; the Heckler claims lie east of them.

Veins are developed on the Patterson claims at two places; at one by an 80-foot shaft and at the other by an open cut. The shaft is sunk on a 6-foot vein containing sulphides and bordered by bleached schists that are strongly mineralized. The open cut crosses four veins aggregating 6 feet of quartz in a width of 16 feet. The main veins consist of milky quartz, but in places bodies of bluish translucent quartz containing albite crystals as much as half an inch in length project from them out into the schists along the structure planes. Both types of quartz are said to be gold bearing.

On the Heckler claims, at an elevation of 1,700 feet, a stripping shows a quartz vein 57 feet across. The section northeast of this cropping along the hillside includes three other veins, two of them 10 feet and the other 12 feet wide, giving an aggregate of 89 feet of quartz within a space of 330 feet. The 57-foot vein is said to be ore; the other veins are not known to have been sampled. But little mineralization is apparent in any of these veins.

At an elevation of 1,360 feet on the Heckler property, directly down the slope from the exposures just described, is the outcropping of the so-called Heckler blanket vein. The vein strikes N. 45° E. and dips 60° NW., conforming with the slope of the hill. It is 3½ to 5 feet thick and has an overburden of bleached mineralized schist 6 feet thick. The vein has been stripped for 90 feet down the slope, over a width of 30 feet. It shows a very pronounced laminated structure. Some laminae are very rich in sulphide minerals and iron carbonate. A layer a few inches thick near the hanging wall contains visible gold and the whole vein is said to give especially high assays for gold. Weathering of the sulphides and iron carbonate has produced large quantities of iron oxide, which fills crevices between the more distinct laminae and also numerous vugs that are lined with quartz crystals.

Southwest of the "blanket vein," at an elevation of 900 feet, a 200-foot tunnel has been driven on a 6-inch vein. The tunnel is said to have been planned to undercut some of the larger veins of the property about 700 feet from the portal. The 6-inch vein is made up of several laminae with margins of interlocking quartz crystals. It is rich in pyrrhotite, pyrite, and iron carbonate, and where weathered all crevices and vugs are filled with iron oxide. It is said to have a high gold tenor. The vein persists with even thickness and structure for the whole length of the tunnel and is exposed at intervals on the slope above the tunnel for several hundred feet. In some of the higher exposures it contains arsenopyrite and pyrrhotite.

Many other veins, 2 to 10 feet thick and trending in various directions, were examined in natural outcrops, open cuts, strippings, and short tunnels in the course of the traverse over the upper group of claims. Their abundance and complex structure indicate that the bedrock over an area of a square mile or more is intricately seamed with intersecting quartz veins of minable size. Evidence of more or less mineralization is generally apparent, though there are croppings here and there without visible sulphide minerals.

The first requirement for further development of the property is an accurate base map, on which the veins may be plotted. Then systematic prospecting and assay work should be employed to determine the extent and relations of valuable lodes and also the best scheme of exploitation.

OTTERSON CLAIMS.

The Otterson claims are southwest of the upper group of the Admiralty Alaska property, in a corresponding topographic position. They were not seen by the writer, but it was learned that the general aspect of the lodes is similar to those of the property to the northeast. They are said to be well-defined quartz veins 20 feet or less in width, in which gold is associated with sulphide minerals. Specimens from some of them show visible gold embedded in quartz and in pyrrhotite patches in the quartz. Prospecting work was in progress on the property in the summer of 1916.

GOLD PLACER MINING IN THE PORCUPINE DISTRICT.

By Henry M. Eakin.

INTRODUCTION.

The Porcupine gold-placer district includes an area drained by westerly headwater tributaries of Chilkat River that centers about 40 miles northwest of Haines, a small town on the shore of Lynn Canal, 75 miles north of Juneau. Placer gold is known to occur in the basins of four tributaries of the Chilkat, which, named in order from north to south, are Bear Creek and Klehini, Salmon, and Takhin rivers. The original discovery in 1898 was made on tributaries of Klehini River which have since been the chief source of production. The other basins have witnessed more or less prospecting and desultory development work, but they have contributed little to the output of the district. For several years mining operations in the district have been confined to Porcupine and Glacier creeks, which are southerly tributaries of Klehini River, 12 and 14 miles respectively from its mouth.

The region was first visited by a Geological Survey party in 1899, when an exploratory expedition passed through it on the way from Pyramid Harbor to Eagle.[1]

In 1903 C. W. Wright, of the Survey, spent three weeks in further examination of the district, and the results of his studies were published the following year.[2] The writer visited the district early in the summer of 1916, spending two weeks in the examination of properties now under development and in the study of bedrock and glacial geology related to the formation of the placer deposits. The publications of the earlier investigations have been freely consulted in assembling the matter of this paper.

TOPOGRAPHY.

The region lies within the coastal mountain province of southeastern Alaska and partakes of its general characteristics of strong relief and glacially developed forms. Summit elevations along the principal divides generally range between 3,000 and 5,000 feet, but

[1] Brooks, A. H., A reconnaissance from Pyramid Harbor to Eagle City, Alaska: U. S. Geol. Survey Twenty-first Ann. Rept., pt. 2, pp. 374-376, 1900.

[2] Wright, C. W., The Porcupine placer district, Alaska: U. S. Geol. Survey Bull. 236, 1904.

individual peaks rise 6,000 to 7,500 feet above sea level. The main valleys are broad and steep sided and are floored by heavy gravel deposits of glacial streams. The topography has a smoothed aspect up to an altitude of about 3,000 feet, marking the level reached by ice during earlier periods of glaciation. Glaciers of considerable size still persist on the headwaters of the streams that drain the higher divides.

EROSIONAL HISTORY.

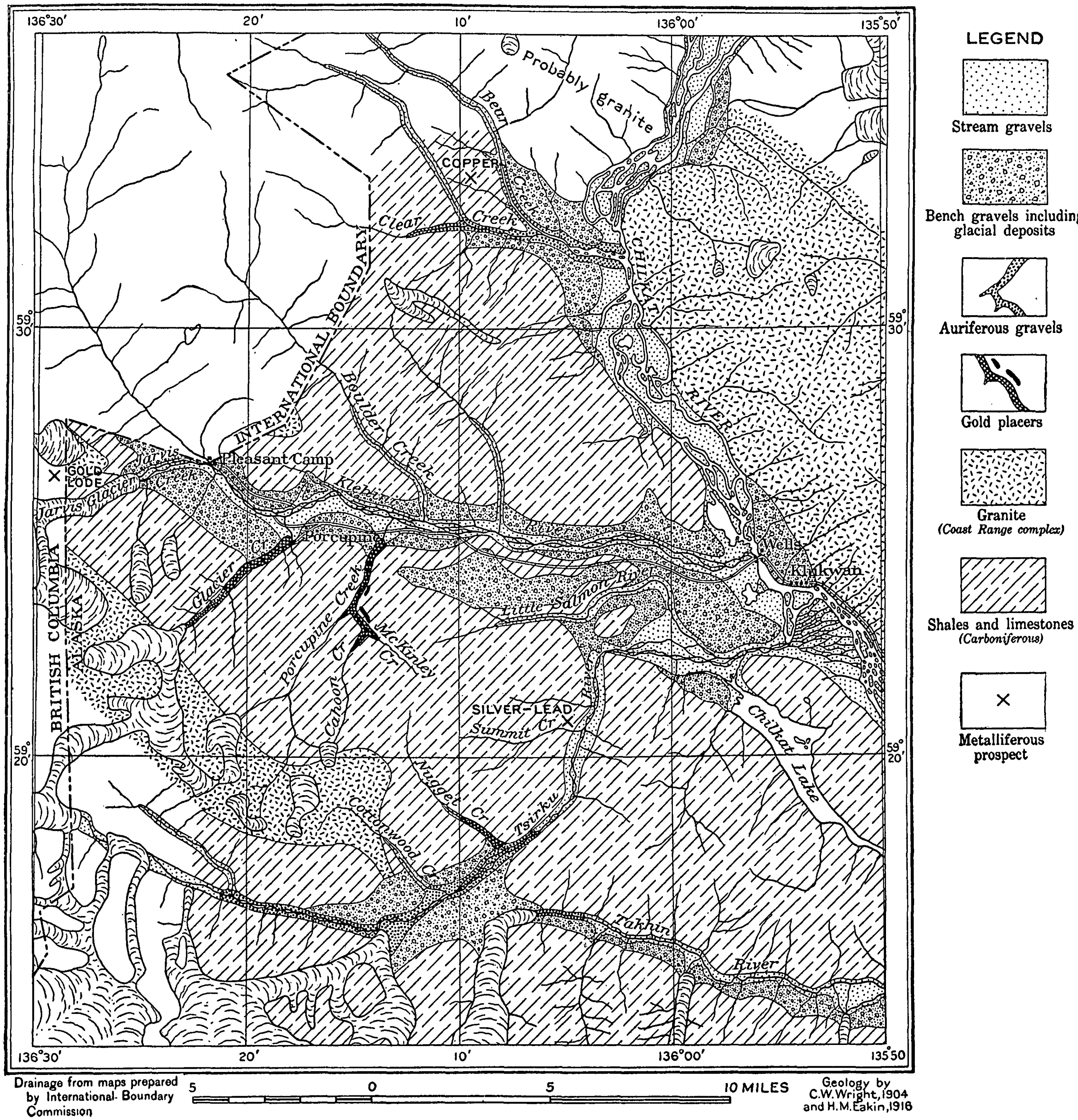
During the period of more extensive glaciation of the region both trunk and tributary valleys were deeply scoured by ice action, but the main valleys were generally lowered below the levels of their tributaries, which thus became hanging valleys. When the ice had retreated the streams from the hanging valleys found abrupt declivities in their courses at the margins of the main valleys. These conditions favored the erosion of canyons in tributary valleys and the deposition of detritus in the form of alluvial fans along the margins of the main valleys. These features are well illustrated in the present canyons and alluvial fans of Glacier and Porcupine creeks.

In places in the Porcupine Valley at the side of the present canyon there are so-called bench deposits. These consist of stream gravels overlain by glacial detritus. It is evident that these deposits occupy sections of a canyon, older than the present one but due to similar processes, which was in some places followed and in others missed by the course of Porcupine Creek when the last intrenchment began. Two distinct ice advances are thus indicated, each of which was followed by intrenchment of the hanging-valley streams.

The modern canyon has been eroded to a lower level than the earlier one throughout the middle and upper sections of Porcupine Valley. Near the lower end of the valley the conditions are not so simple, and it seems likely that the stream accomplished considerable intrenchment along more than two courses.

The identity and relations of the different bedrock canyons at this place could not be fully deciphered from the available exposures. It is clear, however, that the Porcupine was controlled by a lower base-level than that afforded by the present position of Klehini River at the time of maximum intrenchment in each position.

In Glacier Creek valley also there is evidence of two distinct ice advances, with an intervening period of stream erosion. An extremely deep and narrow bedrock gorge filled with glacial detritus has been traced for some distance along the lower part of the valley beneath the modern stream gravels. A base-level of erosion much lower than the present is indicated, the same as in the lower Porcupine Valley. The upstream extension of this older canyon is not now evi-



MAP SHOWING ECONOMIC GEOLOGY IN THE VICINITY OF PORCUPINE.

dent. It may have been destroyed by later ice erosion in Glacier Creek valley or it may have been followed by the stream in its last intrenchment. The narrowness of the valley favors the latter interpretation.

PLACERS.

The concentration of placer gold took place in conjunction with the intrenchment of the hanging-valley streams wherever their courses traversed zones of mineralized bedrock. The placers are therefore of two distinct ages, corresponding with the separate periods of stream erosion. The concentrations are generally found in a thin stratum of stream gravels lying on the bedrock bottoms of the canyons. Locally, as below the falls on McKinley Creek, gold has been found on bare bedrock practically without associated gravels. The gold-bearing stratum is generally overlain by barren or very low grade gravels that are progressively deeper downstream. The stream gravels in the bottoms of the older canyons, which are gold bearing in places, are overlain by glacial detritus whose depth is generally measured by the height of the canyon walls. In the lower section of Glacier Creek modern gravels overlie the glacial fill of the older canyon, which extends to a great depth below the present stream and has a much steeper grade. At the lower ends of the modern canyons, where the alluvial fans begin, there are certain concentrated deposits that extend into the gravels somewhat above bedrock. They are less regular in form and of lower grade than the gravels within the confines of the canyons and extend but a short distance out into the Klehini Valley. Apparently the alluvial fans are devoid of notably concentrated placer deposits except possibly at their very heads.

GEOLOGY.

The solid rocks of the district consist mainly of metamorphosed sedimentary types, including limestones, slates, phyllites, and schists. The schists are apparently developed only locally through excessive alteration of beds that are generally represented by slates and phyllites. Likewise silicification of limestone has produced quartzitic beds in small areas.

The general area of sedimentary rocks is bordered on the northeast by the great belt of diorite that extends southeastward in the Coast Range. Outlying masses of diorite are intruded into the sedimentary rocks for some distance southwest of the principal contact. The general distribution of these rocks is indicated on the geologic map (Pl. VIII), which is reproduced, with slight corrections, from a map drawn by Wright.[1]

[1] Wright, C. W., The Porcupine placer district, Alaska: U. S. Geol. Survey Bull. 236, pl. 5, 1904.

The structure of the sedimentary rocks has not been worked out in detail, but the observations that have been made indicate that it is exceedingly complex. The beds are steeply tilted wherever observed, dips of 75 to 90° being common. The apparent trend of the great limestone band that crosses the lower courses of Glacier and Porcupine creeks is northwesterly. The limestones of the Klehini Valley above Jarvis Creek also strike northwest, and this is the direction of the larger igneous bodies of the region. However, in many places in Klehini and Jarvis valleys where observations on the structure of the slates were made the strike is northeast. The apparent differences in the structure of the slates and limestones suggests that the limestones may be younger and overlie the slates unconformably. This interpretation gains added weight from the fact that the slates have a structure indicating strong compression, whereas the limestones are massive and unsheared.

The general age of the bedded rocks is indicated by fossils found in the limestones on Porcupine Creek.

A small collection made by Wright [1] in 1903 was doubtfully identified as Lower Carboniferous by G. H. Girty, an identification which was corrected the following year, when larger collections were made at Pybus and Herring Bays.[2] The first collection, which was obtained on Porcupine Creek, contains the following specimens, with revised identifications:

Crinoid fragments.
Productus aff. P. mammatus.
Productus aff. P. gruenewaldti.
Spirifer aff. S. marconi and S. musakheylensis.
Camarophoria aff. C. margaritovi.

The same fauna is more completely shown in collections from Saginaw Bay, Kuiu Island, and the facies appears to be that of the *Spirifer arcticus* zone, which, it is believed, may be correlated with the Russian Artinskian.

The indications are that the clastic sedimentary rocks are older rather than younger than the limestones. Presumably the bedded rocks of the region all belong to the Paleozoic, and at least part of them are definitely of Carboniferous age.

MINERALIZATION.

The very general mineralized condition of the sedimentary rocks of the region is well described by Wright,[3] who says:

> The sedimentary rocks have all been more or less mineralized by stringers and veins of quartz and calcite, but an especially noteworthy impregnation of iron sulphides forms an interrupted zone of mineralization in the southern portion of the sedimentary

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[1] Wright, C. W., op. cit., p. 16.
[2] Idem, A reconnaissance of Admiralty Island: U. S. Geological Survey Bull. 278, p. 143, 1906.
[3] Idem, The Porcupine placer district, Alaska: U. S. Geol. Survey, Bull. 236, pp. 17–18. 1904.

series. The sulphides in the slates occur as films or frequently as lenticular masses a few inches in width, parallel with the bedding. Two samples of the mineralized slates, one an average across several feet and the other from a rich seam, gave, respectively, $0.41 and $2.48 per ton in gold. Samples from near the mouth of the Porcupine, where the slates are apparently unmineralized, taken by Mr. Brooks during his short visit to this region in 1899, gave traces of both gold and silver.

The quartz veins are not very abundant and as a rule are short and small, often merely stringers parallel with the structure of the slates. A few which cut directly across the formation carry galena and sphalerite, with a small amount of chalcopyrite, and though quite narrow, often persist for considerable distances. Calcite veins, which are more numerous than those of quartz, are usually a foot or more in width, and are often weathered to a light-brown color on the surface, while of a bluish color and fine granular structure when freshly broken. They often carry cubes of pyrite, which occasionally measure an inch across. From veins of this nature up McKinley Creek some native gold has been reported.

Besides the small veins a quartz ledge 100 feet wide outcrops at an elevation of 2,000 feet on the ridge south of Porcupine. Although apparently quite barren, a small sample from this gave an assay value of $5.28 in gold. A similar ledge occurs across the Klehini at 1,500 feet elevation, on the ridge west of Boulder Creek. About 2 miles below Porcupine is a third mineralized deposit rich in sulphides, with calcite as gangue mineral, but a sample taken here gave an assay value of only 41 cents.

The general zone of mineralization from which the placers of Klehini and Salmon River basins have been derived appears to be elongated in a northwesterly direction, extending from a locality south of Salmon River across the basins of Porcupine, Glacier, and Jarvis creeks and into the mountain mass north of Jarvis Glacier. The richness of mineralization varies from place to place, and there are large areas of lean or barren rock in this zone. But there are also remarkably large areas in which sulphide minerals are generally abundant and samples from which are reported to show a substantial gold content on assay. A band of this sort that cuts across Cahoon Creek near its mouth in a slate formation shows abundant quartz veining and sulphides for a width of nearly 1,200 feet. Random samples taken across this belt are reported to assay as much as several dollars a ton, and a large number of assays ranged between $1 and $2 a ton.

The northwesternmost point along the general zone of mineralization at which gold has been found is in the mountains north of the lower end of Jarvis Glacier. Here, at an elevation of about 4,500 feet, are several gold quartz ledges in a granitic country rock some 300 feet above its contact with limestone. The lower and apparently the most valuable of the ledges is traceable for over 2,000 feet along the strike. It ranges from 1 foot to 4 feet in width. Assays of numerous samples are reported to give from a few dollars to $70 a ton, the higher tenor generally occurring where the vein is relatively narrow. A silver content of a few ounces a ton is indicated in most samples. Picked specimens give much higher assay returns.

Southeast of the main placer area on the slope north of Salmon River are a number of narrow silver-lead veins that show still another type of mineralization in the district. So far as known the largest are less than a foot in width. The maximum gold tenor of samples from these veins is said to be about $3 a ton, silver 60 ounces a ton, and lead about 35 per cent. One sample shows a copper content of nearly 3 per cent.

The mineralization that has furnished the placer gold of Bear Creek has not been studied geologically. Prospectors report that a broad zone along the ridge west of Bear Creek is heavily pyritized and that it contains, locally at least, commercial grades of copper ore. Specimens from this locality show iron, copper, and zinc sulphides in vein form.

HISTORY OF DEVELOPMENT.

Gold was first discovered in the Porcupine district in 1898. The next year mining operations were begun on Porcupine Creek, and the great number of prospectors who assembled staked claims on several other creeks of the district. Gold-bearing gravels were found on Bear Creek, on several tributaries of Salmon River, and on the head of Takhin River, but up to the present time productive operations have been almost entirely limited to Porcupine Creek and its tributaries. A little mining was done on Nugget Creek from 1902 to 1911. The ground was then abandoned and no further work has been done. It is estimated by local operators that about $6,000 worth of gold was produced. The gold production of Porcupine Creek and its tributaries from 1898 to 1903 is given by Wright [1] as follows:

Gold production of the Porcupine region, 1898–1903.

1898	$1,000	1902	$140,000
1899	9,000	1903	150,000
1900	50,000		
1901	110,000		460,000

The production from these creeks is said to have continued at the rate of $150,000 a year until 1906, when the principal works were destroyed by an unusual flood. From 1907 to 1909 large operations were discontinued, and the only production was made by a few laymen who worked small lots of ground by hand. Production on a large scale was resumed in 1910, and it is reported that an average yearly output of $50,000 was maintained until 1915, when another disastrous flood occurred. The total output of the district from 1898 to 1916, inclusive, estimated on the basis of these very incomplete data, is about $1,200,000.

In 1908 the Porcupine Mining Co. was organized to exploit the placers of the main Porcupine Creek on a large scale. It was financed in the Eastern States, and in view of the equipment installed in the next few years it must have had a large investment fund. The first move of the new company was to construct a flume a mile long, 24 to

[1] Wright, C. W., op. cit., p. 13.

30 feet wide, and 6 feet deep, supported on piles, to carry the waters of Porcupine Creek past the placer ground to be worked. This piece of construction, which required nearly a million feet of lumber and several thousand piles, was completed late in the summer of 1909, and mining was begun at the lower end of the canyon. This company operated until August, 1915, when the lower part of the flume was demolished and the pits were filled in by a flood. In the last few years operations were conducted under receivership but with the same local management.

After the disastrous flood of 1915 the property and holdings of the company were taken over by the Alaska Corporation. This concern in 1916 repaired the upper section of the old flume, constructed a new high-line flume to deliver water to the giants, and began the reexcavation of the buried workings.

Little mining was done on the tributaries of Porcupine Creek before 1908, when the Cahoon Creek Gold Mining Co. began work on McKinley and Cahoon creeks. This company has continued to operate to the present time, working out the placers on Cahoon Creek near its mouth and for about 2,000 feet down McKinley Creek below Cahoon. The plan followed in the operations on McKinley Creek was essentially similar to that employed on Porcupine Creek. The stream was diverted into a wooden flume, making the stream bed available for hydraulic mining. Below the workings on McKinley Creek the stream runs through a narrow box canyon. The difficulty of diverting the stream in this reach has thus far prevented the exploitation of the gravels of its bed. In 1916 the company was engaged in working the placers of a high, glacially filled channel on the right side of McKinley Creek, opposite the reach of the modern channel that has been worked out.

A little mining was done on the head of Cahoon Creek in the early days of the camp, but these operations are said to have met with slight success, and the hope of working this ground on any large scale has long been abandoned. However, a little prospecting and "sniping" have been done from time to time by laymen.

The most notable developments in the district in the last few years have been the investigation of the Glacier Creek placers by drilling and the installation of a large hydraulic plant to work this ground. The Glacier Creek placers were staked in the early days of the district, but repeated attempts to prospect and mine the ground by ordinary methods failed owing to the depth of the gravels and the abundance of ground water. In 1911 the claims, which had been abandoned by the previous holders, were restaked, and systematic drilling was begun. Drill sections across the valley bottom were made at short intervals for over a mile upstream from the margin of the Klehini Valley. On the basis of the results of this investigation extensive preparations were made to work a lower section of the valley 4,200 feet long by hydraulic methods. The installation of a very complete plant, including dams, flumes, pipe lines, giants, and hydraulic elevator, was finished in midsummer, 1915, but operation was prevented for the rest of the season by unusual floods.

In 1916 work was started early in spring, but owing to damage done to the workings by a flood the later part of June the season netted but little productive operation.

SUMMARY OF MINING IN 1916.

Mining in the Porcupine district in 1916 was confined to Porcupine Creek, its main east tributary, McKinley Creek, and Glacier Creek. A single hydraulic plant worked on each stream throughout the summer. The principal work done on Porcupine and Glacier creeks consisted of the installation of hydraulic equipment and the repairing of damage done to workings and equipment by floods, so that little productive mining was accomplished. Two small plants were worked by hand on the lower Porcupine part of the summer. The plant on McKinley Creek opened a new pit in an old elevated channel and worked out a considerable area, although the operations were hampered somewhat by the presence of an overburden of glacial till 60 feet thick in which there are numerous large boulders.

About 50 men at an average were employed during the summer in the whole district, being divided about equally among the three active creeks. Although the production for 1916 was small, it is reported that the plants have all been put in good repair and that conditions indicate that a very considerable production may be made in 1917.

WATER-POWER INVESTIGATIONS IN SOUTHEASTERN ALASKA.[1]

By George H. Canfield.

INTRODUCTION.

The streams of Alaska have been important factors in its industrial growth. The success of placer mining in northern and central Alaska has depended primarily on the water available for hydraulicking and dredging, and in southeastern Alaska water power has long been used by mines, canneries, sawmills, and other industries, although until recently most of the plants have been small.

Since 1906 the United States Geological Survey has made systematic studies of the water resources of Alaska. Investigations with special reference to placer mining have been made in Seward Peninsula [2] and the Yukon-Tanana region,[3] and reconnaissance surveys for water power have been made about Prince William Sound, Copper River, Kenai Peninsula, and in other parts of southeastern Alaska.

In the summer of 1914 Leonard Lundgren, district engineer of the Forest Service, made a reconnaissance of water-power sites to determine the possibility of establishing the pulp industry in the Tongass National Forest, which covers a large part of southeastern Alaska. In connection with this reconnaissance a census of water powers was taken (see following table), which has been revised by Mr. Lundgren to January 1, 1917, and is here published by courtesy of the Forester.

Developed water powers in southeastern Alaska Jan. 1, 1917, in horsepower.

[Prepared by Leonard Lundgren, district engineer, U. S. Forest Service.]

Ketchikan region:		
Citizens Light, Power & Water Co.	2,000	
New England Fish Co.	2,200	
Miscellaneous plants	1,000	
		5,200
Wrangell region		0

[1] In cooperation with the United States Forest Service.

[2] Henshaw, F. F., and Parker, G. L., Surface water supply of Seward Peninsula, with a sketch of the geography and geology by P. S. Smith, and a description of methods of placer mining by A. H. Brooks: U. S. Geol. Survey Water-Supply Paper 314, 1913.

[3] Ellsworth, C. E., and Davenport, R. W., Surface water supply of the Yukon-Tanana region, Alaska: U. S. Geol. Survey Water-Supply Paper 342, 1915; A water-power reconnassance in south-central Alaska, with a section on southeastern Alaska by J. C. Hoyt: U. S. Geol. Survey Water-Supply Paper 372, 1915.

Sitka region:			
Sitka Wharf & Power Co		350	
Chichagoff Mining Co		750	
Miscellaneous plants		150	
			1,250
Juneau region:			
Alaska-Treadwell Mining Co.:			
Douglas Island plant	4,000		
Sheep Creek plant	4,100		
Nugget Creek plant	5,700		
		13,800	
Alaska-Gastineau Mining Co.:			
Salmon Creek plant, No. 1	5,000		
Salmon Creek plant, No. 2	5,000		
Annex Creek plant	5,000		
		15,000	
Alaska Electric Light & Power Co		1,000	
Miscellaneous plants		1,000	
			30,800
Skagway region			100
			37,350

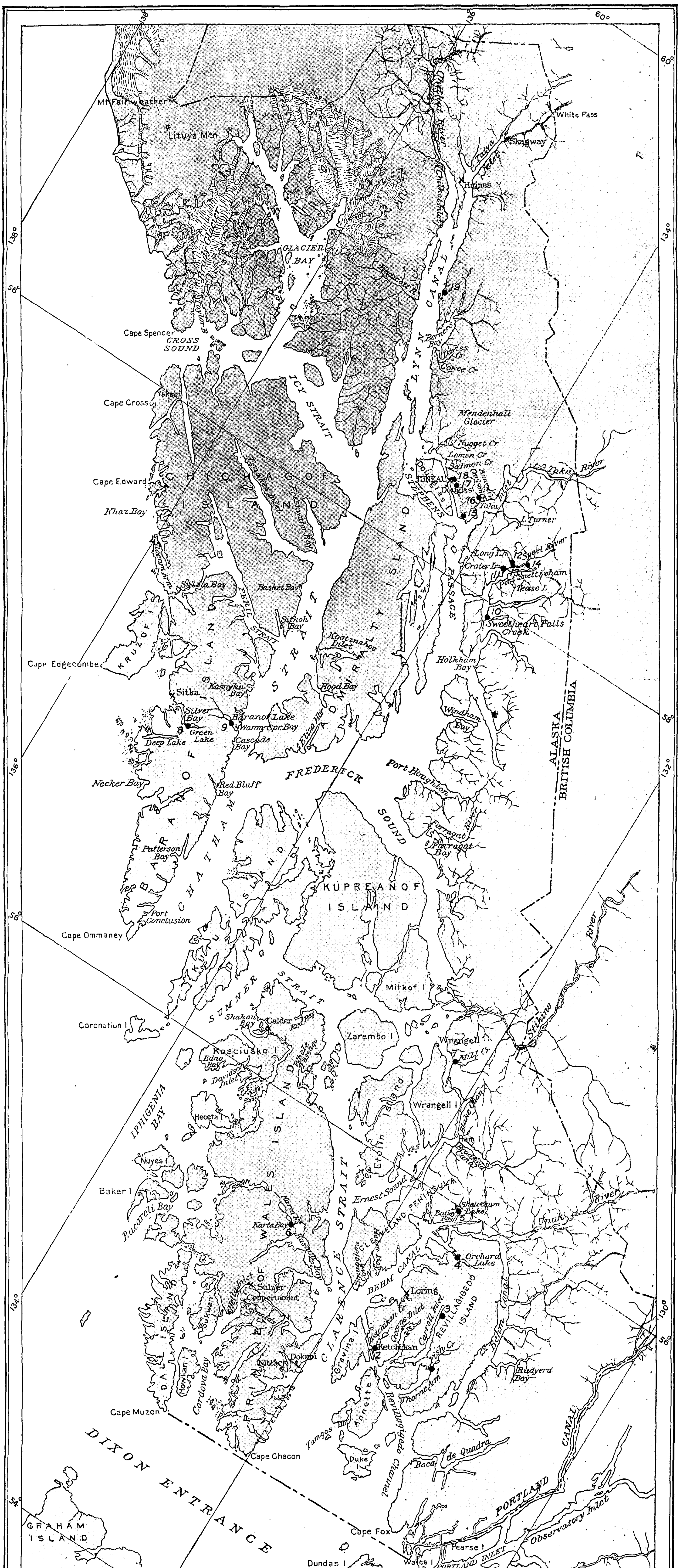
During the last few years some large water-power plants have been installed near Juneau to supply power for mining, and attention has been called to the feasibility of improving other power sites in that region and elsewhere in southeastern Alaska, to meet the increasing demand for power to be used in mining, lumbering, and fisheries, and the possible future demand for its use in the manufacture of wood pulp and electrochemical products. The streams on which it is possible to develop power and the bays or other water bodies into which these streams discharge are listed in the following table and shown on the map (Pl. IX):

Streams affording power sites in southeastern Alaska, with position or water bodies into which they flow.

Mainland.

Porcupine River, near Porcupine.[1]
Endicott River, west coast of Lynn Canal.
Sherman Creek.
Cowie and Davies creeks, Berners Bay.
Lemon Creek, near Juneau.[2]
Gold Creek, at Juneau.
Sheep Creek, near Juneau.
Carlson Creek, Taku Inlet.[3]
Turner Lake outlet, Taku Inlet.[4]
Speel River, Speel River project, Port Snettisham.[5]
Grindstone Creek, north shore of Stephens Passage.[5]
Rhine Creek, north shore of Stephens Passage.[5]

[1] Gaging station maintained in 1909 by Porcupine Gold Mining Co.
[2] Gaging station maintained for short period by mining company of Juneau.
[3] Gaging station being maintained by Alaska-Gastineau Mining Co. of Juneau.
[4] Gaging station maintained in 1908 and 1909 by Alaska-Treadwell Gold Mining Co.
[5] See list of miscellaneous measurements at end of report.



SCALE ON 56TH PARALLEL

10 0 10 20 30 40 50 60 70 MILES

● Stream-gaging station

x Precipitation station

MAP OF SOUTHEASTERN ALASKA, SHOWING LOCATION OF GAGING STATIONS.

Long Lake outlet, Speel River project, Port Snettisham.[1]
Crater Lake outlet, Speel River project, Port Snettisham.[1] [2]
Tease Lake outlet, Speel River project, Port Snettisham.
Sweetheart Falls Creek, south arm of Port Snettisham.[3]
Port Houghton, Stephens Passage.
Farragut Bay, Frederick Sound.
Mill Creek, near Wrangell.[3]
Bradfield Canal, upper end of Cleveland Peninsula.
Smugglers Cove, southeast shore of Cleveland Peninsula.
Helm Bay, southeast shore of Cleveland Peninsula.
Shelockum Lake outlet, Bailey Bay.[3]
Chickamin River, east shore of Behm Canal.
Rudyerd Bay, east shore of Behm Canal.

Baranof Island.

Port Conclusion, southeast coast.
Patterson Bay, east coast.
Red Bluff Bay, east coast.
Cascade Bay, east coast.
Baranof Lake outlet, Warm Spring Bay, east coast.[3]
Kasnyku Bay, east coast.
Green Lake outlet, Silver Bay, west coast.[3]
Necker Bay, west coast.
Deep or Redoubt Lake, west coast.

Chichagof Island.

Slocum Arm, west coast.
Suloia Bay, Peril Strait.
Khaz Bay, west coast.
Freshwater Bay, east coast.
Sitkoh Bay, southeast coast.
Basket Bay, southeast coast.
Pinta Bay, west coast.

Admiralty Island.

Kootznahoo Inlet, west coast.
Hood Bay, west coast.

Kosciusko Island.

Davidson Inlet.

Prince of Wales Island.

Karta River, Karta Bay.[3]
Whale Passage, behind Thorne Island, northeast coast.
Myrtle Lake outlet, near Niblack post office.
Reynolds Creek, near Coppermount.[2]

Revillagigedo Island.

Orchard Lake outlet, at Shrimp Bay.[3]
Beaver Falls, George Inlet.
White River, George Inlet.
Swan Lake outlet, east shore near head of Carroll Inlet.
Fish Creek, Thorne Arm.[3]
Gokatchin Creek, Thorne Arm.[2]
Ketchikan Creek, at Ketchikan.[3]

Annette Island.

Tamgas Harbor.

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1 Gaging station maintained since January, 1913, by the Speel River project of Juneau.
2 See list of miscellaneous measurements at end of report.
3 Gaging station maintained by Geological Survey.

Lack of definite information in regard to the quantity of water available and other physical factors that determine the feasibility of a power site has been one of the principal impediments to development. For this reason a systematic investigation, designed to determine the location and the feasibility of water-power sites in southeastern Alaska, was begun by the Geological Survey, in cooperation with the Forest Service, in the spring of 1915.

The practicability of a water-power site depends on the quantity of water available, the fall, and the possibility of storing water. Information in regard to fall and storage can be obtained by surveys at any time, but the volume and distribution of flow can be determined only by observations extending over several years, as future flow must be predicted from that of the past. In beginning the investigations, therefore, the collection of stream-flow data was given precedence and constituted the principal work. Some general information, however, has been obtained, and in the fall of 1915 a few rainfall stations were established at higher elevations to supplement observations at mean sea level by the United States Weather Bureau. As a result of the investigations records of flow are now available for 19 gaging stations, as shown by the following list, and indicated by corresponding numbers on Plate IX. The date of establishment is indicated in parentheses.

1. Fish Creek near Sea Level, Revillagigedo Island (May 19, 1915).
2. Ketchikan Creek at Ketchikan (established Nov. 1, 1909; discontinued June 30, 1912; reestablished July 1, 1915).
3. Swan Lake outlet at Carroll Inlet, Revillagigedo Island (Aug. 24, 1916).
4. Orchard Lake outlet at Shrimp Bay, Revillagigedo Island (May 28, 1915).
5. Shelockum Lake outlet at Bailey Bay (June 4, 1915).
6. Karta River at Karta Bay, Prince of Wales Island (July 16, 1915).
7. Mill Creek on mainland near Wrangell (June 17, 1915).
8. Green Lake outlet at Silver Bay, near Sitka (Aug. 22, 1915).
9. Baranof Lake outlet at Baranof, Baranof Island (June 28, 1915).
10. Sweetheart Falls Creek near Snettisham (July 31, 1915).
11. Crater Lake outlet at Speel River, Port Snettisham (Jan. 23, 1913).
12. Long Lake outlet at Port Snettisham (Jan. 23, 1913).
13. Long River below Second Lake at Port Snettisham (Nov. 11, 1915).
14. Speel River at Port Snettisham (July 15, 1916).
15. Grindstone Creek at Stephens Passage (May 6, 1916).
16. Carlson Creek at Sunny Cove, Taku Inlet (July 18, 1916).
17. Sheep Creek near Thane (July 26, 1916).
18. Gold Creek at Juneau (July 20, 1916).
19. Sherman Creek at Kensington mine, Lynn Canal (Aug. 17, 1914).

The available power sites in each area were carefully considered, and gaging stations were established at those which apparently afforded the greatest opportunities for development.

The records have been collected in accordance with the standard methods used elsewhere in the United States by the Geological Survey. Owing to the inaccessibility of the stations, water-stage recorders were used at all the stations except that on Ketchikan Creek, and cables have been installed from which discharge measurements are made. Special arrangements were made for observations through the winter to obtain a record of the low-water flow which occurs at that season.

The data collected at the gaging stations are presented in the following pages and include a general description of each station and tables showing the results of discharge measurements and the computed daily discharge.

Much of the work has been made possible by the use of the Forest Service launches, on which transportation has been furnished to the engineers and others engaged in installing and maintaining the stations. The local knowledge of the Forest Service employees has also been of great assistance in carrying on the work, and special acknowledgment is due to W. G. Weigle, forest supervisor at Ketchikan, who has represented the Forest Service in the cooperation; to Leonard Lundgren, district engineer; and to George L. Drake, J. W. Wyckoff, C. T. Gardner, George H. Peterson, James Allen, W. H. Babbitt, Lyle Blodgett, and Milo Caughrean, who have assisted in various ways.

During the winter of 1916–17 the field work was carried on by C. O. Brown, assistant engineer, United States Geological Survey.

The following individuals and organizations assisted in maintaining gaging stations as indicated:

T. J. Jones, Seattle, Wash., furnished a Stevens water-stage recorder, materials, and labor for installing a gage on Swan Lake outlet.

The Alaska Gastineau Mining Co. installed gages and furnished gage-height records for Gold Creek near Juneau, Sheep Creek near Thane, and Carlson Creek at Sunny Cove.

The Alaska Taku Mining Co. furnished a Lietz gage, labor, material, and transportation for the installation of a gage on Grindstone Creek at Stephens Passage.

The Speel River Project (Inc.), of Juneau, installed and maintained gages and furnished gage readings and discharge measurements for Crater Lake outlet at Speel River, Long Lake outlet at Port Snettisham, Long River below Second Lake, and Speel River at Port Snettisham.

The Kensington Mining Co., of Comet, furnished gage readings for Sherman Creek at Kensington mine.

The Citizens Light, Power & Water Co., of Ketchikan, furnished gage readings for Ketchikan Creek at Ketchikan.

STATION RECORDS.

FISH CREEK NEAR SEA LEVEL, REVILLAGIGEDO ISLAND.

Location.—In latitude 55° 24′ N., longitude 131° 12′ W., near outlet of Lower Lake on Fish Creek, 600 feet from tidewater at head of Thorne Arm, 2 miles northwest of mine at Sea Level, and 25 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 19, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on right shore of Lower Lake, 200 feet above outlet.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable across creek, 1 mile upstream from gage and 500 feet above head of Lower Lake; at low stages made by wading at cable. Only one small creek enters Lower Lake, at point opposite gage, between the cable site and control section.

CHANNEL AND CONTROL.—The lake is about 500 feet wide opposite the gage. Outlet consists of two channels, each about 60 feet wide, separated by an island 40 feet wide. From the lake to tidewater, 200 feet, the creek falls 20 feet. Bedrock exposed at the outlet of the lake forms a well-defined and permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 4.94 feet at 3 a. m. October 15, 1915 (discharge, computed from an extension of the rating curve, 4,020 second-feet; revised since published in Bulletin 642); minimum stage recorded, 0.50 foot February 11, 1916 (discharge, 22 second-feet).

ICE.—Lower Lake freezes over, but as gage is set back in the bank ice does not form in well, and the relatively warm water from the lake and the swift current keep the control open.

ACCURACY.—Stage-discharge relation practically permanent; affected by brush lodged at control August 23 to December 31. Rating curve used May 19, 1915, to August 23, 1916, well defined below and fairly well defined above 1,500 second-feet. Rating curve used after August 23, 1916, when control was obstructed by brush, defined below 1.5 feet (discharge, 253 second-feet) by discharge measurements made January 25, 1917, at gage height 1.48 feet (discharge, 243 second-feet) and March 2, 1917, at gage height 0.86 foot (discharge, 65 second-feet). Above a stage of 1.50 feet the curve was drawn 0.16 foot above curve applicable when control was not obstructed. Operation of water-stage recorder satisfactory except for periods indicated by breaks in record shown in the footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table mean daily gage heights for regular intervals of day. Results excellent, except for short periods of break in record and for period when control was obstructed by brush, for which they are fair.

There are three large lakes in the upper drainage basin: Big Lake, 2 miles from beach at elevation 275 feet, covers 1,700 acres; Third Lake, 250 acres; and Mirror Lake, at elevation 1,000 feet, 800 acres. Two-thirds of the drainage basin is covered with a thick growth of timber and brush interspersed with occasional patches of beaver swamp and muskeg. Only the tops of the highest mountains are bare. This large area of lake surface and vegetation, notwithstanding the steep slopes and shallow soil, affords a little ground storage and after a heavy precipitation maintains a good run-off. During a dry, hot period in summer, however, after the snow has melted, the flow becomes very low because of lack of ice or glaciers in the drainage basin.

Discharge measurements of Fish Creek near Sea Level during the period May 19, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
May 20	G. H. Canfield	1.48	328	Jan. 26	G. H. Canfield	0.64	42
July 10	.....do	1.01	118	Apr. 6	.....do	1.36	269
Sept. 13	Canfield and Hoyt	1.04	129	13	.....do	2.35	976
Oct. 13	G. H. Canfield	2.53	1,120	July 30	.....do	2.74	1,360
				Aug. 4	Canfield and Brooks	1.46	308

Daily discharge, in second-feet, of Fish Creek near Sea Level for the period May 19, 1915, to Dec. 31, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.								
1	....	270	143	84	127	632	1,010	660
2	....	312	134	78	150	455	1,070	804
3	....	324	134	73	250	346	780	764
4	....	384	130	69	590	329	660	668
5	....	425	127	67	700	362	639	625
6	....	413	124	69	569	351	583	780
7	....	401	124	73	425	334	455	772
8	....	548	124	152	334	488	413	569
9	....	507	124	340	285	764	285	425
10	....	407	120	1,190	235	756	230	334
11	....	351	117	1,720	190	876	199	265
12	....	312	117	1,470	174	876	178	217
13	....	285	112	1,620	143	1,030	340	178
14	....	255	104	1,170	124	1,120	455	154
15	....	250	99	1,060	117	2,510	527	154
16	....	285	96	892	124	3,160	455	158
17	....	296	91	632	130	1,950	500	204
18	....	270	84	474	130	1,230	534	250
19	362	245	82	378	127	999	488	290
20	340	270	78	307	117	1,320	455	329
21	356	660	76	250	112	1,520	494	395
22	356	716	117	204	101	1,220	407	462
23	334	541	178	170	96	884	362	437
24	307	413	204	140	91	732	318	425
25	285	340	194	127	94	668	270	340
26	290	285	170	104	166	812	226	285
27	334	245	147	101	235	945	226	340
28	362	199	127	107	445	1,120	260	275
29	351	178	112	104	945	1,170	312	226
30	307	158	96	96	900	884	520	204
31	275	....	91	96	....	772	....	182

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.												
1	158	34	142	264	362	678	414	694	143	421	610	447
2	143	31	123	280	351	694	402	518	130	318	486	390
3	134	31	111	296	378	774	384	408	119	240	414	318
4	124	30	106	318	512	734	408	334	112	202	362	280
5	114	28	116	302	686	618	460	290	107	187	395	227
6	107	27	119	285	718	618	492	254	107	187	434	194
7	102	26	126	499	567	595	447	228	159	179	402	190
8	91	25	142	532	428	567	402	210	296	162	434	172
9	84	23	275	553	351	518	373	192	368	146	390	162
10	76	22	428	492	302	434	368	180	480	132	318	166
11	73	22	428	454	269	408	408	172	595	122	249	187
12	71	35	351	670	269	434	414	165	480	114	202	179
13	69	204	285	983	264	492	378	157	351	162	169	166
14	67	190	238	938	264	726	368	161	269	356	146	179
15	65	488	220	718	302	983	351	188	209	782	132	218
16	65	1,110	228	532	362	884	340	275	172	553	117	227
17	64	1,170	197	473	428	758	334	302	150	421	132	259
18	64	740	172	395	486	694	324	259	137	334	231	307
19	62	576	165	318	539	581	368	233	140	454	378	259
20	60	724	153	264	662	486	539	329	235	625	766	209
21	58	604	180	233	702	434	610	512	506	518	670	176
22	55	488	176	215	625	428	595	588	454	486	480	146
23	51	407	168	206	499	440	518	798	378	702	351	127
24	48	351	149	210	421	460	408	857	362	625	466	112
25	45	302	142	233	402	473	351	602	567	866	539	100
26	41	260	153	254	447	512	312	428	920	956	473	114
27	40	230	157	302	486	567	290	318	782	956	362	85
28	38	204	153	368	466	567	351	254	902	1,550	334	80
29	38	174	136	384	460	506	750	202	929	1,190	384	91
30	37	....	153	384	525	460	1,300	176	610	956	384	109
31	35	....	206	....	610	....	1,000	159	....	718	....	130

NOTE.—Discharge Sept. 6–12, Nov. 23 to Dec. 1, 1915, Jan. 2–5, Feb. 7–11, 18–29, Oct. 16–30, 1916, estimated, because of gage clock stopping, from maximum and minimum stages indicated by recording pencil, from climatic records, and from comparison of the hydrograph for this station with that for Karta River.

Monthly discharge of Fish Creek near Sea Level for the period May 19, 1915, to Dec. 31, 1916.

Month.	Discharge in second-feet.			Run off (tota in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
May 19-31	362	275	328	8,460
June	716	158	352	20,900
July	204	76	122	7,500
August	1,720	67	433	26,600
September	945	91	274	16,300
The period				79,800
1915-16.				
October	3,160	329	988	60,800
November	1,070	178	455	27,100
December	804	154	393	24,200
January	158	35	73.5	4,520
February	1,170	22	295	17,000
March	428	106	190	11,700
April	983	206	412	24,500
May	718	264	456	28,000
June	983	408	584	34,800
July	1,300	290	466	28,700
August	857	159	338	20,700
September	929	107	372	22,200
The year	3,160	22	419	304,000
1916.				
October	1,550	114	504	31,000
November	766	117	374	22,200
December	447	80	196	11,900
The period				65,100

KETCHIKAN CREEK AT KETCHIKAN.

LOCATION.—One-fourth mile below power house of Citizens Light, Power & Water Co., one-third mile northeast of Ketchikan post office, downstream 200 feet from mouth of Schoenbar Creek (entering from right), 1¼ miles from mouth of Granite Basin Creek (entering from left), and 1½ miles from outlet of Ketchikan Lake.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 1, 1909, to June 30, 1912; June 9, 1915, to December 31, 1916.

GAGE.—Vertical staff fastened to a telephone pole near board walk on left bank at bend of creek 200 feet downstream from mouth of Schoenbar Creek; read by employee of the Citizens Light, Power & Water Co. The gage used since June 9, 1915, consists of the standard United States Geological Survey enameled gage section graduated in hundredths, half-tenths, and tenths from zero to 10 feet The original gage established November, 1909, and read until June 30, 1912, is at same location and same datum. It is a staff with graduations painted every tenth.

DISCHARGE MEASUREMENTS.—At medium and high stages from footbridge about 500 feet upstream from gage; measuring section poor, as the bridge makes an angle of 20° with the current, and at high stages the flow is broken by large stumps near left bank and at middle of bridge; at low stages, by wading 50 feet below bridge or at another section 100 feet above gage. The flow of Schoenbar Creek has been added to obtain total flow past gage.

CHANNEL AND CONTROL.—Gage is located in a large deep pool of still water at a bend in creek. The bed of the stream at the outlet of this pool is a solid rock ledge, which forms an excellent permanent control at the gage.

Extremes of discharge.—Maximum stage recorded during 1916, 5 feet July 29 (discharge, 1,490 second-feet); minimum stage recorded, 0.35 foot in January and February (discharge, 40 second-feet).

1909–1912 and 1915–16: Maximum stage recorded, 8.2 feet December 2, 1911 (discharge, 3,400 second-feet); minimum stage recorded, 0.28 foot September 24, 1915 (discharge, 34 second-feet).

Ice.—Ice forms along banks but control remains open.

Diversions.—A small quantity of water is diverted above the station for the use of the town of Ketchikan, the New England Fish Co., and the Standard Oil Co.

Regulation.—Small timber dam and headgates are located at outlet of Ketchikan Lake. Water diverted through power house is returned to creek a' ove gage but causes very little diurnal fluctuation. During low water the flow is increased by water from the reservoir.

Accuracy.—Stage-discharge relation permanent. Rating curve well defined below and poorly defined above 2,000 second-feet. Gage read once daily. Daily discharge ascertained by applying daily gage heights to rating table. Results fair.

Discharge measurements of Ketchikan Creek at Ketchikan during the period June 9, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
June 9	G. H. Canfield	1.15	145	Jan. 15	Canfield and Gardner	0.35	38
July 17	Drake and Canfield	.60	64	27	G. H. Canfield	.44	50
Sept. 12	Hoyt and Canfield	.43	63	Apr. 13	do	3.40	760
Oct. 27	Canfield and Wycoff	2.82	522	July 29	do	4.96	1,470
30	do	1.58	232	31	do	1.87	326
				Dec. 4	C. O. Brown	.81	95

Note.—Discharge of all measurements includes measured or estimated flow of Schoenbar Creek.

Daily discharge, in second-feet, of Ketchikan Creek at Ketchikan for the years ending Sept. 30, 1910–1912 and 1915–16.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1909-10.												
1	......	685	79	54	79	40	151	160	262	274	308	220
2	......	553	79	54	230	44	100	160	285	241	1,540	170
3	......	300	60	54	160	......	90	180	262	220	685	142
4	......	200	50	44	180	......	80	180	241	252	332	190
5	......	200	49	79	332	......	72	252	241	382	262	170
6	......	125	44	72	200	......	60	270	200	382	210	160
7	......	86	44	49	125	......	44	296	200	285	200	220
8	......	70	44	60	93	......	70	220	553	252	210	108
9	......	60	40	60	85	220	108	190	523	274	170	100
10	......	49	40	80	86	270	79	241	332	285	142	100
11	......	44	44	252	60	332	44	241	285	332	125	79
12	......	44	44	108	49	464	108	296	285	965	125	79
13	......	44	66	79	45	332	125	436	464	2,040	142	79
14	......	44	274	60	44	296	100	274	584	685	220	66
15	......	44	296	50	40	320	285	436	464	357	220	66
16	......	44	210	40	40	382	210	436	493	241	220	72
17	......	44	134	142	35	553	160	274	464	210	220	180
18	......	44	100	72	36	560	142	262	285	200	220	241
19	......	44	79	60	38	553	108	210	262	190	142	252
20	......	44	54	50	40	382	125	241	285	190	125	200
21	......	44	50	49	40	274	160	274	285	200	125	160
22	......	44	49	45	35	220	210	262	308	493	125	200
23	......	44	44	44	35	142	285	274	262	436	108	151
24	......	44	40	40	36	160	142	274	308	296	93	125
25	......	44	40	36	36	200	125	262	296	464	93	200
26	......	100	40	49	36	142	142	320	308	241	93	170
27	......	200	40	116	38	116	180	523	274	296	160	170
28	......	300	40	66	40	93	210	464	262	220	142	241
29	......	200	79	230	......	142	170	436	285	241	436	493
30	......	108	66	100	......	125	151	382	332	241	464	685
31	......	......	54	72	......	160	......	308	......	210	285	......

Daily discharge, in second-feet, of Ketchikan Creek at Ketchikan for the years ending Sept. 30, 1910–1912 and 1915–16—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1910-11.												
1	436	125	79	296	......	......	72	125	296	296	160	180
2	880	357	66	436	......	......	66	180	274	274	170	190
3	685	252	54	464	......	......	66	296	230	252	160	134
4	493	160	54	493	......	......	66	320	200	241	160	125
5	464	252	54	285	......	......	66	252	296	274	160	125
6	382	151	54	241	......	......	66	190	274	285	151	100
7	320	125	54	125	......	......	66	125	230	285	160	93
8	685	142	66	93	......	......	66	125	382	274	142	100
9	436	108	66	93	......	......	60	357	332	285	125	93
10	332	100	66	93	......	......	49	332	241	296	125	93
11	220	66	79	93	......	......	49	220	1,190	274	125	93
12	151	66	464	93	......	......	49	180	1,010	210	125	93
13	493	464	230	93	......	......	54	170	553	200	125	100
14	436	493	493	......	......	......	54	160	382	200	108	523
15	357	252	1,010	......	......	......	252	241	332	210	108	357
16	252	285	920	......	......	......	220	262	320	220	100	332
17	170	320	523	......	......	......	72	357	274	252	100	220
18	436	200	1,440	......	......	151	125	262	262	262	100	357
19	1,700	108	840	......	......	142	357	220	252	262	100	262
20	720	382	553	......	......	100	880	464	220	262	100	220
21	800	436	262	......	......	86	800	308	230	220	93	180
22	436	382	230	......	......	93	220	220	230	241	93	142
23	382	357	262	......	......	125	180	180	230	1,290	93	134
24	241	262	320	......	......	93	170	200	220	760	93	180
25	220	108	262	......	......	93	151	220	220	436	93	200
26	241	100	274	......	......	79	125	241	230	262	86	230
27	1,290	93	210	......	......	86	108	220	285	200	125	190
28	2,220	66	200	......	......	125	108	200	274	180	180	274
29	584	66	523	......	......	108	108	357	274	170	180	200
30	382	54	553	......	......	125	125	357	274	170	151	151
31	210	......	262	......	......	86	......	382	......	160	170	......
1911-12.												
1	142	125	616	93	285	79	180	93	200	......	......	......
2	125	160	3,400	93	220	79	108	86	180	......	......	......
3	108	125	1,760	86	160	66	125	151	160	......	......	......
4	220	142	553	79	134	66	108	210	125	......	......	......
5	285	160	308	79	125	66	160	252	134	......	......	......
6	409	108	220	79	108	54	170	332	125	......	......	......
7	357	108	464	79	108	54	125	262	142	......	......	......
8	285	108	436	79	180	54	100	170	108	......	......	......
9	180	93	241	72	241	54	93	160	116	......	......	......
10	180	79	262	66	308	54	100	151	86	......	......	......
11	160	66	464	66	320	54	72	160	79	......	......	......
12	160	66	553	66	409	49	79	190	108	......	......	......
13	125	66	332	66	493	49	66	220	116	......	......	......
14	160	54	285	66	584	49	79	252	116	......	......	......
15	220	54	262	66	616	44	79	241	108	......	......	......
16	142	125	170	66	170	44	86	210	108	......	......	......
17	160	262	200	66	142	44	79	200	108	......	......	......
18	125	285	220	66	125	44	79	180	116	......	......	......
19	332	116	210	66	108	44	66	190	108	......	......	......
20	200	116	200	86	108	44	66	190	108	......	......	......
21	160	108	241	436	308	44	66	200	108	......	......	......
22	125	220	230	332	180	44	66	180	116	......	......	......
23	125	464	210	180	125	44	66	180	93	......	......	......
24	125	409	180	200	125	44	66	160	93	......	......	......
25	125	308	125	436	160	40	66	180	93	......	......	......
26	108	230	108	241	125	44	66	200	86	......	......	......
27	108	220	100	220	93	200	93	190	86	......	......	......
28	108	180	100	262	93	108	125	142	79	......	......	......
29	108	220	93	230	66	66	79	125	79	......	......	......
30	93	285	93	220	......	93	142	160	79	......	......	......
31	93	......	93	436	......	108	......	180	......	......	......	......

Daily discharge, in second-feet, of Ketchikan Creek at Ketchikan for the years ending Sept. 30, 1910–1912 and 1915–16—Continued.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1915.				1915.				1915.			
1	85	59	332	11	102	880	54	21	59	46	38
2	85	59	553	12	85	523	48	22	200	46	36
3	82	61	584	13	79	553	44	23	108	46	34
4	79	54	220	14	74	285	42	24	79	44	34
5	87	44	118	15	71	1,920	54	25	66	41	66
6	85	41	79	16	66	308	46	26	66	41	56
7	108	66	87	17	66	125	42	27	64	41	41
8	200	464	102	18	61	102	41	28	61	41	56
9	142	382	79	19	61	71	41	29	59	41	79
10	125	2,640	61	20	61	64	39	30	59	41	85
								31	59	262	......

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	71	241	523	80	40	74	190	142	296	200	436	79
2	54	210	553	72	40	66	118	142	262	190	190	79
3	79	220	523	69	40	61	122	142	274	180	142	76
4	220	296	436	66	40	64	122	210	274	200	108	74
5	108	357	296	66	40	64	122	274	332	220	105	125
6	85	285	357	60	40	64	108	357	285	200	106	241
7	66	200	241	57	40	64	111	252	252	180	102	357
8	274	190	170	54	40	90	200	170	308	180	99	308
9	180	160	115	51	40	409	210	122	200	160	102	210
10	160	108	102	47	40	180	200	87	142	285	102	523
11	274	102	85	43	40	142	200	85	200	332	99	274
12	274	79	59	40	80	118	200	105	200	262	96	170
13	840	553	54	40	200	99	230	93	220	200	93	108
14	308	464	61	40	616	79	436	90	274	160	96	99
15	1,540	308	64	40	436	85	262	102	262	200	93	93
16	1,010	553	108	40	142	102	151	142	262	180	96	90
17	382	308	90	40	120	85	142	220	262	190	90	87
18	493	308	160	40	100	76	125	285	252	180	82	90
19	241	230	170	40	100	105	122	357	210	262	79	93
20	685	190	200	40	100	111	115	523	200	230	357	200
21	760	285	200	40	100	102	90	332	200	200	357	241
22	436	241	220	40	100	108	82	252	200	200	523	262
23	262	180	200	40	100	96	93	200	180	170	357	274
24	285	200	200	40	100	105	99	142	200	125	332	357
25	296	180	160	40	100	108	111	151	252	134	210	523
26	296	142	102	45	80	102	122	180	285	125	200	493
27	285	102	96	48	80	85	125	200	285	142	108	274
28	493	108	85	45	80	76	134	200	241	357	93	553
29	523	252	85	40	80	76	160	200	230	1,060	102	296
30	241	93	82	40	......	200	151	200	200	1,010	87	200
31	285	......	82	40	......	200	......	210	......	1,010	82	......

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1916.				1916.				1916.			
1	108	262	180	11	79	93	108	21	210	180	85
2	90	285	115	12	82	87	105	22	308	142	82
3	82	296	118	13	180	71	76	23	357	170	66
4	79	200	93	14	840	76	241	24	308	262	64
5	76	262	111	15	332	79	125	25	382	200	64
6	71	262	74	16	180	85	82	26	436	180	66
7	71	220	170	17	170	90	160	27	493	220	74
8	69	210	180	18	200	142	190	28	523	210	71
9	66	170	125	19	252	409	87	29	382	180	69
10	69	142	111	20	308	650	85	30	241	190	69
								31	190	......	170

NOTE.—No gage readings Nov. 3–5, 8, 13–15, 17, 20, 21, 23–26, 28, 29, Dec. 3, 4, 6, 7, 9, 21, 25, 26, and 28, 1909; Jan. 2, 10, 14, 15, 19, 20, 22, 24, Feb. 9, 11, 13, 15, 19, 26–28, Mar. 1, 3–8, 10, 15, 18, 24, Apr. 3, 4, 6, 8, 16, 21, and May 6, 1910; discharge estimated. Discharge estimated from climatic records as follows: Jan. 14 to Mar. 17, 1911; Jan. 2–14, 16–26, Jan. 28 to Feb. 13, and Feb. 17–29, 1916. Estimates of discharge Nov. 1, 1909, to June 30, 1912, and June 9, 1915, to Feb. 29, 1916, differ from that published in Bulletin 642 because of a revision of rating curve, based upon discharge measurements made in 1916.

Monthly discharge of Ketchikan Creek at Ketchikan for the years ending Sept. 30, 1910–1912 and 1915–16.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1909–10.				
November	685	44	130	7,740
December	296	40	76.5	4,700
January	252	36	76.3	4,690
February	332	36	82.0	4,550
March	560	40	237	14,600
April	285	44	135	8,030
May	523	160	291	17,900
June	584	200	330	19,600
July	2,040	190	374	23,000
August	1,540	93	256	15,700
September	685	66	183	10,900
The period				131,000
1910–11.				
October	2,220	151	550	33,800
November	493	54	211	12,600
December	1,440	54	339	20,800
January	493		125	7,690
February			70	3,890
March			100	6,150
April	880	49	162	9,640
May	464	125	249	15,300
June	1,190	200	334	19,900
July	1,290	160	297	18,300
August	180	86	128	7,870
September	523	93	189	11,200
The year	2,220		231	167,000
1911–12.				
October	409	93	173	10,600
November	464	54	169	10,100
December	3,400	93	411	25,300
January	436	66	151	9,280
February	616	66	214	12,300
March	200	40	62.1	3,820
April	180	66	95.2	5,660
May	332	86	187	11,500
June	200	79	112	6,660
The period				95,200
1951.				
July	200	59	86.6	5,320
August	2,640	41	303	18,600
September	584	34	106	6,310
The period				30,200
1915–16.				
October	1,540	54	371	22,800
November	553	79	238	14,200
December	553	54	190	11,700
January	80	40	47.8	2,940
February	616	40	109	6,270
March	409	61	110	6,760
April	436	82	155	9,220
May	523	85	199	12,200
June	332	142	241	14,300
July	1,060	125	281	17,300
August	523	79	165	10,100
September	553	74	228	13,600
The year	1,540	40	195	141,000
1916.				
October	840	66	233	14,300
November	650	71	201	12,000
December	241	64	110	6,760
The period				33,100

NOTE.—See footnote to daily-discharge table.

SWAN LAKE OUTLET AT CARROLL INLET, REVILLAGIGEDO ISLAND.

LOCATION.—Halfway between Swan Lake and tidewater; on east shore of Carroll Inlet, 1 mile from its head; 30 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 24 to December 31, 1916.

GAGE.—Stevens water-stage recorder on left bank, half a mile from tidewater; reached by a trail which leaves beach back of old cabin one-fourth mile south of mouth of creek.

DISCHARGE MEASUREMENTS.—At medium and high stages, made from a cable across stream 100 feet downstream from gage; at low stages made by wading.

CHANNEL AND CONTROL.—The gage well is in a deep pool 25 feet upstream from a contracted portion of channel, where a fall of a foot over bed rock forms a permanent control. The effect of the violent fluctuation of the water surface outside of gage well is decreased in the inner float well because the intake holes at the bottom are very small. At the cable section the bed is rough, the water shallow, and the current very swift. Point of zero flow is at gage height 0.0±0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 4.74 feet at 7 p. m. October 28 (discharge, 1,210 second-feet); minimum stage recorded, 1.23 feet December 28 (discharge, 73 second-feet).

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined between 50 and 900 second-feet. Operation of water-stage recorder satisfactory except December 8–31. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph. Results fair.

Swan Lake, whose area is about 350 acres, is 1½ miles from tidewater, at an elevation of 225 feet above sea level.

Discharge measurements of Swan Lake outlet at Carroll Inlet during period Aug. 24 to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Aug. 24	G. H. Canfield	3.40	726	Dec. 8	C. O. Brown	1.75	238
Nov. 1	C. T. Gardner	2.84	612				

Daily discharge, in second-feet, of Swan Lake outlet at Carroll Inlet for the period Aug. 24 to Dec. 31, 1916.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		213	452	568	394	16		226	666	151	201
2		198	347	485	337	17		198	485	98	216
3		177	278	452	291	18		186	375	414	238
4		159	238	407	260	19		207	502	449	216
5		154	244	414	216	20		334	683	617	201
6		168	235	410	183	21		568	634	551	171
7		356	207	394	180	22		468	534	426	142
8		568	180	423	171	23		414	716	334	114
9		534	156	378	156	24	766	394	650	340	88
10		700	139	313	142	25	600	666	749	398	81
11		700	131	254	171	26	468	918	816	310	88
12		568	134	210	156	27	391	749	749	325	84
13		430	229	180	156	28	334	816	1,090	303	77
14		334	446	159	142	29	294	816	1,020	325	88
15		269	850	159	171	30	260	617	799	356	88
						31	238		650		101

NOTE.—Discharge Dec. 8–31 estimated from maximum and minimum stages indicated by recording pencil and comparison with gage-height graph for Fish Creek near Sea Level.

Monthly discharge of Swan Lake outlet at Carroll Inlet for the period Aug. 24 to Dec. 31, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
August 24-31	766	238	419	6,650
September	918	154	437	26,000
October	1,090	131	496	30,500
November	617	98	353	21,000
December	394	77	172	10,600
The period				94,800

ORCHARD LAKE OUTLET AT SHRIMP BAY, REVILLAGIGEDO ISLAND.

LOCATION.—In latitude 55° 50′ N., longitude 131° 27′ W., at outlet of Orchard Lake, one-third mile from tidewater at head of Shrimp Bay, an arm of Behm Canal, 46 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 28, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on right bank 300 feet below Orchard Lake and 100 feet above site of timber-crib dam, which was built in 1914 for proposed pulp mill and washed out by high water August 10, 1915. Datum of gage lowered 2 feet September 15, 1915. Gage heights May 29 to August 10 referred to first datum; August 11, 1915, to August 17, 1916, to second datum. Datum of gage lowered 1 foot August 17, 1916. Gage heights August 18 to December 31, 1916, referred to this datum.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable 50 feet downstream from gage; at low stages by wading near cable.

CHANNEL AND CONTROL.—From Orchard Lake, at elevation 134 feet above high tide, the stream descends in a series of rapids for 1,000 feet through a narrow gorge, then divides into two channels and enters the bay in two cascades of 100-foot vertical fall. Opposite the gage the water is deep and the current sluggish. At the site of the old dam bedrock is exposed, but for 30 feet upstream the channel is filled in with loose rock and brush placed during construction of dam. This material forms a riffle which acts as a control for water surface at gage at low and medium stages and is scoured down when ice goes out of lake; the rock outcrop at site of old dam acts as a control at high stages and is permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 8.4 feet at 2 a. m. October 16, 1915 (discharge, 6,230 second-feet); minimum, estimated, 20 second-feet February 11, 1916.

ICE.—Ice forms on Orchard Lake, but because of swift current and relatively warm water from lake the outlet and control remain open.

ACCURACY.—Stage-discharge relation changed August 10, 1915, when timber dam below gage was washed out, and changed for low stages February 15 and April 13, when the old gravel cofferdam under cable was scoured down by ice passing out of lake. Fifteen discharge measurements were made during period, by means of which rating curves have been constructed applicable as follows: May 28 to August 10 well-defined below and poorly defined above 2,000 second-feet; August 11, 1915, to February 14, 1916, well defined; February 15 to April 12, poorly defined; April 13 to December 31, 1916, fairly well defined. Operation of water-stage recorder satisfactory, except for periods when clock stopped, as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights, determined by inspecting gage-height graph, or for days of considerable fluctuation by averaging the discharge for equal intervals of the day, except April 13 to November 2, 1916, for which the daily discharge was ascertained by use of the discharge integrator. Results fair.

The highest mountains on this drainage basin are only 3,500 feet above sea level and are covered to an elevation of 2,500 feet by a heavy stand of timber and a thick undergrowth of brush, ferns, alders, and devil's club. The topography is not so rugged as that of the area surrounding Shelockum Lake, and the proportion of vegetation, soil cover, and lake area is greater, so that more water is stored and the flow in the Orchard Lake drainage basin is better sustained.

Discharge measurements of Orchard Lake outlet at Shrimp Bay for the period May 28, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
May 29	G. H. Canfield	2.88	444	Jan. 20	G. H. Canfield	−0.34	36
July 8	.....do	1.96	248	Mar. 15	.....do	.43	156
Aug. 7	Gardner and Williams	.90	145	Apr. 18	.....do	1.51	473
Sept. 15	Canfield and Hoyt	a 1.40	341	18	.....do	1.50	469
16	.....do	1.71	428	Aug. 18	.....do	b 1.92	314
Oct. 16	G. H. Canfield	7.58	5,280	Nov. 3	Gardner and Smith	2.35	507
16	.....do	6.78	4,270	Dec. 7	C. O. Brown	1.33	173
17	.....do	5.22	2,720				

a Datum of gage lowered 2 feet before making discharge measurement.
b Datum of gage lowered 1 foot before making discharge measurement.

Daily discharge, in second-feet, of Orchard Lake outlet at Shrimp Bay for the period May 28, 1915, to Dec. 31, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.								
1		362	271	170	159	640	1,260	320
2		362	271	161	239	406	1,000	974
3		373	280	151	488	299	710	1,130
4		422	263	145	610	372	710	930
5		450	263	135	570	478	690	690
6		495	271	134	453	385	630	975
7		580	263	146	374	336	551	944
8		620	252	240	310	806	460	611
9		528	242	792	257	1,280	412	403
10		480	227	3,480	208	930	382	299
11		480	219	4,700	188	1,400	382	232
12		495	209	2,550	180	1,260	368	192
13		480	202	1,980	159	1,520	570	157
14		436	196	1,200	161	1,300	710	138
15		450	193	1,250	317	4,140	532	124
16		800	194	1,020	427	4,990	421	135
17		700	197	616	368	2,430	444	142
18		580	191	418	329	1,170	551	174
19		480	183	334	276	830	460	208
20		465	178	272	232	1,260	412	283
21		700	176	228	202	1,320	525	434
22		680	262	198	178	1,010	444	450
23		545	385	178	155	880	346	403
24		465	373	159	138	930	344	354
25		410	318	150	232	955	336	290
26		410	271	142	354	1,570	294	235
27		350	248	136	385	1,260	241	232
28	465	308	224	133	1,010	1,840	204	214
29	450	280	208	126	1,720	1,480	218	174
30	422	271	195	133	1,090	951	239	157
31	373		183	198		805		140

Daily discharge, in second-feet, of Orchard Lake outlet at Shrimp Bay for the period May 28, 1915, to Dec. 31, 1916—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.												
1	122	29	168	341	673	1,430	694	1,490	198	516	516	488
2	118	28	159	394	704	1,370	700	1,030	185	370	452	379
3	116	28	150	440	838	1,430	615	595	173	285	426	297
4	112	27	142	460	888	1,080	656	463	160	233	412	266
5	108	25	133	421	844	870	832	437	150	258	406	223
6	103	24	126	380	858	828	928	404	158	291	429	191
7	98	23	118	650	728	783	756	376	360	252	406	173
8	94	22	110	630	566	783	658	366	845	214	467	162
9	88	22	206	570	472	789	619	347	818	186	443	149
10	84	21	322	517	446	894	610	328	1,040	160	357	140
11	79	20	290	453	438	944	628	317	1,070	146	282	179
12	75	62	243	548	434	1,130	555	304	761	148	230	179
13	70	150	206	1,380	434	1,270	665	294	518	258	195	163
14	65	240	174	1,100	514	1,520	870	288	378	443	278	162
15	60	813	155	754	687	1,560	653	378	296	1,320	179	227
16	54	1,070	155	560	890	1,360	575	409	234	886	181	225
17	48	685	145	522	1,020	1,240	559	359	207	559	238	208
18	43	514	132	481	1,050	1,130	530	309	182	396	522	234
19	41	760	121	421	1,100	888	831	289	230	452	522	234
20	37	1,150	116	369	1,020	764	1,750	350	408	849	748	199
21	36	810	136	358	910	780	1,900	677	892	929	628	165
22	36	610	157	344	776	839	1,380	768	648	701	446	142
23	36	450	163	340	670	866	1,020	1,020	508	951	346	122
24	35	363	152	375	656	900	760	990	485	785	348	108
25	35	324	143	470	758	968	659	660	728	980	434	97
26	35	294	150	543	978	1,080	645	487	1,200	1,200	418	87
27	34	261	161	720	988	1,160	646	383	916	1,010	354	82
28	34	232	163	918	822	1,060	728	316	926	1,600	330	78
29	33	204	154	846	966	888	1,730	274	1,130	1,480	390	73
30	32	....	163	746	1,160	753	2,110	246	781	916	415	84
31	30	....	250	....	1,350	....	1,370	221	....	654	....	91

NOTE.—Discharge estimated (no gage record) for following periods: Aug. 22 to Sept. 2, from climatic records and flow before and after the period· Nov. 3–16, 1915, from climatic records and minimum stage indicated by recorder; Jan. 3 to Feb. 13, from climatic records and one current-meter measurement; Mar. 2–8, because water surface was below bottom of well, and July 13–17, 19–31, Aug. 1, 2, 15, and 16, 1916, from climatic records and comparison with records of flow for Shelockum Lake outlet.

Monthly discharge of Orchard Lake outlet at Shrimp Bay for period June 1, 1915, to Dec. 31, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
June	800	271	482	28,700
July	385	176	239	14,700
August	4,700	126	699	43,000
September	1,720	138	392	23,300
The period	....	....	....	110,000
1915–16.				
October	4,990	299	1,270	78,100
November	1,260	204	495	29,500
December	1,130	124	392	24,100
January	122	30	64.2	3,950
February	1,150	20	319	18,300
March	322	110	167	10,300
April	1,380	340	568	33,800
May	1,350	434	795	48,900
June	1,560	753	1,050	62,500
July	2,110	530	891	54,800
August	1,490	221	490	30,100
September	1,200	150	553	32,900
The year	4,990	20	588	427,000
1916.				
October	1,600	146	627	38,600
November	748	179	393	23,400
December	488	73	181	11,100
The period	....	....	....	73,100

SHELOCKUM LAKE OUTLET AT BAILEY BAY.

LOCATION.—In latitude 56° 00′ N., longitude 131° 36′ W. on mainland near outlet of Shelockum Lake, three-fourths mile by Forest Service trail from tidewater at north end of Bailey Bay, and 52 miles by water north of Ketchikan.

DRAINAGE AREA.—18 square miles (measured on sheets Nos. 5 and 8 of the Alaska Boundary Tribunal, edition of 1895).

RECORDS AVAILABLE.—June 1, 1915, to December 31, 1916.

GAGE.—Stevens water stage recorder on right shore of lake, 250 feet above outlet.

DISCHARGE MEASUREMENTS.—Made from cable across outlet of lake, 200 feet below gage and 50 feet upstream from crest of falls.

CHANNEL AND CONTROL.—Opposite the gage the lake is 600 feet wide; at the outlet bedrock is exposed and the water makes a nearly perpendicular fall of 150 feet. This fall forms an excellent and permanent control for the gage. At extremely high stages the lake has another outlet about 200 feet to left of main outlet. Point of zero flow is at gage height 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 6.5 feet (estimated) October 15, 1915 (discharge, 2,440 second-feet); minimum flow, estimated from gage record and climatic data, 9 second-feet February 11, 1916.

ICE.—Ice forms on Shelockum Lake and at gage, but because of the swift current and relatively warm water from lake, the control remains open and stage-discharge relation is not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Operation of water-stage recorder satisfactory except for periods of break in record shown in the footnote to daily-discharge table. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by inspection of gage-height graph, or, for days of considerable fluctuation, by averaging the discharge for equal intervals of the day, except March 27 to November 1, 1916 for which discharge was ascertained by use of discharge integrator. Results excellent except for periods of break in record, for which they are fair.

Shelockum Lake, at elevation 344 feet, is only 350 acres in area. The drainage basin above the lake is rough and precipitous and is covered with little soil or vegetation. There are no glaciers or ice fields at the source of the tributary streams. Therefore, as there is little natural storage, the run-off after a heavy rainfall is rapid and not well sustained, and during a hot, dry summer the flow becomes very low. The large amount of snow that accumulates during the winter months maintains a good flow.

Discharge measurements of Shelockum Lake outlet at Bailey Bay, during the period June 1, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915		*Feet.*	*Sec.-ft.*	1915.		*Feet.*	*Sec.-ft.*
June 4[a]	G. H. Canfield	2.78	294	Oct. 15	G. H. Canfield	6.32	2,280
July 9	.....do	1.78	87	17	.....do	3.47	484
Aug. 6	Gardner and Williams	1.20	22.5				
Sept. 14	Canfield and Hoyt	1.35	42	1916.			
15	.....do	1.75	86	Apr. 18	.....do	1.90	103

[a] Measurement made from boat at cable section.

Daily dischage, in second-feet, of Shelockum Lake outlet at Bailey Bay, for the period June 1, 1915, to Dec. 31, 1916.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.												
1						325	91	27			480	94
2						310	91	24			334	222
3						300	90	23			248	268
4						295	85	21			258	245
5						278	91	20			241	200
6						265	102	25			191	250
7						312	109	45			144	280
8						352	96				104	187
9						270	87				83	125
10						222	77				69	88
11						216	69				63	70
12						216	60				57	55
13						206	55				86	47
14						185	50		39		175	45
15						198	47		77	2,220	179	41
16						255	42		94	1,030	158	50
17						227	40		99	510	156	55
18						187	36		96	347	177	61
19						158	33		81	250	154	64
20						258	31		75	338	127	70
21						448	31			379	121	90
22						325	49			325	110	101
23						232	63			262	91	91
24						179	65			320	97	84
25						166	60			339	102	70
26						158	53			580	88	61
27						131	48			450	83	65
28						113	43			620	72	58
29						102	38			456	71	48
30						94	33			288	69	46
31							31			292		45
1916.												
1	39	12	51	96	220	530	270	458	49	162	166	134
2	33	11	49	110	245	486	270	385	43	112	144	107
3	31	11	48	152	295	610	253	264	39	81	120	84
4	29	11	47	160	379	442	262	195	37	71	104	78
5	29	11	46	141	318	374	282	168	46	98	120	71
6	28	11	45	119	268	438	300	152	118	91	138	63
7	27	10	44	151	216	386	258	146	290	75	138	61
8	24	10	43	168	164	329	252	136	438	63	179	59
9	23	10	84	166	136	267	247	120	345	54	156	53
10	22	10	142	166	134	242	266	114	528	46	115	52
11	21	9	107	146	131	328	284	106	379	44	87	51
12	21	22	71	148	132	410	260	98	231	75	69	45
13	21	107	59	333	138	450	252	90	150	246	57	44
14	19	172	55	291	158	712	307	108	103	413	51	52
15	19	393	54	199	218	718	277	130	80	602	70	75
16	18	407	53	149	302	532	256	136	64	354	70	70
17	17	183	52	134	352	483	268	120	55	211	107	69
18	17	120	48	126	379	450	314	96	64	140	202	73
19	19	227	46	106	393	359	428	118	115	274	206	67
20	21	450	44	93	366	323	594	229	270	540	234	58
21	20	325	45	90	366	315	599	473	378	454	183	52
22	19	216	47	87	302	330	383	371	260	320	134	46
23	16	136	48	81	250	332	272	478	210	375	105	38
24	16	96	46	96	234	352	206	436	204	305	97	35
25	15	67	44	134	162	384	182	272	455	392	110	32
26	14	60	44	162	347	455	178	181	600	455	109	31
27	14	57	48	217	352	502	179	130	358	359	91	30
28	14	54	48	281	308	462	223	100	427	565	85	28
29	13	51	49	275	379	391	769	83	386	448	91	30
30	13		49	238	480	325	755	69	252	287	110	35
31	13		67		536		413	58		200		41

NOTE.—June 1–3, discharge estimated; Aug. 8 to Sept. 14, Sept. 21 to Oct. 4, 1915, and July 1–8, 1916, gage clock stopped; discharge estimated from maximum and minimum stages indicated by the recorder and by a comparison of the record for this station with that for Orchard Lake outlet. Jan. 23 to Mar. 13, ice in well; discharge estimated from climatic records at Ketchikan and by a comparison of hydrograph for this station with that for Orchard Lake outlet. Estimates of discharge below 91 second-feet, June 1, 1915, to Feb. 21, 1916, differ from that published in Bulletin 642 because of a revision of the rating curve.

Monthly discharge of Shelockum Lake outlet at Bailey Bay for 1915–16.

[Drainage area, 18 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.
1915.						
June	448	94	233	12.9	14.39	13,900
July	109	31	61.2	3.40	3.92	3,760
August			129	7.17	8.27	7,930
September			101	5.61	6.26	6,010
The period						31,600
1915–16.						
October	2,220		401	22.3	25.71	24,700
November	480	57	146	8.11	9.05	8,690
December	280	41	106	5.89	6.79	6,520
January	39	13	20.8	1.16	1.34	1,280
February	450	9	112	6.22	6.71	6,440
March	142	43	55.6	3.09	3.56	3,420
April	333	81	160	8.89	9.92	9,520
May	536	131	279	15.5	17.87	17,200
June	718	242	424	23.6	26.33	25,200
July	769	178	324	18.0	20.75	19,900
August	478	58	194	10.8	12.45	11,900
September	600	37	232	12.9	14.39	13,800
The year	2,220	9	205	11.4	154.87	149,000
1916.						
October	602	44	255	14.2	16.37	15,700
November	234	51	122	6.78	7.56	7,260
December	134	28	56.9	3.16	3.64	3,500
The period						26,500

KARTA RIVER AT KARTA BAY, PRINCE OF WALES ISLAND.

LOCATION.—In latitude 55° 34′ N., longitude 132° 37′ W., at head of Karta Bay, an arm of Kasaan Bay, on east coast of Prince of Wales Island, 42 miles by water across Clarence Strait from Ketchikan.

DRAINAGE AREA.—49.5 square miles (U. S. Forest Service reconnaissance map of Prince of Wales Island, 1914).

RECORDS AVAILABLE.—July 1, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on left bank, half a mile above tidewater, at head of Karta Bay and 1¼ miles below outlet of Little Salmon Lake. Two per cent of total drainage of Karta River enters between outlet of lake and gage.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable across river 50 feet upstream from gage; at low stages by wading at cable section.

CHANNEL AND CONTROL.—From Little Salmon Lake, 1½ miles from tidewater, the river descends 105 feet in a series of rapids in a wide, shallow channel, the banks of which are low but do not overflow. The bed is of course gravel and boulders; rock crops out only at outlet of lake. Gage and cable are at a pool of still water formed by a riffle of coarse gravel that makes a well-defined and permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 4.4 feet, October 16 (discharge, 3,340 second-feet); minimum flow, estimated from discharge measurement, gage record, and climatic data, 21 second-feet, February 11.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation practically permanent, except when affected by ice January 8 to February 16. Rating curve well defined between 80 and 1,500 second-feet; extended below 80 second-feet to the point of zero flow and above 1,500 second-feet by estimation. Operation of water-stage recorder satisfactory except for periods indicated by breaks in record as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or for days of considerable fluctuation by averaging results obtained by applying to rating table mean gage heights for regular intervals of day. Results excellent except for periods of break in record, for period affected by ice, and for discharge above 1,500 second-feet, for which they are fair.

The combined area of Little Salmon Lake at elevation 105 feet, and Salmon Lake at elevation 110 feet, is 1,600 acres. The slopes along the right shore of lakes and at head of Salmon Lake are gentle, and the area included by the 250-foot contour above lake outlet is 5,500 acres. The drainage area to elevation 2,000 feet is heavily covered with timber and dense undergrowth of ferns, brush, and alders. The upper parts of the mountains are covered with thin soil and brush. Only a few peaks at an elevation of 3,500 feet are bare. This large lake and flat area and thick vegetal cover afford considerable natural storage, which, after heavy precipitation, maintains a good run-off. The snow usually melts by the end of June, and the run-off becomes very low during a dry, hot summer.

The Forest Service in summer of 1916 constructed a pack trail from tidewater to outlet of Little Salmon Lake.

Discharge measurements of Karta River at Karta Bay during the period July 1, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
July 6	G. H. Canfield	....	90	Jan. 29	G. H. Canfield	*a*1.45	31
16	.....do	1.00	85	Feb. 29	.....do	1.38	229
Sept. 7	.....do	1.49	283	May 18	.....do	2.06	680
17	Canfield and Hoyt	1.06	109				
Oct. 20	G. H. Canfield	2.94	1,500				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Karta River at Karta Bay for the period July 1, 1915, to Dec. 31, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.							1915.						
1	......	48	150	540	1,920	1,020	16	88	695	109	3,000	960	351
2	......	46	200	385	1,340	1,330	17	88	524	103	1,960	870	375
3	......	44	300	290	1,000	1,540	18	83	419	100	1,240	843	475
4	......	44	400	285	987	1,330	19	76	328	91	1,150	671	601
5	......	44	510	305	1,000	1,390	20	74	268	88	1,490	653	852
6	......	44	350	296	834	1,980	21	69	220	81	1,310	987	987
7	......	118	283	258	631	1,860	22	74	184	78	1,010	852	915
8	......	356	278	416	489	1,100	23	76	156	76	1,000	843	738
9	......	695	253	650	375	720	24	76	135	71	1,050	746	679
10	......	1,200	215	643	316	517	25	71	121	74	960	655	531
11	......	1,080	180	750	299	387	26	66	112	120	1,170	531	426
12	......	1,170	160	750	278	305	27	64	97	197	1,170	440	433
13	......	1,170	138	882	1,090	253	28	60	88	360	1,620	432	363
14	......	1,130	125	1,000	1,680	215	29	58	81	830	1,460	789	305
15	......	987	115	2,120	1,400	206	30	54	88	770	1,050	754	268
							31	52	135	......	1,350	......	238

Daily discharge, in second-feet, of Karta River at Karta Bay for the period July 1, 1915, to Dec. 31, 1916—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.												
1	206	30	201	382	480	565	344	314	112	410	565	1,010
2	172	29	176	441	480	625	320	285	97	320	515	748
3	152	29	156	494	387	550	290	243	88	244	970	625
4	138	29	142	494	522	515	274	210	88	215	1,370	572
5	128	27	135	448	558	515	230	176	81	188	1,480	460
6	121	27	125	460	657	480	290	156	76	168	1,120	363
7	112	26	121	681	565	448	280	142	142	149	799	332
8	106	26	118	714	467	415	259	128	180	132	773	290
9	106	24	176	764	402	370	243	118	201	121	673	248
10	103	22	248	681	363	350	259	115	274	112	529	264
11	103	21	243	602	326	363	320	103	320	103	422	376
12	100	32	220	730	376	428	344	100	302	94	338	370
13	100	172	192	1,510	408	515	314	94	264	125	280	326
14	100	132	172	1,370	422	689	280	88	224	217	248	428
15	97	278	172	1,000	448	657	264	88	188	480	264	595
16	97	580	197	730	508	610	264	86	164	474	254	501
17	94	679	176	618	590	580	269	83	145	389	467	515
18	88	566	156	515	673	536	259	83	142	332	764	610
19	83	608	156	454	665	487	280	88	172	402	764	536
20	81	679	156	543	649	441	290	106	248	448	871	474
21	74	566	188	565	595	415	290	149	370	515	730	396
22	71	447	254	515	522	396	290	172	344	550	572	320
23	66	363	254	529	441	396	259	269	308	730	454	264
24	60	334	224	494	408	402	229	338	280	673	793	220
25	54	328	290	487	422	422	210	308	363	808	1,000	188
26	48	299	296	474	487	460	184	259	665	835	799	168
27	44	273	290	501	480	480	176	224	665	934	756	152
28	39	253	243	565	467	467	172	188	730	1,680	739	142
29	32	224	220	565	480	434	290	160	681	1,450	714	135
30	30	....	248	522	513	382	376	142	529	970	888	145
31	30	....	338	....	550	....	350	125	....	730	....	160

NOTE.—Discharge July 1-15, 1915, estimated at 95 second-feet from one discharge measurement and from a comparison of hydrograph for this station with that for Fish Creek. Discharge Jan. 8 to Feb. 16, 1916, estimated because of ice; Sept. 1-6, Sept. 23 to Oct. 18, 1915, May 17 and May 30 to June 14, 1916, estimated because of clock stopping, from maximum and minimum stages indicated by recorder and from a comparison of record for this station with that for Fish Creek.

Monthly discharge of Karta River at Karta Bay for the period July 1, 1915, to Dec. 31, 1916.

[Drainage area, 49.5 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.
1915.						
July	....	52	82.5	1.67	1.92	5,070
August	1,200	44	382	7.72	8.90	23,500
September	830	71	227	4.59	5.12	13,500
The period	....	....	....	....	....	42,100
1915-16.						
October	3,000	258	1,020	20.6	23.75	62,700
November	1,920	278	822	16.6	18.52	48,900
December	1,980	206	732	14.8	17.06	45,000
January	206	30	91.5	1.85	2.13	5,630
February	679	21	245	4.95	5.34	14,100
March	338	118	203	4.10	4.73	12,500
April	1,510	382	628	12.7	14.17	37,400
May	673	326	494	9.98	11.51	30,400
June	689	350	480	9.70	10.82	28,600
July	376	172	276	5.58	6.43	17,000
August	338	83	166	3.35	3.86	10,200
September	730	76	281	5.68	6.34	16,700
The year	3,000	21	453	9.15	124.66	329,000
1916.						
October	1,680	94	484	9.78	11.28	29,800
November	1,480	248	697	14.1	15.73	41,500
December	1,010	135	385	7.78	8.97	23,700
The period	....	....	....	....	....	95,000

MILL CREEK NEAR WRANGELL.

LOCATION.—In latitude 56° 28′ N., longitude 132° 12′ W., near outlet of Lake Virginia on east shore of Eastern Passage, a narrow channel between Wrangell Island and mainland, 6 miles by water from Wrangell.

DRAINAGE AREA.—50[1] square miles (measured on U. S. Coast and Geodetic Survey chart 8200).

RECORDS AVAILABLE.—June 17, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on left bank one-fourth mile below Lake Virginia and three-fourths mile above tidewater.

DISCHARGE MEASUREMENTS.—Made from cable across creek, 10 feet upstream from gage.

CHANNEL AND CONTROL.—From the outlet of the lake, at an elevation of 100 feet above sea level and at a distance of 1 mile from tidewater, the creek descends in a series of rapids and falls. The bed is glacial drift and boulders at the rapids and rock outcrop at points of concentrated fall. The gage is in a pool of still water created by a small fall at a contracted point of channel. This fall makes a well-defined, permanent, and sensitive control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 8 feet October 16, 1915 (discharge, computed from extension of rating curve, about 3,310 second-feet, differs from that published in Bulletin 642 because of revision of rating curve); minimum stage recorded, 0.02 foot February 11 (discharge, 15 second-feet).

ICE.—Ice forms on the lake, at gage, and along the banks, but the swift current and flow of relatively warm water from the lake keeps the control open.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined below 1,200 second-feet; extended above 1,200 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by averaging discharge for equal intervals of the day. Results good except for periods when water-stage recorder was not operating satisfactorily.

The drainage basin is covered with a heavy stand of timber to an elevation of 2,500 feet and a dense undergrowth of ferns, brush, alders, and devil's club, but because of the steep slopes and thin soil the run-off after heavy rains is rapid and the ground storage is small. During a dry, hot period in summer the flow is augmented by melting ice from glaciers at the headwaters of two of the tributary streams.

Discharge measurements of Mill Creek near Wrangell during the period June 17, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
June 19	Canfield and Allen	2.54	477	Feb. 1[a]	G. H. Canfield	0.10	19
July 1	.....do	2.30	421	24	.....do	1.32	164
Nov. 3	G. H. Canfield	1.94	318	Sept. 21	.....do	4.01	1,060

[a] Ice at gage; control open.

[1] Revised since last published.

Daily discharge, in second-feet, of Mill Creek near Wrangell for the period June 17, 1915, to Dec. 31, 1916.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.							
1	....	418	421	421	575	299	125
2	....	469	370	610	370	273	376
3	....	492	325	1,810	294	299	525
4	....	466	294	1,310	510	400	454
5	....	510	278	770	645	430	340
6	....	575	355	558	415	325	253
7	....	454	451	492	286	236	370
8	....	394	610	406	427	294	340
9	....	394	870	355	610	142	219
10	....	325	1,610	309	475	128	156
11	....	291	1,510	268	850	118	128
12	....	331	1,560	236	810	109	110
13	....	376	1,910	236	1,240	153	100
14	....	385	1,310	409	1,110	286	87
15	....	349	1,460	988	2,120	312	87
16	....	358	850	830	2,620	243	82
17	662	373	540	592	1,480	190	90
18	575	355	540	492	715	194	105
19	492	340	460	379	575	190	120
20	525	358	394	400	540	170	135
21	645	409	355	698	510	212	150
22	525	510	325	492	475	212	164
23	451	525	320	343	445	160	144
24	424	492	340	312	415	139	124
25	445	454	385	790	385	137	107
26	469	525	409	715	355	130	98
27	397	610	331	510	325	118	97
28	349	610	312	942	325	107	88
29	346	558	340	1,460	325	102	83
30	382	525	355	1,040	299	114	80
31	....	463	394	....	299	....	74

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.												
1	69	21	93	166	258	830	645	1,990	343	325	....	180
2	62	19	78	263	337	742	610	1,340	320	241	....	155
3	57	18	71	304	457	1,030	525	920	289	186	....	132
4	55	18	67	294	469	750	475	698	263	180	....	122
5	54	18	67	222	424	592	645	662	278	424	....	114
6	54	17	64	192	376	662	732	628	409	361	....	105
7	51	17	64	349	309	645	628	662	575	256	....	98
8	45	16	64	325	238	582	540	628	1,140	205	....	....
9	43	15	63	258	194	492	592	510	698	182	....	....
10	41	14	66	210	174	409	610	492	1,370	168	....	....
11	41	14	68	162	172	645	850	492	1,100	188	....	....
12	42	20	68	205	170	770	680	492	698	480	....	....
13	40	22	67	525	174	890	1,170	558	445	1,220	....	....
14	42	26	64	421	243	1,240	1,440	770	315	927	....	....
15	40	72	60	276	349	1,460	875	770	278	1,400	....	....
16	40	253	60	207	474	1,080	810	558	278	750	....	....
17	37	205	57	180	540	988	875	397	281	445	....	....
18	36	168	55	178	645	890	830	302	382	294	....	....
19	32	376	52	155	575	810	1,120	370	920	452	....	....
20	32	715	51	135	510	715	1,340	558	1,000	1,510	460	....
21	30	412	51	130	610	645	875	1,170	1,050	1,050	320	....
22	30	263	52	127	364	680	645	1,100	645	645	238	....
23	29	200	55	122	312	645	540	1,400	510	....	186	....
24	29	170	56	127	322	628	454	1,500	592	....	200	....
25	28	168	55	168	370	790	442	810	775	....	278	....
26	28	160	55	217	406	1,010	525	592	1,340	....	281	....
27	27	140	59	337	403	1,080	575	525	715	....	205	....
28	25	124	62	464	370	988	755	469	1,080	....	164	....
29	25	109	62	340	610	810	1,610	427	875	....	155	....
30	24	....	65	286	770	680	1,660	391	510	....	166	....
31	22	....	98	....	830	....	988	373	....	....	....	....

NOTE.—Water-stage recorder not working properly for following periods: Oct. 5 to Nov. 2, 1915; daily discharge estimated from maximum and minimum stages indicated by recorder, from climatic records and comparison with gage-height records for stations in adjacent drainage basins. Dec. 18-21, 1915; discharge interpolated. Oct. 1 to Nov. 20 and Dec. 8-31, 1916; discharge estimated from maximum and mimimum stages indicated by recorder and by comparison with record for Shelockum Lake outlet as follows: Oct. 23-31, 1,000 second-feet; Nov. 1-19, 253 second-feet; Dec. 8-31, 90 second-feet. Water frozen in well Jan. 23 to Feb. 11, 1916; discharge estimated from one discharge measurement and climatic records.

Monthly discharge of Mill Creek near Wrangell for the period June 17, 1915, to Dec. 31, 1916.

[Drainage area, 50 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.
1915.						
June 17-30	662	346	478	9.56	4.98	13,300
July	610	291	442	8.84	10.19	27,200
August	1,910	278	645	12.9	14.87	39,700
September	1,780	236	639	12.8	14.28	38,000
The period						118,000
1915-16.						
October	2,620	286	672	13.4	15.45	41,300
November	430	102	207	4.14	4.62	12,300
December	525	74	175	3.50	4.04	10,800
January	69	22	39.0	.780	.90	2,400
February	715	14	131	2.62	2.83	7,540
March	98	51	63.5	1.27	1.46	3,900
April	525	122	245	4.90	5.47	14,600
May	830	170	402	8.04	9.27	24,700
June	1,460	409	806	16.1	17.96	48,000
July	1,660	442	808	16.2	18.68	49,700
August	1,990	302	728	14.6	16.83	44,800
September	1,370	263	649	13.0	14.50	38,600
The year	2,620	14	411	8.22	112.01	299,000
1916.						
October	1,510	168	674	13.5	15.56	41,400
November		*a* 89	248	4.96	5.53	14,800
December		*a* 52	98.9	1.98	2.28	6,080
The period						62,300

a Minimum stage recorded by the water-stage recorder, exact date not known.

GREEN LAKE OUTLET AT SILVER BAY, NEAR SITKA.

LOCATION.—In latitude 56° 59′ N., longitude 135° 5′ W., at outlet of Green Lake, at head of Silver Bay, 10½ miles by water south of Sitka.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 22, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on right bank at outlet of lake, reached by trail which leaves the beach one-fourth mile north of mouth of stream, ascends a 600-foot ridge, and then drops down to the outlet of the lake.

DISCHARGE MEASUREMENTS.—Made from cable across outlet 30 feet below gage.

CHANNEL AND CONTROL.—From Green Lake, 240 feet above sea level and 1,800 feet from tidewater, the stream descends in a series of falls and rapids through a narrow canyon whose exposed rock walls rise perpendicularly more than a hundred feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 10.22 feet at 5 a. m. September 19, 1916 (discharge, computed from extension of rating curve, 2,400 second-feet); minimum flow, estimated from hydrograph for Baranof Lake outlet and climatic records, 24 second-feet February 13.

ICE.—Ice forms on lake and at gage, but because of current and flow of relatively warm water from the lake the control remains open.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 100 and 1,300 second-feet. Operation of water-stage recorder satisfactory except for periods indicated by breaks in record, as shown in the footnote to the daily-discharge table. Daily discharge for 1915 and February 15 to March 2 and November 1 to December 27, 1916, ascertained by applying to the rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table gage heights for regular intervals of day. Discharge April 3 to October 31, 1916, ascertained by use of discharge integrator.

In the fall and winter the flow is low because there is little ground storage and on most of the drainage area the precipitation is in the form of snow. This accumulated snow produces a large run-off during the spring, and the melting ice from the glacier and the ice-capped mountains augment the run-off from precipitation during the summer. The area of Green Lake is estimated to be only 100 acres.

Discharge measurements of Green Lake outlet at Silver Bay, near Sitka, during the period Aug. 22, 1915, to Dec. 31, 1916.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1915.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*
Aug. 22[a]	2.39	259	Feb. 16	0.47	96	Oct. 24	3.10	434
Nov. 22	1.18	136	June 7	2.66	346	24	4.22	630
Dec. 6	2.15	261	Oct. 24	2.92	397	25	6.61	1,210

[a] Tree lodged on control, causing backwater at gage.

Daily discharge, in second-feet, of Green Lake outlet at Silver Bay, near Sitka, for the period Aug. 22, 1915, to Dec. 31, 1916.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.						1915.					
1		278	620		83	16		942	717		70
2		943	380		130	17		577			73
3		765	368		224	18		438			89
4		451	593		281	19		365			107
5		315	1,070		210	20		537			163
6		257	515		239	21		510		226	126
7		246	299		278	22	262	443		148	115
8		228	359		173	23	278	236		126	116
9		208	413		120	24	293	242		114	98
10		184	337		97	25	325	890		104	80
11		173	895		84	26	383	1,310		97	75
12		169	848		75	27	315	732		88	77
13		326	1,090		69	28	374	734		80	74
14		913	1,040		68	29	448	1,380		78	77
15		1,400	1,180		68	30	470	1,010		80	65
						31	356				60

Daily discharge, in second-feet, of Green Lake outlet at Silver Bay, near Sitka, for the period Aug. 22, 1915, to Dec. 31, 1916—Continued.

Day.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1916.											
1	....	66	61	176	576	596	544	366	246	161	88
2	....	65	75	230	586	524	537	325	190	140	81
3	....	....	92	255	738	500	464	272	166	179	75
4	....	....	96	280	572	420	424	240	302	228	74
5	....	....	88	184	458	399	496	233	506	188	72
6	....	....	90	138	422	418	488	260	321	158	68
7	....	....	118	116	359	416	538	334	222	261	65
8	....	....	110	102	310	416	482	326	192	344	65
9	....	....	120	98	286	465	407	288	180	192	60
10	....	....	124	103	254	522	414	603	175	133	65
11	....	....	106	104	307	524	454	952	181	111	101
12	....	....	97	106	360	419	542	658	440	101	92
13	....	....	162	136	578	396	512	474	680	95	85
14	40	....	182	151	606	426	684	713	431	96	321
15	94	....	138	173	564	415	662	473	755	484	330
16	94	....	103	250	472	442	453	374	498	486	166
17	71	....	88	560	531	428	323	372	302	695	135
18	166	....	78	744	533	414	258	800	232	512	182
19	306	....	72	628	437	446	284	1,880	499	275	136
20	302	....	78	468	398	423	353	878	950	232	105
21	168	....	90	339	469	379	474	660	887	194	87
22	120	....	88	241	598	335	460	471	637	148	74
23	99	....	88	188	649	306	746	462	554	126	65
24	89	....	98	194	650	304	1,310	510	534	126	58
25	88	....	125	244	802	355	646	619	1,120	133	55
26	86	....	148	343	939	440	512	995	710	120	52
27	83	....	174	289	1,020	478	434	630	653	105	51
28	77	....	224	278	955	508	380	868	957	99	48
29	69	35	208	454	883	608	394	544	560	97	50
30	....	45	176	593	725	587	417	352	312	95	55
31	....	55	....	604	....	496	391	....	209	....	55

NOTE.—Discharge, Aug. 22–31, 1915, because of backwater caused by tree lodged on control, computed by applying recorded gage heights reduced by 0.25 foot to rating table. Because of clock stopping or water falling below well, discharge estimated, from climatic record at Sitka and from comparison of hydrograph for this station with that for Baranof Lake outlet, as follows: Oct. 17–31, 292 second-feet; Nov. 1–20, 1915, 281 second-feet; Jan. 1–31, 35 second-feet; Feb. 1–13, 24 second-feet; Feb. 14, 40 second-feet; Mar. 3–28, 1916, 45 second-feet.

Monthly discharge of Green Lake outlet at Silver Bay, near Sitka, for the period Aug. 22, 1915, to Dec. 31, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
August 22–31	470	262	350	6,940
September	1,400	169	573	34,100
1915–16.				
October	1,180	....	487	29,900
November	....	78	188	11,200
December	281	60	118	7,260
January	....	....	35	2,150
February	306	....	78.1	4,490
March	....	....	46.3	2,850
April	224	61	117	6,960
May	744	98	283	17,400
June	1,020	254	568	33,800
July	608	304	445	27,400
August	1,310	258	499	30,700
September	1,880	233	564	33,600
The year	1,880	....	286	208,000
1916.				
October	1,120	166	471	29,000
November	695	95	210	12,500
December	330	48	97.3	5,980

BARANOF LAKE OUTLET AT BARANOF, BARANOF ISLAND.

LOCATION.—In latitude 57° 5′ N., longitude 134° 54′ W., at townsite of Baranof, at head of Warm Spring Bay, east coast of Baranof Island, 18 miles east of Sitka across island, but 96 miles from Sitka by water through Peril Strait.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 28, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on right bank 700 feet below Baranof Lake and 800 feet above tidewater at head of Warm Spring Bay.

DISCHARGE MEASUREMENTS.—Made from cable across stream 100 feet below lake and 600 feet above gage.

CHANNEL AND CONTROL.—From Baranof Lake, at elevation 130 feet above sea level, and 1,500 feet from tidewater, the stream descends in a series of rapids and small falls and enters the bay in a cascade of about 100 feet concentrated fall. The bed is of glacial drift, boulders, and rock outcrop. The gage is in an eddy 50 feet downstream from the foot of a small fall and 100 feet upstream from a riffle which forms a well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 5.3 feet August 10, 1915 (discharge, computed from extension of rating curve, 3,350 second-feet); minimum flow estimated by discharge measurement and climatic data, 28 second-feet on February 13.

ICE.—Because of the swift current and flow of relatively warm water from the lake, the stream remains open.

DIVERSIONS.—The flume to Olsen's sawmill diverts from the stream 200 feet below gage only sufficient water to operate a 25-horsepower Pelton water wheel.

ACCURACY.—Stage-discharge relation permanent, not affected by ice. Rating curve well defined below 2,000 second-feet. Operation of water-stage recorder satisfactory except for short periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging discharge for equal intervals of day. Results good except for periods when recorder did not operate satisfactorily, and for periods when water was frozen in well, for which they are fair.

The drainage area is rough and precipitous, and the vegetable and soil cover is thin, even on the foothills of the mountains. The run-off is rapid, and the ground storage is small. During a dry, hot period, however, the flow is greatly augmented by melting ice from several small glaciers and ice-capped mountains.

Discharge measurements of Baranof Lake outlet at Baranof during the period June 28, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
June 28	Canfield and Drake	2.70	608	Feb. 13	G. H. Canfield	0.35	28.5
Sept. 4	Canfield and Peterson	2.78	621	May 23	do	2.24	389
27	Canfield and Gardner	3.12	833				
28	do	4.05	1,700				
Dec. 9	G. H. Canfield	1.79	255				

Daily discharge, in second-feet, of Baranof Lake outlet at Baranof for the period June 28, 1915, to Dec. 31, 1916.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.							
1	....	725	615	400	650	433	125
2	....	820	525	1,000	485	375	185
3	....	788	477	1,000	437	405	361
4	....	788	453	640	900	497	525
5	....	1,100	453	497	892	453	473
6	....	1,480	477	425	548	335	525
7	....	1,050	636	457	495	269	473
8	....	788	867	453	695	222	335
9	....	695	2,100	405	586	185	248
10	....	615	3,000	357	505	161	208
11	....	568	....	326	725	141	163
12	....	640	....	305	755	125	133
13	....	668	....	397	926	200	112
14	....	695	....	616	764	299	101
15	....	668	....	890	1,050	296	94
16	....	695	....	788	755	269	114
17	....	695	....	615	615	284	118
18	....	640	....	485	485	255	119
19	....	640	....	445	389	215	131
20	....	640	....	525	378	212	195
21	....	695	....	525	305	266	190
22	....	725	....	425	255	235	179
23	....	695	....	344	304	220	161
24	....	640	....	430	615	190	161
25	....	615	....	920	568	167	141
26	....	695	....	1,100	453	147	120
27	....	788	....	890	405	122	116
28	590	820	....	1,420	545	119	102
29	590	890	....	1,480	525	125	90
30	640	855	....	1,000	385	122	88
31	....	725	....	....	344	....	80

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.												
1	70	28	52	50	312	1,050	930	731	522	359	285	141
2	64	28	45	60	330	1,010	788	719	484	291	261	125
3	56	28	44	92	352	1,050	749	651	436	250	303	119
4	52	28	44	108	362	855	701	600	388	294	388	112
5	50	28	44	108	312	743	656	600	359	420	388	101
6	46	28	44	112	273	673	646	625	362	356	315	92
7	42	28	44	135	240	568	615	690	468	306	291	90
8	40	28	44	155	197	504	605	668	488	276	352	88
9	40	28	44	179	177	456	640	605	440	258	306	89
10	39	28	44	175	177	420	713	630	609	248	248	82
11	40	28	44	169	183	420	743	662	820	250	199	80
12	39	28	44	150	185	440	662	690	755	448	169	74
13	39	27	44	250	189	545	646	656	640	684	145	72
14	39	27	44	280	218	684	668	662	890	620	139	100
15	39	34	43	215	261	719	656	625	701	890	250	157
16	39	39	43	160	321	713	662	522	563	646	359	153
17	40	41	43	136	476	713	673	428	514	460	724	151
18	40	62	43	137	827	737	615	366	739	370	737	157
19	40	102	43	120	883	678	620	352	1,850	550	527	147
20	38	145	43	113	906	651	635	370	1,230	890	428	127
21	37	137	42	113	740	651	586	440	890	930	336	110
22	36	120	39	113	574	743	532	472	630	788	267	96
23	35	107	37	119	408	788	492	656	532	678	228	86
24	33	90	35	127	388	820	476	1,010	484	590	228	79
25	33	80	37	153	422	970	536	855	586	890	240	73
26	32	73	41	185	563	1,230	673	695	930	788	205	67
27	31	66	39	218	554	1,480	743	600	820	600	185	62
28	30	62	37	267	558	1,480	749	545	1,010	695	171	58
29	30	57	37	318	707	1,280	855	536	695	605	177	60
30	29	....	39	321	890	1,050	855	558	492	464	163	67
31	28	....	44	....	970	....	737	545	....	352	....	67

NOTE.—Discharge estimated for following periods, because of unsatisfactory operation of water-stage recorder: Aug. 11–13 (mean discharge, 886 second-feet), and Sept. 1–3, 1915, by comparison with records of flow for streams in adjacent drainage basins, and from minimum stage for period indicated by recording pencil; Jan. 20 to Feb. 13 from climatic records and discharge measurement of Feb. 13; Apr. 12–17 by comparison with record of flow for Green Lake outlet; May 21 and 22, 1916, interpolated.

Monthly discharge of Baranof Lake outlet at Baranof, for the period of July 1, 1915, to Dec. 31, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1915.				
July	1,480	568	759	46,700
August	3,000	....	910	56,000
September	1,480	305	652	38,800
The period	....	....	....	142,000
1915–16.				
October	1,050	255	572	35,200
November	497	119	245	14,600
December	525	80	199	12,200
January	70	28	40.2	2,470
February	145	27	55.3	3,180
March	52	35	42.3	2,600
April	321	50	161	9,580
May	970	177	450	27,700
June	1,480	420	804	47,800
July	930	476	673	41,400
August	1,010	352	605	37,200
September	1,850	359	678	40,300
The year	1,850	27	378	274,000
1916.				
October	930	248	524	32,200
November	737	139	300	17,900
December	157	58	99.4	6,110
The period	....	....	....	56,200

SWEETHEART FALLS CREEK NEAR SNETTISHAM.

LOCATION.—In latitude 57° 56½′ N., longitude 133° 41′ W., on east shore 1 mile from head of south arm of Port Snettisham, 3 miles south of mouth of Whiting River, 7 miles by water from Snettisham, and 42 miles by water from Juneau. No large tributaries enter river between gaging station and outlet of large lake, 2½ miles upstream.

DRAINAGE AREA.—27 square miles (measured on the United States Geological Survey topographic map of the Juneau gold belt, edition of 1905).

RECORDS AVAILABLE.—July 31, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on right bank 300 feet upstream from tidewater on east shore of Port Snettisham.

DISCHARGE MEASUREMENTS.—Made from cable across river one-fourth mile upstream from gage.

CHANNEL AND CONTROL.—From the outlet of lake at an elevation of 520 feet above sea level and 2½ miles from tidewater, the river descends in a series of rapids and falls through a narrow, deep canyon. Gage is in a pool at foot of two falls, each 25 feet high, which are known as Sweetheart Falls; outlet of pool is a natural rock weir, which forms a well-defined and permanent control for gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 4.2 feet August 14, 1915 (discharge, computed from an extension of the rating curve, 1,420[1] second-feet); minimum flow, estimated from discharge measurement and climatic data, 15 second-feet February 11.

ICE.—Stage-discharge relation not seriously affected by ice.

[1] Differs from that published in Bulletin 642 because of a revision of rating curve.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice January 19 to February 22. Rating curve well defined between 80 and 1,300 second-feet; extended beyond these limits by estimation. Operation of water-stage recorder satisfactory except for periods indicated by breaks in record, as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or for days of considerable fluctuation by averaging results obtained by applying to rating table gage heights for regular intervals of day. Results excellent except for periods of break in record and for stages below 80 and above 1,300 second-feet, for which they are fair.

In the fall and winter the run-off is small because the precipitation is in the form of snow and because of the small amount of ground storage; during a hot, dry period the low run-off from the ground and lake storage is augmented by melting ice from one glacier.

Discharge measurements of Sweetheart Falls Creek near Snettisham during period July 31, 1915, to Dec. 31, 1916.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1915.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*	1916.	*Feet.*	*Sec.-ft.*
July 31	1.95	520	Feb. 5	[a]0.33	17.8	Oct. 14	3.20	996
Aug. 29	1.49	329	June 21	2.22	564	Nov. 12	.72	112
Nov. 13	1.07	195	Oct. 13	3.82	1,240			
Dec. 14	.53	82						

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Sweetheart Falls Creek near Snettisham for the period Aug. 1, 1915, to Dec. 31, 1916.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.						1915.					
1	453	298	700	180	105	16	1,070	554	902	205	82
2	396	542	504	188	140	17	740	550	700	170	87
3	352	840	406	234	145	18	562	478	504	165	99
4	335	780	534	280	136	19	456	482	386	140	105
5	328	589	573	260	124	20	386	632	316	130	97
6	328	467	442	240	134	21	346	760	257	143	99
7	324	396	369	220	161	22	316	593	211	138	108
8	316	335	346	200	132	23	291	449	180	124	116
9	335	284	284	180	106	24	284	431	158	114	99
10	431	247	324	160	87	25	346	600	147	105	86
11	497	222	493	140	92	26	403	700	147	101	82
12	780	202	558	130	87	27	372	600	151	97	90
13	1,220	194	628	188	82	28	346	760	163	94	79
14	1,330	247	772	270	81	29	335	1,090	194	87	69
15	1,220	414	1,070	247	82	30	328	986	180	99	70
						31	305	....	158	....	65

Daily discharge, in second-feet, of Sweetheart Falls Creek near Snettisham for the period Aug. 1, 1915, to Dec. 31, 1916—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.												
1	55	22	36	....	306	840	760	....	322	438	277	103
2	50	21	37	....	355	902	680	....	316	342	230	98
3	48	21	36	....	442	1,030	585	....	296	277	197	94
4	48	19	39	....	467	910	534	....	283	303	160	100
5	49	19	37	....	386	760	486	....	316	467	152	103
6	47	18	36	....	319	752	463	....	362	410	150	98
7	43	18	36	....	270	640	438	....	346	336	178	94
8	42	18	36	....	224	542	435	....	379	286	209	90
9	45	18	36	....	203	467	449	....	355	255	181	83
10	47	18	37	....	192	424	463	....	815	233	148	86
11	47	18	37	....	189	463	478	....	952	325	124	88
12	45	18	38	....	192	512	467	....	760	960	112	86
13	46	18	39	168	200	684	456	....	808	1,220	100	80
14	43	....	39	181	215	944	442	....	760	1,060	103	105
15	42	....	39	170	252	1,120	431	....	640	1,200	224	132
16	39	....	39	146	303	1,010	438	....	512	944	255	128
17	38	....	40	128	362	989	460	....	445	652	329	105
18	38	....	40	114	396	808	497	....	616	489	369	139
19	36	....	41	105	435	688	....	....	1,090	700	316	135
20	34	....	42	100	456	620	....	....	1,040	1,190	306	118
21	31	....	43	100	453	597	....	....	936	993	270	105
22	30	....	44	102	417	640	....	....	724	696	230	98
23	29	56	45	103	379	696	....	....	740	620	200	88
24	29	54	....	120	362	740	....	....	672	546	189	88
25	29	47	....	137	372	832	....	....	732	776	175	68
26	29	36	....	155	403	973	....	680	860	804	155	48
27	28	29	....	195	403	1,070	....	562	736	644	130	27
28	26	29	....	245	417	1,070	....	493	898	700	118	33
29	25	32	....	283	546	1,020	....	456	792	589	112	32
30	25	....	....	299	700	881	....	400	577	442	112	31
31	23	....	....	....	788	....	....	365	....	342	....	36

NOTE.—Because of clock stopping or backwater from ice, discharge estimated from climatic record at Juneau and from comparison of hydrograph for this station with those for Long River and Mill Creek: Nov. 5-11, 1915, Jan. 19 to Feb. 13 and Mar. 18–22, Dec. 25, 26, and 29, 1916, daily discharge; Feb. 14–22, 64 second-feet; Mar. 24–31, 55 second-feet; Apr. 1–12, 152 second-feet; July 19–31, 505 second-feet; and Aug. 1-25, 1916, 604 second-feet. Discharge, Aug. 1 to Oct 19, 1915, above 335 second-feet, differs from that published in Bulletin 642, because of a revision of the rating curve, based on highwater measurements obtained in 1916.

Monthly discharge of Sweetheart Falls Creek near Snettisham for the period Aug. 1, 1915, to Dec. 31, 1916.

[Drainage area, 27 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.
1915.						
August	1,330	284	501	18.6	21.44	30,800
September	1,090	194	524	19.4	21.64	31,200
1915–16.						
October	1,070	147	412	15.3	17.64	25,300
November	280	87	168	6.22	6.94	10,000
December	161	65	101	3.74	4.31	6,210
January	55	23	38.3	1.42	1.64	2,360
February	....	18	38.1	1.41	1.52	2,190
March	....	....	43.0	1.59	1.83	2,640
April	....	....	156	5.78	6.45	9,280
May	788	189	368	13.6	15.68	22,600
June	1,120	424	787	29.1	32.47	46,800
July	....	....	501	18.6	21.44	30,800
August	[a]1,180	....	582	21.6	24.90	35,800
September	1,090	283	636	23.6	26.33	37,800
The year	1,120	18	319	11.8	161.15	232,000
1916.						
October	1,220	233	621	23.0	26.52	38,200
November	369	100	194	7.19	8.02	11,500
December	139	27	87.7	3.25	3.75	5,390
The period	....	....	....	....	....	55,100

[a] Maximum stage indicated by water-stage recorder; exact date not known.

CRATER LAKE OUTLET AT SPEEL RIVER, PORT SNETTISHAM.

Location.—At outlet of Crater Lake, 1 mile upstream from the edge of tide flats at head of north arm of Port Snettisham, 2 miles by trail from cabins of Speel River Project (Inc.), which are 42 miles by water from Juneau.

Drainage area.—11.9 square miles (measured on topographic maps of the Alaska Boundary Tribunal, edition of 1895).

Records available.—January 23, 1913, to December 31, 1916.

Gage.—Stevens water-stage recorder on left shore of lake, 100 feet upstream from outlet. A locally-made water-stage recorder having a natural vertical scale and a time scale of 1 inch to 24 hours was used until replaced by Stevens gage June 29, 1916. The gage datum remained the same during the period. During the winter months, because of inaccessible location and deep snow, the operation of the gage at the lake was discontinued, and the stage read at staff gage in channel exposed at low tide at beach. The first gage at beach was set at an unknown datum and washed out in winter of 1915–1916. Another staff gage was set at about the same location and used after November 24, 1916.

Discharge measurements.—Made from cable across outlet of lake, 100 feet downstream from gage and 10 feet upstream from crest of first falls. The rope sling from which discharge measurements were first made was replaced in fall of 1915 by a standard United States Geological Survey gaging car, making more accurate measurements possible.

Channel and control.—The gage is on left shore of lake, 100 feet upstream from outlet where the stream becomes constricted into a narrow channel, the bed of which is composed of large boulders and rock outcrop, which form a well-defined and permanent control.

Extremes of discharge.—Maximum stage during the period, 5.9 feet, August 13, 1915 (discharge, estimated from extension of rating curve, 1,680 second-feet); minimum flow, 5 second-feet, February 1 to 13, 1916, estimated from one discharge measurement and climatic records.

Accuracy.—Stage-discharge relation permanent. Rating curve defined by 19 discharge measurements, 13 of which were made by employees of the Speel River Project (Inc.) and 6 by an engineer of the United States Geological Survey, and is well defined below and extended above 1,000 second-feet. Rating curve used November 24 to December 31, 1916, for staff gage at beach, fairly well defined. Operation of water-stage recorder used during 1914 and 1915 not satisfactory because of slippage of float cord and unfavorable time and gage-height scales. Errors from these sources probably compensating in computation of monthly mean discharge. Operation of Stevens water-stage recorder satisfactory except September 1 to 28, 1916, when it stopped. Daily discharge for 1913, except as indicated in note to daily-discharge table, is the result of discharge measurements made nearly every day by float or current meter and was furnished by the Speel River Project (Inc.). Discharge record January 1 to May 2, December 1 to 31, 1914, and January 1 to April 20, 1915, computed from gage-height records for staff gage at beach and furnished by the Speel River Project (Inc.). Daily discharge May 3 to November 30, 1914, and April 21 to November 25, 1915, ascertained by engineers of the United States Geological Survey by applying to rating table mean daily gage heights furnished by Speel River Project (Inc.). Daily discharge July to November, 1916, ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, and December 9 to 23, 1916, from occasional readings of staff gage at beach. Results good for records obtained from gage at lake; other records probably fair.

Crater Lake is at an elevation of 1,010 feet above sea level and covers 1.1 square miles. The sides of the mountains surrounding the lake are steep and barren and the tops are covered by glaciers.

Discharge measurements of Crater Lake outlet at Speel River during the period Oct. 13, 1914, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1914.		*Feet.*	*Sec.-ft.*	1916.		*Feet.*	*Sec.-ft.*
Oct. 13	Kennedy and Lindsay.	1.7	235	Feb. 4	G. H. Canfield.........	(a)	5.0
15	Mark Rascovich........	3.17	614	May 10	.....do.................	b 0.47	50.6
27	Kennedy and Lindsay.	1.45	179	June 29	.....do.................	3.22	616
29	Kennedy and Peterson.	2.52	376	July 1	.....do.................	2.58	448
30	Kennedy and Lindsay.	2.05	276	30	Gust Grosseth.........	3.98	878
Nov. 19	Lindsay and Peterson..	1.58	205	Aug. 11	.....do.................	2.19	325
				31	G. H. Canfield.........	2.22	344
1915.				Oct. 17	.....do.................	1.59	199
May 21	R. L. Lindsay.........	1.87	241	Nov. 17	.....do.................	.60	73
June 21	Gust Grosseth.........	2.30	344	Dec. 12	Gust Grosseth.........	a 1.19	33
23	R. L. Lindsay.........	2.20	294	16	.....do.................	.10	37.6
Aug. 3	G. H. Canfield.........	2.49	397				
11	....	3.16	586				

a Measurement made at tidewater flats.
b Gage height referred to temporary gage; datum unknown.

Daily discharge, in second-feet, of Crater Lake outlet at Speel River for the period Jan. 23, 1913, to Dec. 31, 1916.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1913.												
1		a 55	30	36	66	648	732	528	741	405	108	41
2		50	35	79	58	533		528	a 600	a 350	134	47
3		a 42	35	67	58	389		528	a 500	291	123	76
4		33	44	70	53	394		689	445	231	108	a 65
5		a 49	68	56	51	410		1,100	396	a 220	98	55
6		a 65	88	45	52	395		1,100	396	206	a 98	41
7		81	77	a 40	53	385		1,220	463	a 180	98	41
8		a 60	94	36	58	542	770	1,120	a 460	162	134	61
9		44	94	41	66	395	770	1,100	a 460	128	134	61
10		31	88	41	78	400	794	1,100	463	a 110	a 140	61
11		a 29	a 76	41	94	424	794	924	567	99	146	53
12		28	64	45	108	395	794	871	666	a 90	a 146	55
13		40	59	77	160	377	823	773	666	a 80	146	38
14		43	45	77	172	377	a 840	773	726	71	a 160	31
15		85	56	81	211	a 400	a 860	689	726	77	a 180	31
16		78	53	69	160	a 500	888	689	580	182	a 200	31
17		69	45	56	160	528	888	594	523	99	a 170	30
18		75	39	78	210	528	1,100	594	352	99	a 140	a 28
19		48	36	64	293	528	1,100	594	231	a 750	a 110	a 25
20		46	34	61	270	586	1,100	570	249	1,400	86	23
21		49	32	53	270	625	990	542	523	774	a 80	21
22		37	29	64	293	625	888	542	a 600	a 650	79	39
23	34	36	29	66	354	625	858	542	a 500	519	a 80	17
24		33	26	64	354	625	752	990	a 450	387	a 70	18
25		32	a 26	56	343	625	689	1,070	396	123	a 60	18
26		28	27	53	343	625		1,100	315	77	a 50	18
27	66	23	34	50	354	752		1,330	196	a 66	a 40	18
28		28	39	50	354	752		1,390	449	54	36	16
29	71		a 36	50	400	794		1,110	a 500	a 44	39	43
30			34	53	400	752		1,010	580	35	38	43
31			24		400			880		108		38

a Estimated.

Daily discharge, in second-feet, of Crater Lake outlet at Speel River for the period Jan. 23, 1913, to Dec. 31, 1916—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914.												
1	32	13	27	21	280	178	429	350	429	429	253	70
2	27	13	27	18	180	130	429	350	429	594	219	50
3	27	13	27	17	94	94	594	429	350	692	153	32
4	27	13	45	18	94	94	429	429	350	517	124	27
5	26	13	35	21	94	94	429	429	293	429	100	24
6	26	13	40	22	94	130	350	429	293	429	85	23
7	26	12	35	22	94	178	350	429	293	429	76	22
8	26	16	32	26	94	178	350	350	293	429	82	22
9	26	14	30	32	130	178	429	350	350	....	126	22
10	26	16	26	40	130	221	429	350	692	....	113	22
11	26	16	32	50	130	233	429	293	350	....	98	21
12	27	16	32	83	112	241	594	293	350	....	88	21
13	27	16	35	80	94	293	594	293	221	221	81	18
14	35	27	43	113	94	293	815	293	130	692	75	16
15	42	333	43	98	130	350	815	293	94	692	61	10
16	32	118	45	80	130	350	692	221	94	350	48	13
17	24	80	37	77	112	350	594	293	94	221	52	16
18	22	118	40	65	94	350	594	350	94	293	104	16
19	21	55	62	65	130	293	594	429	261	178	174	10
20	20	45	55	58	178	221	429	429	241	221	159	10
21	16	45	53	52	178	221	594	350	94	153	131	21
22	16	45	45	60	178	293	594	350	94	94	98	21
23	16	35	45	57	221	350	594	350	178	94	92	45
24	6	35	43	53	221	350	815	429	293	261	82	40
25	6	40	37	50	221	350	815	429	350	261	78	35
26	6	35	35	45	178	429	429	429	350	94	78	27
27	6	34	32	55	178	429	350	594	293	178	73	24
28	6	30	27	60	130	429	350	815	221	221	71	18
29	6	....	27	65	130	429	350	815	221	350	67	16
30	10	....	24	80	178	429	350	594	178	293	64	16
31	10	....	22	....	178	....	429	429	....	293	....	13

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1915.											
1	18	18	32	47	49	203	472	429	362	241	52
2	21	16	32	47	64	219	457	402	762	233	59
3	38	16	32	48	73	282	443	402	658	174	161
4	42	13	33	53	82	350	429	402	626	274	114
5	45	10	38	57	103	350	429	416	626	304	49
6	55	10	38	62	114	416	402	402	626	227	45
7	53	10	40	65	139	362	327	388	388	136	45
8	53	10	42	67	161	316	282	375	221	113	45
9	55	42	42	67	186	293	282	429	223	89	40
10	53	42	45	72	212	338	350	517	200	112	37
11	48	16	45	72	261	375	457	728	178	241	34
12	45	16	45	77	327	443	472	1,190	164	350	32
13	38	18	42	78	327	487	472	1,680	159	176	34
14	38	18	40	90	327	532	457	868	205	327	46
15	40	16	38	104	327	658	472	532	304	487	42
16	45	16	40	112	327	710	472	487	388	832	42
17	55	10	45	120	327	562	487	375	388	375	36
18	45	10	48	120	327	502	487	282	338	183	31
19	42	12	48	104	327	457	517	272	375	153	34
20	38	10	48	78	316	443	578	272	443	104	36
21	33	10	53	79	274	416	578	278	517	92	38
22	32	12	62	78	257	416	578	274	443	75	32
23	32	13	62	75	267	388	547	274	261	53	34
24	27	16	57	73	282	416	517	282	241	51	34
25	24	18	45	70	280	429	547	338	562	43	35
26	21	24	53	68	280	416	578	429	642	41	....
27	18	27	53	65	280	350	658	517	443	37	....
28	18	32	48	61	280	375	762	402	402	39	....
29	16	....	48	58	263	443	762	327	282	60	....
30	16	....	45	52	233	472	642	293	251	58	....
31	16	....	45	....	216	....	487	278	....	58	....

Daily discharge, in second-feet, of Crater Lake outlet at Speel River for the period Jan. 23, 1913, to Dec. 31, 1916—Continued.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.							1916.						
1	429	457	......	124	......	......	16	316	362	......	338	53	39
2	388	375	......	108	......	......	17	362	265	......	214	78	42
3	327	327	......	108	......	......	18	402	221	......	152	101	46
4	316	304	......	150	......	......	19	388	338	......	265	83	41
5	316	362	......	253	......	......	20	338	675	......	517	78	36
6	282	388	......	178	......	......	21	327	885	......	304	68	33
7	276	429	......	139	......	......	22	276	692	......	251	58	29
8	282	375	......	121	......	......	23	245	547	......	208	50	26
9	293	316	......	120	......	29	24	231	780	......	166	......	......
10	316	304	......	146	34	36	25	263	594	......	293	......	......
11	338	338	......	338	32	42	26	338	457	......	316	......	......
12	338	517	......	990	35	34	27	375	416	......	208	......	......
13	316	728	......	762	38	35	28	532	416	443	193	......	......
14	293	868	......	472	38	36	29	850	388	267	156	......	......
15	304	562	......	547	41	38	30	850	362	174	119	......	......
							31	578	338	......	111	......	......

NOTE.—Discharge estimated by comparison with records of flow for streams in adjacent drainage basins as follows: July 2–7, 750 second-feet; July 26–31, 1913, 800 second-feet; Oct. 9–12, 1914, 150 second-feet; and Nov. 26–30, 1915, 32 second-feet. No gage-height record available Nov. 26, 1915, to June 30, 1916.

Monthly discharge of Crater Lake outlet at Speel River for the periods Feb. 1, 1913, to Nov. 30, 1915, and July 1 to Dec. 31, 1916.

[Drainage area, 11.9 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.
1913.						
February	85	23	47.0	3.95	4.11	2,610
March	94	24	48.3	4.06	4.68	2,970
April	81	36	57.3	4.82	5.38	3,410
May	400	51	203	17.1	19.71	12,500
June	794	377	531	44.6	49.76	31,600
July	1,100	....	830	69.7	80.36	51,000
August	1,390	528	858	72.1	83.12	52,800
September	741	196	491	41.3	46.08	29,200
The period	....	....	....	....	....	186,000
1913–14.						
October	1,400	35	260	21.8	25.13	16,000
November	200	36	108	9.08	10.13	6,430
December	76	16	38.2	3.21	3.70	2,350
January	42	6	20.9	1.76	2.03	1,290
February	333	12	45.0	3.78	3.94	2,500
March	62	22	36.7	3.08	3.55	2,260
April	113	17	52.8	4.44	4.95	3,140
May	280	94	144	12.1	13.95	8,850
June	429	94	272	22.9	25.55	16,200
July	815	350	517	43.4	50.04	31,800
August	815	221	409	34.4	39.66	25,100
September	692	94	266	22.4	24.99	15,800
The year	1,400	6	182	15.3	207.62	132,000
1914–15.						
October	692	94	313	26.3	30.32	19,200
November	255	48	104	8.74	9.75	6,190
December	70	10	23.9	2.01	2.32	1,470
January	55	16	36.1	3.03	3.49	2,220
February	42	10	17.2	1.45	1.51	955
March	62	32	44.6	3.75	4.32	2,740
April	120	47	74.0	6.22	6.94	4,400
May	327	49	235	19.7	22.71	14,400
June	710	203	414	34.8	38.83	24,600
July	762	282	497	41.8	48.19	30,600
August	1,680	272	469	39.4	45.42	28,800
September	762	159	389	32.7	36.48	23,100
The year	1,680	10	219	18.4	250.28	159,000

Monthly discharge of Crater Lake outlet at Speel River for the period Feb. 1, 1913, to Nov. 30, 1915, and July 1, to Dec. 31, 1916—Continued.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1915.						
October	832	37	185	15.5	17.87	11,400
November	161	....	44.9	3.77	4.21	2,670
1916.						
July	850	231	370	31.1	35.85	22,800
August	885	221	464	39.0	44.96	28,500
September	....	....	470	39.5	44.07	28,000
October	990	108	270	22.7	26.17	16,600
November	101	....	51.2	4.30	4.80	3,050
December	46	....	32.7	2.75	3.17	2,010

LONG LAKE OUTLET NEAR PORT SNETTISHAM.

Location.—At outlet of Long Lake, 5 miles upstream from mouth of Long River; 2 miles by trail and water across Second Lake from cabins of the Speel River Project (Inc.), which are at head of north arm of Port Snettisham and 42 miles by water from Juneau.

Drainage area.—31.9 square miles (measured on topographic maps of the Alaska Boundary Tribunal, edition of 1895).

Records available.—January 23, 1913, to November 10, 1915.

Gage.—Lietz 7-day graph. water-stage recorder on left shore in still water of lake 30 feet upstream from crest of falls in left channel of outlet. Vertical movement of float in a tank set at lake edge transmitted, by system of pulleys and counterpoise, to gage in house 15 feet back from bank.

Discharge measurements.—At all stages made, with meter on rod, from log footbridge across left channel and suspension footbridge across right channel. Measuring section poor because of rough bed, swift current, and large angle which direction of current makes with measuring section.

Channel and control.—The outlet from lake consists of two narrow channels separated by a small island. The bed, which consists of rock ledge and large boulders at measuring section about 30 feet below gage, breaks off abruptly into high falls. Control permanent.

Extremes of discharge.—Maximum discharge during the periods of records, 4,250 second-feet, October 20, 1913; minimum flow, 32 second-feet, several days in January and February, 1914.

Ice.—Stage-discharge relation not affected by ice.

Accuracy.—Stage-discharge relation permanent. Rating curve defined by 9 discharge measurements, 5 of which were made in 1914 by employees of the Speel River Project (Inc.), and 4 in 1915 and 1916 by an engineer of the United States Geological Survey, and is fairly well defined between 30 and 1,800 second-feet.

The gage was operated, daily gage heights determined and furnished by the Speel River Project (Inc.). Daily discharge was ascertained by applying gage heights to rating table. Results fair except below 150 second-feet and above 1,500 second-feet, for which they are poor. Because gage could not be operated during the winter and because satisfactory measurements of discharge could not be made at high stages, this gaging station was replaced by another one installed on Long River below outlet of Second Lake on November 11, 1915.

Long Lake is 808 feet above sea level and covers 3.1 square miles. The sides of mountains surrounding lake are steep and barren, and the tops are covered with glaciers.

Discharge measurements of Long Lake outlet at Port Snettisham, during the period Jan. 30, 1914, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1914.		*Feet.*	*Sec.-ft.*	1915.		*Feet.*	*Sec.-ft.*
Jan. 30	Gust Grosseth	−0.70	31.4	Aug. 4	G. H. Canfield	2.82	981
May 29	....do	1.41	416				
	Lass and Peterson	1.22	363	1916.			
Oct. 14	Lindsay and Kennedy	3.00	1,160	June 30	....do	3.22	1,080
19	Kennedy and Grosseth	2.75	990	July 15	....do	2.38	696
				Nov. 16	....do	.35	141

NOTE.—Results of measurements in 1914 furnished by Speel River Project (Inc.), Juneau.

Daily discharge, in second-feet, of Long Lake outlet at Port Snettisham, for the period Jan. 23, 1913, to Nov. 10, 1915.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1913.												
1	....	[a]110	102	98	144	737	1,830	1,830	1,770	2,090	546	201
2	....	117	116	[a]100	149	738	....	1,370	968	1,370	582	188
3	....	....	[a]120	88	149	660	....	1,370	[a]840	[a]1,000	654	172
4	....	....	138	[a]100	112	596	....	1,770	717	764	588	314
5	....	....	189	105	161	624	....	2,080	[a]600	643	[a]460	294
6	....	....	[a]250	98	112	612	....	2,620	[a]700	492	330	250
7	....	....	235	85	108	660	....	2,770	814	[a]400	[a]500	220
8	....	....	[a]290	85	154	636	....	2,090	[a]800	302	919	282
9	....	88	297	[a]88	135	579	1,340	2,090	[a]800	[a]300	[a]700	306
10	....	[a]76	[a]260	90	149	817	1,340	1,770	884	295	[a]500	352
11	....	71	224	86	144	817	1,370	1,640	1,160	[a]250	[a]400	286
12	....	72	196	86	219	817	1,370	1,340	1,370	210	340	306
13	....	70	188	[a]100	202	908	1,500	1,210	1,770	[a]220	340	154
14	....	142	176	112	375	869	[a]2,000	1,210	2,190	228	421	146
15	....	203	151	171	411	[a]900	[a]2,400	1,080	2,410	[a]226	615	146
16	....	113	142	141	426	[a]1,000	2,620	1,080	2,140	223	518	109
17	....	128	134	171	451	1,000	2,620	1,080	1,670	228	361	124
18	....	128	125	176	500	1,160	2,740	1,000	1,360	223	382	[a]114
19	....	210	[a]110	185	510	1,550	2,740	1,000	1,180	[a]2,000	311	105
20	....	174	97	184	510	1,550	2,740	1,000	1,410	4,250	258	96
21	....	128	[a]90	171	512	1,530	2,500	1,000	[a]1,500	[a]3,600	188	84
22	....	104	83	171	539	1,600	2,280	[a]1,000	1,770	[a]3,200	167	84
23	130	104	78	171	556	1,600	2,080	[a]1,000	[a]1,450	2,870	155	80
24	....	100	[a]76	161	556	1,600	1,890	1,770	[a]1,100	1,850	159	76
25	....	100	75	161	880	1,640	1,830	2,280	814	1,930	146	69
26	90	100	78	159	880	1,600	1,830	2,620	717	1,610	[a]140	62
27	102	96	[a]83	149	909	1,770	1,870	2,870	644	1,360	139	63
28	187	96	88	144	974	1,770	1,640	3,170	884	[a]1,200	159	105
29	96	....	85	144	1,000	1,770	1,830	2,670	[a]1,500	1,000	146	99
30	....	....	82	144	[a]1,000	1,640	2,010	2,620	2,080	550	134	80
31	....	....	[a]80	....	1,000	....	1,890	2,190	....	919	....	73

[a] Estimated.

Daily discharge, in second-feet, of Long Lake outlet at Port Snettisham, for the period Jan. 23, 1913, to Nov. 10, 1915—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1914.												
1	58	32	89	62	240	413	1,140	1,040	1,190	384	630	125
2	62	32	89	58	289	413	1,290	940	990	384	556	137
3	54	34	37	58	315	398	1,090	890	844	356	458	137
4	58	34	50	58	342	370	940	940	754	342	398	137
5	58	32	50	58	289	342	754	1,190	798	592	328	137
6	54	32	89	46	289	315	712	1,190	844	798	276	132
7	58	34	89	50	289	370	712	1,090	844	611	228	126
8	58	37	77	50	264	413	630	890	754	458	228	126
9	58	37	77	50	289	490	670	844	754	398	315	126
10	54	37	77	58	315	506	940	798	1,040	398	302	126
11	58	32	69	71	315	556	1,290	798	1,090	413	264	122
12	54	32	77	116	342	592	1,290	754	754	398	228	122
13	52	32	77	132	328	798	1,410	712	630	522	194	103
14	65	32	65	160	315	940	1,950	670	556	990	171	92
15	62	50	67	171	342	940	1,650	670	490	1,290	171	56
16	56	240	75	160	342	940	1,470	670	428	1,040	171	74
17	52	132	102	171	328	990	1,410	844	398	754	217	92
18	52	124	102	160	315	1,040	1,470	1,090	342	630	302	92
19	52	116	124	160	342	940	1,240	1,090	289	522	398	56
20	50	102	116	160	370	754	1,040	1,090	276	458	398	56
21	50	102	109	141	370	754	1,530	990	328	413	342	122
22	50	89	116	132	370	940	1,470	890	384	342	289	122
23	50	89	116	132	370	940	1,650	798	384	276	264	257
24	32	77	109	132	384	890	1,950	940	328	264	206	228
25	32	77	102	124	370	940	1,710	1,190	670	289	171	200
26	37	77	89	116	370	940	1,290	1,290	844	428	150	152
27	37	77	83	116	384	990	1,090	1,590	630	490	141	137
28	37	77	67	132	384	940	940	1,830	458	522	132	103
29	32	......	67	132	398	940	890	2,220	384	844	132	99
30	32	......	58	171	398	940	844	1,650	384	844	132	92
31	37	......	67	......	413	......	940	1,350	......	712	......	74

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1915.								
1	......	132	556	990	1,350	844	1,140	141
2	......	132	556	1,040	1,190	1,530	754	160
3	......	141	592	1,040	1,090	1,830	592	217
4	......	182	754	1,040	940	1,350	940	264
5	......	252	754	990	940	1,040	940	252
6	......	342	844	990	940	844	670	217
7	......	398	890	890	890	712	522	194
8	......	428	798	798	890	670	428	150
9	......	428	754	754	890	630	342	141
10	......	428	754	712	1,090	556	342	96
11	......	428	798	798	1,470	522	490	......
12	......	458	890	890	2,080	490	630	......
13	......	522	940	990	3,050	490	556	......
14	......	592	990	990	3,210	592	670	......
15	......	670	1,040	1,040	2,650	754	1,350	......
16	......	712	1,190	1,040	2,150	890	1,140	......
17	......	712	1,190	1,040	1,710	844	890	......
18	428	754	890	1,040	1,240	712	630	......
19	370	712	940	1,040	890	798	458	......
20	315	670	890	1,090	798	1,140	370	......
21	264	670	844	1,190	754	1,470	302	......
22	228	630	798	1,240	754	1,190	252	......
23	206	670	798	1,140	712	592	182	......
24	194	712	798	1,090	754	844	160	......
25	194	670	798	1,090	940	1,290	141	......
26	194	670	844	1,290	1,140	1,470	132	......
27	182	712	798	1,410	990	1,140	132	......
28	171	670	798	1,530	940	1,290	132	......
29	150	670	844	1,650	890	1,950	150	......
30	141	630	890	1,650	844	1,590	150	......
31	......	592	......	1,530	754	......	141	......

NOTE.—Mean discharge estimated as follows: Feb. 3-8, 1913, 140 second-feet; July 2-8, 1913, 1,500 second-feet.

Monthly discharge of Long Lake outlet at Port Snettisham, for the period Feb. 1, 1913, to Nov. 10, 1915.

[Drainage area, 31.9 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.
1913.						
February	....	70	120	3.76	3.92	6,660
March	297	75	143	4.48	5.16	8,790
April	185	85	131	4.11	4.59	7,800
May	1,000	108	449	14.1	16.26	27,600
June	1,770	579	1,120	35.1	39.16	66,600
July	2,740	....	1,900	59.6	68.71	117,000
August	3,170	1,000	1,760	55.2	63.64	108,000
September	2,410	600	1,270	39.8	44.40	75,600
The period	....	....	....	....	....	418,000
1913-14.						
October	4,250	210	1,150	36.1	41.62	70,700
November	919	134	375	11.8	13.17	22,300
December	352	62	163	5.11	5.89	10,000
January	65	32	50.0	1.57	1.81	3,070
February	240	32	67.8	2.13	2.22	3,770
March	124	37	83.3	2.61	3.01	5,120
April	171	46	111	3.48	3.88	6,600
May	413	240	338	10.6	12.22	20,800
June	1,040	315	724	22.7	25.33	43,100
July	1,950	630	1,210	37.9	43.69	74,400
August	2,220	670	1,060	33.2	38.28	65,200
September	1,190	276	629	19.7	21.98	37,400
The year	4,250	32	501	15.7	213.10	362,000
1914-15.						
October	1,290	264	554	17.4	20.06	34,100
November	630	132	273	8.56	9.55	16,200
December	257	56	121	3.79	4.37	7,440
April 18-30	428	141	234	7.34	3.55	6,030
May	754	132	529	16.6	19.14	32,500
June	1,190	556	841	26.4	29.45	50,000
July	1,650	712	1,100	34.5	39.77	67,600
August	3,210	712	1,260	39.5	45.54	77,500
September	1,950	490	1,000	31.3	34.92	59,500
1915.						
October	1,350	132	507	15.9	18.33	31,200
November 1-10	264	96	183	5.74	2.13	3,630

LONG RIVER BELOW SECOND LAKE AT PORT SNETTISHAM.

LOCATION.—One-half mile downstream from outlet of Second Lake, 1 mile downstream from outlet of Long Lake, one-half mile upstream from head of Indian Lake; 2½ miles by trail and boat across Second Lake from cabins of the Speel River project at head of the North Arm of Port Snettisham, 42 miles by water from Juneau.

DRAINAGE AREA.—33.2 square miles (measured on sheet No. 12 of the Alaska Boundary Tribunal maps, edition of 1895).

RECORDS AVAILABLE.—November 11, 1915, to December 31, 1916.

GAGE.—Stevens water-stage recorder on right bank one-half mile below outlet of Second Lake.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable across river at gage; at low stages made by wading one-fourth mile downstream.

CHANNEL AND CONTROL.—At the gage the channel is deep and the current sluggish; banks are low and are overflowed at extremely high stages; bed smooth except for one large boulder. A rapid, 500 feet downstream, forms a well-defined and permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 6.55 feet at 7 a. m., September 19 (discharge, 2,340 second-feet); minimum flow estimated from one discharge measurement and climatic data, 23 second-feet, February 13.

ICE.—Stage-discharge relation affected by ice during January, February, and March.

ACCURACY.—Stage-discharge relation permanent; affected by ice January 16 to April 2. Rating curve fairly well defined between 50 and 400 second-feet and well defined between 400 and 2,000 second-feet. Operation of water-stage recorder satisfactory throughout the open-water period except for short periods in December, 1915, and January, 1916. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by inspecting the gage-height graph. Results good except for stages below 400 second-feet for which they are fair.

The area draining to Long River between Long Lake Outlet and this station comprise only 1.3 square miles, including First Lake and Second Lake. Because this area is at a low altitude and has no glaciers the run-off per square mile from it is greater in the early spring but much less in summer than that from the area above Long Lake, which is partly covered by glaciers.

Discharge measurements of Long River below Second Lake at Port Snettisham during the period Nov. 11, 1915, to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 4[a]	G. H. Canfield	....	24	Oct. 12	G. H. Canfield	5.38	1,620
May 11	.....do	1.65	150	15	.....do	4.76	1,270
June 20	.....do	3.34	694	23	Gust Grosseth	3.00	517
25	.....do	4.28	1,050	27	.....do	2.95	493
30	.....do	4.65	1,230	Nov. 16	G. H. Canfield	1.80	155
July 25	Gust Grosseth	3.27	651	Dec. 15	Gust Grosseth	1.33	117
29	.....do	5.22	1,550	29	.....do	.65	56
Aug. 10	.....do	3.57	695				

[a] Stage-discharge relation affected by ice on control; ice in gage well prevented operation of float.

Daily discharge, in second-feet, of Long River below Second Lake at Port Snettisham for the period Nov. 11, 1915, to Dec. 31, 1916.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1915.			1915—Con.			1915—Con.		
1	....	88	11	102	....	21	157	83
2	....	114	12	93	....	22	196	100
3	....	134	13	128	....	23	108	118
4	....	131	14	151	....	24	94	96
5	....	112	15	126	....	25	89	89
6	....	118	16	114	....	26	85	83
7	....	174	17	106	....	27	85	89
8	....	126	18	103	....	28	84	96
9	....	96	19	91	....	29	82	96
10	....	....	20	105	....	30	85	83
						31	....	82

Daily discharge, in second-feet, of Long River below Second Lake at Port Snettisham for the period Nov. 11, 1915, to Dec. 31, 1916—Continued.

Day.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1916.										
1	80	87	172	700	1,090	1,160	820	365	158	90
2	70	128	205	760	975	975	800	263	133	89
3	70	151	272	908	840	862	740	194	115	85
4	60	123	275	975	800	780	680	326	112	83
5	62	100	185	780	740	840	840	492	113	82
6	60	109	165	740	740	862	1,160	412	205	79
7	56	154	170	700	720	908	1,020	320	176	76
8	56	136	148	580	720	872	840	275	129	77
9	56	138	138	468	740	800	820	266	121	75
10	56	130	143	387	760	760	1,690	296	110	74
11	56	123	152	485	780	800	1,550	560	96	73
12	56	123	165	506	780	1,110	1,110	1,520	88	72
13	56	144	181	720	760	1,520	952	1,380	86	73
14	56	138	183	930	740	1,690	1,180	1,180	98	109
15	56	128	176	1,040	740	1,380	975	1,300	187	113
16	....	120	190	975	760	1,040	820	975	179	104
17	....	106	227	885	820	800	840	660	249	108
18	....	110	252	840	885	660	1,410	502	249	120
19	....	104	281	740	862	840	2,110	780	201	111
20	....	100	308	680	800	1,280	1,630	952	284	108
21	....	115	335	680	760	1,600	1,300	740	192	121
22	....	119	305	700	700	1,440	1,020	640	150	100
23	....	114	272	780	620	1,260	1,060	540	134	83
24	....	142	257	930	580	1,600	1,020	496	128	71
25	....	136	275	1,090	620	1,380	975	680	125	67
26	....	130	278	1,330	780	1,150	862	660	117	64
27	....	157	275	1,460	862	1,060	862	513	117	64
28	....	152	305	1,460	1,020	1,020	952	560	102	63
29	....	169	408	1,460	1,460	952	740	412	96	69
30	....	172	520	1,230	1,660	908	520	290	96	79
31	....	....	612	....	1,380	840	....	194	....	96

NOTE.—Discharge estimated from climatic records and comparison with records of flow for streams in adjacent drainage basins and one discharge measurement made Feb. 4, as follows: Dec. 10-20, 1915, 85 second-feet; Jan. 16-31, 40 second-feet; Feb. 1-13, 24 second-feet; Feb. 14-29, 70 second-feet; and Mar. 1-31, 50 second-feet.

Monthly discharge of Long River below Second Lake at Port Snettisham for the period Nov. 11, 1915, to Dec. 31, 1916.

[Drainage area 33.2 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.
1915.						
November 11-30	196	82	109	3.28	2.44	4,320
December	....	....	98.2	2.96	3.41	6,040
1916.						
January	....	....	49.9	1.50	1.73	3,070
February	....	....	49.4	1.49	1.61	2,840
March	....	....	50	1.51	1.74	3,070
April	172	87	129	3.89	4.34	7,680
May	612	138	253	7.62	8.78	15,600
June	1,460	387	864	26.0	29.01	51,400
July	1,660	580	855	25.8	29.74	52,600
August	1,690	660	1,070	32.2	37.12	65,800
September	2,110	520	1,040	31.3	34.92	61,900
October	1,520	194	605	18.2	20.98	37,200
November	284	86	145	4.37	4.88	8,630
December	121	63	86.4	2.60	3.00	5,310
The year	2,110	....	434	13.1	177.85	315,000

SPEEL RIVER AT PORT SNETTISHAM.

LOCATION.—At entrance of canyon one-fourth mile downstream from mouth of Long River, and 8 miles upstream from tide flats and the cabins of the Speel River Project (Inc.), which are at head of north arm of Port Snettisham, and 42 miles by water from Juneau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 1 to December 31, 1916.

GAGE.—Stevens water-stage recorder 150 feet to the left of the constriction of the river at the entrance of the canyon. The gage is reached from cabins of the Speel River Project by trail to head of Second Lake, boat across Second Lake, trail to head of Indian Lake, boat across Indian Lake, trail down Long River and Indian River to canyon, and cable across river near entrance of the canyon—a total distance of about 7 miles.

DISCHARGE MEASUREMENTS.—At all stages made from cable having a clear span of 400 feet across river, one-half mile below gage and one-fourth mile below lower end of canyon.

CHANNEL AND CONTROL.—For several miles above the canyon the river flows in several channels through a wide, flat, sandy valley in which the channels are continually shifting. The river is constricted from a width of 500 feet to 75 feet at entrance of canyon. This constriction of channel and rock outcrop at entrance of canyon form a very sensitive and permanent control. The extreme range in stage is 28 feet. Above a stage of 22 feet part of the flow passes through a secondary channel (the bed of which is rock overgrown with brush) which begins near gage and rejoins main channel at lower end of canyon. Below a stage of about 4 feet water from stream does not reach the well except by seepage through gravel. Stage-discharge relation is therefore not permanent for stages below 4 feet. At the gaging cable the bed of the river is gravel, with one large rock outcrop near middle of stream. The current is very swift and carries a large quantity of sand in suspension.

ICE.—Ice does not form at control, but so much frost forms in gage shelter and on metal parts of gage that the gage does not operate satisfactorily during the winter.

ACCURACY.—Stage-discharge relation permanent except for stages below about 1,000 second-feet, when frequent measurements are necessary to estimate the flow. Rating curve fairly well defined between 1,200 and 10,000 second-feet; extended above 10,000 second-feet. Operation of water-stage recorder not satisfactory for periods indicated in footnote to daily-discharge table because of the frequent stopping of clock, owing to the binding of paper-supply roll. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph. Results fair for periods when gage was operating satisfactorily; poor for periods when clock was not running.

Discharge measurements of Speel River at Port Snettisham during the period July 1 to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 12	G. H. Canfield	12.80	5,020	Oct. 30	Gust Grosseth	5.7	1,340
27	Gust Grosseth	14.13	5,860	Nov. 8	....do		768
Aug. 16	....do	13.25	4,870	14	G. H. Canfield	2.18	470
Sept. 1	G. H. Canfield	14.90	6,350	15	....do	5.70	1,580
Oct. 12	....do	16.75	9,140	Dec. 20	Gust Grosseth	1.20	401
24	Gust Grosseth	8.96	2,660				

Daily discharge, in second-feet, of Speel River at Port Snettisham for the period July 1 to Dec. 31, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1		6,360	6,360			16	5,140	5,220	5,060	4,070	1,420
2		5,220	5,950			17	5,480	4,370	5,750	2,900	1,420
3		5,060	5,060			18	5,300	4,010	10,300		1,320
4		4,980	4,620			19	4,980	5,140	12,600		1,250
5		5,220	5,220			20	4,900	7,160			
6		5,570	6,050			21	4,760	10,700			
7		5,660	4,690			22	4,430	8,330			
8		5,220	4,310			23	4,130	8,610			
9		4,980	4,430			24	4,130	11,400		2,680	
10		5,300	10,500			25	4,690	10,100		3,230	
11		5,750	7,790	2,680		26	5,570	9,660			
12		8,190	5,850	7,530		27	6,250	8,050			
13		11,200	5,390	6,580		28	6,920	7,920			
14		11,700	6,250	5,570	470	29	9,200	7,400			
15	4,980	7,040	5,300	5,750	1,490	30	8,750	6,580			
						31	7,530	6,360			

NOTE.—Discharge estimated by comparison with records of flow for streams in adjacent drainage basins, as follows: July 1–14, 5,070 second-feet; Sept. 20–30, 5,920 second-feet; Oct. 1–10, 1,560 second-feet; Oct. 8–23, 3,370 second-feet; Oct. 26–31, 2,130 second feet; Nov. 1–13, 612 second-feet; Nov. 20–30, 680 second-feet; and Dec. 1–31, 420 second-feet.

Monthly discharge of Speel River at Port Snettisham for the period July 1 to Dec. 31, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July	9,200	4,130	5,420	333,000
August	11,700	4,010	7,050	433,000
September	12,600		6,220	370,000
October	7,530		2,890	178,000
November			760	45,200
December			420	25,800
The period				1,380,000

GRINDSTONE CREEK AT STEPHENS PASSAGE.

LOCATION.—On north shore of Stevens Passage between Point Bishop and Point Salisbury, one-fourth mile west of mouth of Rhine Creek and 11 miles by water from Juneau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 6 to December 31, 1916.

GAGE.—Stevens water-stage recorder on left bank, 200 feet from tidewater, installed September 16. A Lietz seven-day graph water-stage recorder was used May 6 to June 17.

DISCHARGE MEASUREMENTS.—At all stages made by wading either in the channel on the beach, which is exposed at low tide or 100 feet below gage at high tide.

CHANNEL AND CONTROL.—For a distance of one-fourth mile from tidewater the stream descends in a series of rapids and falls through a narrow rocky channel. The gage is at upper end of a turbulent pool between two falls, the lower of which forms a well-defined control. When gage was installed, logs were jammed in channel near upper end of pool.

EXTREMES OF DISCHARGE.—Maximum stage recorded during periods of record, 4.95 feet at 9 a. m September 10 (discharge, about 416 second-feet); minimum stage recorded, 0.25 foot during period December 12–31, exact date not known (discharge, 11 second-feet).

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation not permanent because logs occasionally lodged on the control and were washed away during high water. Discharge measurements made during the period May 6 to September 6 indicate that there was no material change at the control. On September 10 logs evidently lodged on the control. When they were cut loose on September 30, the water surface fell 0.2 foot, after which the discharge measurement indicated that the stage-discharge relation was the same as that before September 6. Additional logs were washed away by the high water October 12, after which there was no further change at the control. Rating curve used May 6 to June 16 and September 6 to October 11, fairly well defined between 18 and 80 second-feet; 0.2 foot was subtracted from gage heights September 10 to 29 before applying to rating table. Rating curve used October 12 to December 11 well defined between 10 and 120 second-feet.

Operation of Lietz gage not satisfactory because clock lost about 12 hours each week; operation of Stevens gage satisfactory except December 12 to 31, when paper stuck to guides. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph. Results below 100 second-feet fair; above 100 second-feet poor.

Discharge measurements of Grindstone Creek at Stephens Passage during the period May 6 Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 9	G. H. Canfield	0.83	20.7	Oct. 20	G. H. Canfield	1.50	96
June 12	.....do	1.55	72	20	.....do	1.48	93
Sept. 6	.....do	1.22	51	Nov. 24	Brown and Canfield	.86	34.6
30	.....do	1.25	52				

Daily discharge, in second-feet, of Grindstone Creek at Stephens Passage for 1916.

Day.	May.	June.	Sept.	Oct.	Nov.	Dec.	Day.	May.	June.	Sept.	Oct.	Nov.	Dec.
1		78		44	41	19	16	45	75	56	66	29	
2		82		39	36	18	17	48		48	56	48	
3		103		37	32	18	18	48		54	60	49	
4		86		136	29	17	19	48		69	134	43	
5		83		84	28	16	20	44		56	101	36	
6	28	112	38	57	27	16	21	39		52	83	29	
7	25	98	27	50	28	16	22	34		52	77	26	
8	21	80	25	44	26	14	23	32		64	64	24	
9	22	68	48	40	23	12	24	32		56	74	32	
10	22	60	206	48	22	17	25	32		76	104	34	
11	22	75	77	126	21	18	26	32		85	87	26	
12	26	78	63	251	20		27	37		92	78	22	
13	34	95	102	110	20		28	49		97	77	22	
14	34	90	171	92	25		29	74		63	64	20	
15	37	91	81	84	42		30	73		50	52	19	
							31	73			47		

NOTE.—Discharge Dec. 12–31 estimated at 15 second-feet by comparison with records of flow for Carlson, Sheep, and Gold creeks. No record June 17 to Sept. 5.

Monthly discharge of Grindstone Creek at Stephens Passage for 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
May 6-31	74	21	38.9	2,010
June 1-16	112	60	84.6	2,680
September 6-30	206	25	72.3	3,590
October	251	37	79.5	4,890
November	49	19	29.3	1,740
December			15.5	953

CARLSON CREEK AT SUNNY COVE.

LOCATION.—At Sunny Cove on west shore of Taku Inlet, 20 miles by water from Juneau.

DRAINAGE AREA.—22.26 square miles (determined by engineering department of Alaska Gastineau Mining Co. from surveys made by that company).

RECORDS AVAILABLE.—July 18 to December 31, 1916.

GAGE.—Stevens water-stage recorder on left bank, 2 miles from tidewater; inspected several times a week by employees of the Alaska Gastineau Mining Co.

DISCHARGE MEASUREMENTS.—At high stages, made from cable across river one-half mile downstream from gage; at medium and low stages, by wading 500 feet upstream from gage.

CHANNEL AND CONTROL.—Above the gage the stream meanders in one main channel and several small channels through a flat, sandy basin about a mile long; just below gage channel contracts and stream passes over rocky falls that form a well-defined and permanent control. Point of zero flow, gage height −1.5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 6.15 feet September 18 (discharge, computed from an extension of rating curve, 2,850 second-feet); minimum stage, −0.53 foot November 13 (discharge, 58 second-feet.)

ICE.—Stage-discharge relation affected by ice in January and February.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 90 and 1,200 second-feet, extended below 90 second-feet to point of zero flow and above 1,200 second-feet by estimation. Operation of water-stage recorder satisfactory except for a few days; as gage was visited several times a week, breaks in record caused by clock stopping were short. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation by averaging results obtained by applying to rating table mean gage heights for regular intervals of the day. Results good except for stages below 90 second-feet and above 1,200 second-feet for which they are fair.

Discharge measurements of Carlson Creek at Sunny Cove during the period July 18 to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 22	Canfield and Perkins	1.20	365	Sept. 28	G. H. Canfield	2.33	716
27	do	1.37	408	Oct. 7	do	.35	173
Sept. 5	do	2.90	888	Nov. 1	Canfield and Perkins	.14	128
28	G. H. Canfield	3.07	966	4	do	−.18	96

Daily discharge, in second-feet, of Carlson Creek at Sunny Cove for the period July 18 to Dec. 31, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		530	288	200	132	57	16		355	316	382	306	83
2		459	261	170	115	57	17		336	513	266	404	70
3		385	234	138	108	56	18	445	352	1,540	337	274	79
4		487	243	523	94	55	19	445	749	1,310	988	183	74
5		545	604	350	88	54	20	487	960	921	821	162	61
6		620	808	206	95	54	21	459	808	650	439	121	64
7		575	393	170	95	53	22	363	572	692	642	98	61
8		401	306	165	89	53	23	347	892	808	371	88	58
9		355	613	167	75	52	24	445	970	700	387	78	53
10		393	1,400	243	65	51	25	487	545	755	714	67	50
11		412	605	634	63	51	26	501	425	605	590	64	48
12		825	385	1,430	60	50	27	459	395	824	374	60	46
13		775	665	584	58	60	28	690	376	916	525	59	44
14		620	779	858	81	79	29	1,670	344	406	311	58	45
15		473	390	755	336	104	30	1,050	308	274	208	58	43
							31	605	286		155		43

Monthly discharge of Carlson Creek at Sunny Cove for 1916

[Drainage area, 22.26 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.
July 18-31	1,670	347	604	27.1	14.11	16,800
August	970	286	533	23.9	27.55	32,800
September	1,540	234	640	28.8	32.13	38,100
October	1,430	138	455	20.4	23.52	28,000
November	404	58	122	5.49	6.12	7,260
December	104	43	58.2	2.61	3.00	3,600
The period						127,000

SHEEP CREEK NEAR THANE.

LOCATION.—At lower end of flat basin, above diversion dam for flume leading to Treadwell power house at beach, and 1 mile by tramway and ore railway from Thane.

DRAINAGE AREA.—4.57 square miles above gaging bridge (measured on United States Geological Survey map of Juneau and vicinity, edition of 1917).

RECORDS AVAILABLE.—July 26 to December 31, 1916.

GAGE.—Stevens water-stage recorder on right bank at pool formed by an artificial control just below small island three-tenths mile upstream from diversion dam. Recorder inspected once a week by an employee of the Alaska Gastineau Mining Co.

DISCHARGE MEASUREMENTS.—At extremely high stages made from gaging bridge two-tenths mile downstream from gage; at low stages made by wading near bridge section. No streams enter between gage and measuring section but seepage inflow varies from a small amount to 10 per cent of total flow, the per cent of inflow usually being large after periods of heavy precipitation.

CHANNEL AND CONTROL.—The station is near lower end of flat basin through which the stream meanders in a channel having low banks and bed of sand and gravel. An artificial control was built 2 feet below intake for gage well to confine the flow in one channel during high water and to insure a permanent stage-discharge relation. The spillway of the control at low stages consists of a timber, 16 feet long, set in the bed of the stream. During medium and high stages another timber, 8 feet long, bolted at top near right end, forms part of the control. A 3-foot cut-off wall is driven at upstream face of spillway. There are wing walls at each end and an 8-foot apron extends downstream from control.

ICE.—Ice forms in the channel above and below, but not on the spillway of the control.

ACCURACY.—On July 29 high water probably caused a readjustment in the gravel bed of channel disturbed during the construction of the control. Rating curve used July 25 to 29, based on one discharge measurement and shape of subsequent curve. Rating curve used July 30 to October 8 based on nine discharge measurements and is fairly well defined. During this period the intake pipe was obstructed with gravel, and water surface in well was maintained at level of water surface in creek 10 feet upstream from control by seepage through gravel. After October 8, the intake pipe was kept open and the stage-discharge relation was permanent; rating curve used October 9 to December 31 based on 7 discharge measurements and is well defined below and poorly defined above 150 second-feet. Operation of water-stage recorder satisfactory; the gage was inspected at least once a week. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation by averaging results obtained by applying to rating table mean gage heights for regular intervals of the day. Results fair.

Discharge measurements of Sheep Creek near Thane during the period July 26 to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 21	Canfield and Perkins...	1.00	50	Oct. 6	G. H. Canfield.........	0.90	55
Aug. 29	.....do..................	.95	61	9	.....do..................	.83	44
Sept. 2	Enoch Perkins.........	.84	47	20	.....do..................	1.16	126
14	G. H. Canfield.........	1.28	141	Nov. 6	.....do..................	.76	30
19	.....do..................	1.23	127	23	Brown and Canfield....	.76	31
27	.....do..................	1.48	172	Dec. 22	C. O. Brown...........	.57	13.9
29	.....do..................	1.06	89	28	.....do..................	.51	11.3
Oct. 4	.....do..................	1.31	134				
6	.....do..................	.90	52				

Daily discharge, in second-feet, of Sheep Creek near Thane for the period July 26 to Dec. 31, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1....	....	80	48	59	36	21	16...	....	63	78	74	38	16
2....	....	74	43	50	45	19	17...	....	59	72	55	55	16
3....	....	64	45	45	43	18	18...	....	59	111	71	43	17
4....	....	80	48	108	36	19	19...	....	93	122	149	43	16
5....	....	86	78	68	34	19	20...	....	93	100	127	41	15
6....	....	100	102	55	30	18	21...	....	87	82	100	36	14
7....	....	85	59	50	32	17	22...	....	76	91	133	30	13
8....	....	66	50	47	29	15	23...	....	108	102	92	29	12
9....	....	63	88	45	28	14	24...	....	126	87	105	29	12
10....	....	68	227	49	23	14	25...	....	82	126	139	30	12
11....	....	63	102	97	22	14	26...	52	74	104	89	28	12
12....	....	97	87	246	23	14	27...	50	68	143	41	23	12
13....	....	97	129	108	23	14	28...	107	68	115	67	25	11
14....	....	82	153	120	27	14	29...	129	63	82	38	25	11
15....	....	70	93	97	39	17	30...	100	59	68	39	23	11
							31...	78	51	....	39	....	11

Monthly discharge of Sheep Creek near Thane for 1916.

[Drainage area, 4.57 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.
August	126	51	77.5	17.0	19.60	4,770
September	227	43	94.5	20.7	23.09	5,620
October	246	38	83.9	18.4	21.21	5,160
November	55	22	32.3	7.07	7.89	1,920
December	21	11	14.8	3.24	3.74	910
The period						18,400

GOLD CREEK AT JUNEAU.

Location.—At highway bridge at lower end of Last Chance basin, 200 feet upstream from diversion dam of Alaska Electric Light & Power Co., and one-fourth mile from Juneau.

Drainage area.—9.47 square miles (determined by engineering department of Alaska Gastineau Mining Co., from surveys made by that company).

Records available.—July 20 to December 31, 1916.

Gage.—Stevens water-stage recorder on left bank at upstream side of highway bridge. A staff gage was installed September 19 on left wing wall of diversion dam 200 feet downstream and used in determining the time of changes in stage-discharge relation at the well gage.

Discharge measurements.—At medium and high stages made from gaging bridge suspended, at right angles to current, from floor of highway bridge; at low stages, made by wading near gage.

Channel and control.—Station is at lower end of a flat gravel basin three-fourths mile long. For 20 feet upstream from gage the stream is confined between the abutments of an old bridge, and for 15 feet downstream it is confined between the abutments of present bridge. For a distance of 130 feet farther downstream the stream is confined in a narrow channel which is not subject to overflow. Because of the steep gradient of channel opposite and for 150 feet below gage, a short stretch of the channel immediately below the gage acts as the control. The operation of the head gates of flume at diversion dam, 200 feet downstream, does not affect the stage-discharge relation at gage, but the swift current during high stages shifts the gravel in bed of stream, thereby causing changes in the stage-discharge relation.

Ice.—Stage-discharge relation not affected by ice.

Diversion.—Water diverted at several points upstream for power development is returned to creek above gage, except about one-second foot used by the Alaska Juneau Mining Co. The dam 200 feet downstream diverts water into the flume of the Alaska Electric Light & Power Co.

REGULATION.—No storage reservoirs above station that regulate the flow.

ACCURACY.—Stage-discharge relation changed during periods of high water; 20 discharge measurements and 4 simultaneous readings of water-stage recorder and staff gage at diversion dam were made during the period, by use of which rating curves have been constructed applicable as follows: July 24 to August 22, rating curve well defined below and poorly defined above 200 second-feet; August 24 to September 9, well defined below and poorly defined above 200 second-feet; September 11–17, well defined below and poorly defined above 250 second-feet; September 19 to October 11, well defined; October 13–24, well defined between 160 and 260 second-feet, and poorly defined above and below these limits; October 26 to December 31, well defined. The operation of the water-stage recorder was satisfactory throughout the period, as the gage was visited about every other day by an employee of the Alaska Gastineau Mining Co. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging the results obtained by applying to rating table mean gage heights for equal intervals of the day. Results fair.

Discharge measurements of Gold Creek at Juneau during the period July 20 to Dec. 31, 1916.

Date.	Made by—	Gage height, in feet.		Discharge.
		Staff gage at dam.	Water-stage recorder.	
				Sec.-ft.
July 20	Perkins and Canfield		1.66	166
24	Canfield and Perkins		1.38	110
26	....do		1.54	145
Aug. 28	....do		1.97	159
Sept. 1	Enoch Perkins		1.80	120
4	....do		1.70	104
12	G. H. Canfield		1.75	137
18	....do		2.15	235
18	....do		2.68	445
19	....do		2.56	517
19	....do	0.93	1.98	305
23	....do	.97	1.97	308
23	....do	1.17	2.24	400
26	....do	.62	1.62	199
Oct. 2	....do	.06	0.99	76
9	....do	.00	.90	64
27	....do	.66	1.57	209
Nov. 6	....do		.61	34.5
Dec. 20	C. O. Brown		.30	15.9
28	....do		.08	8
Oct. 15			1.53	a228
21			1.38	a180
22			1.68	a250
28			1.66	a227

a Simultaneous readings taken of water-stage recorder and staff gage; discharge ascertained from rating curve for staff gage.

Daily discharge, in second-feet, of Gold Creek at Juneau for the period July 20 to Dec. 31, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	213	127	95	70	20	16	....	150	150	167	78	15
2	....	189	117	80	59	18	17	....	142	190	125	140	17
3	....	150	108	69	47	16	18	....	146	380	127	100	18
4	....	191	108	225	42	16	19	....	297	406	330	76	16
5	....	224	197	134	41	15	20	166	323	282	280	63	15
6	....	271	234	86	37	14	21	150	291	234	182	48	13
7	....	235	147	74	40	14	22	120	238	260	240	38	11.5
8	....	164	125	67	33	14	23	120	288	322	170	34	10
9	....	148	198	67	28	12	24	130	286	232	187	32	9.5
10	....	171	494	99	23	11	25	135	202	273	290	35	8.5
11	....	174	222	219	24	9.5	26	159	181	222	212	29	8
12	....	310	140	545	24	10	27	155	173	254	152	25	8
13	....	300	220	227	22	13	28	262	173	325	215	23	8
14	....	235	325	253	29	22	29	472	158	182	146	23	9
15	....	184	170	248	91	19	30	337	136	122	104	21	10
							31	229	127	....	84	....	9.5

NOTE.—Discharge July 21-24 estimated by comparison with record of flow of Carlson Creek at Sunny Cove.

Monthly discharge of Gold Creek at Juneau for the period July 20 to Dec. 31, 1916.

[Drainage area, 9.47 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.
July 20-31	472	120	203	21.4	9.55	4,830
August	323	127	209	22.1	25.48	12,900
September	494	108	226	23.9	26.67	13,400
October	545	67	177	18.7	21.56	10,900
November	140	21	45.8	4.84	5.40	2,730
December	22	8	13.2	1.39	1.60	812
The period						45,600

SHERMAN CREEK AT KENSINGTON MINE.

LOCATION.—At Kensington mine, on east shore of Lynn Canal, one-fourth mile downstream from mouth of Ophir Creek, 1 mile above mouth of creek, and 12 miles north of Berners Bay. Creek at this point flows through a flume 10 feet wide and 20 feet long, constructed for the purpose of affording a better section for making discharge measurements.

DRAINAGE AREA.—3.65 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 17, 1914, to December 31, 1916.

GAGE.—Vertical staff graduated to tenths and half-tenths, fastened in center of flume, about half the distance along tramway from beach to main camp of mine; read by an employee of Kensington Mining Co.

DISCHARGE MEASUREMENTS.—Made near lower end of flume in which gage is located. At high stages measuring section is poor because of wave pulsations in flume.

CHANNEL AND CONTROL.—The natural bed of channel upstream and downstream from gage is very rough. The entire flow at all stages passes through the flume. A free fall at lower end of flume forms a permanent control for gage. Point of zero flow, zero gage height.

EXTREMES OF DISCHARGE.—1914–1916: Maximum stage recorded, 2.00 feet October 15, 1915 (discharge determined from an extension of rating curve, 208 second-feet); minimum stage, 0.20 foot January 25, 27, 29, February 2, 4, 8, and 10, 1916 (discharge, 2.8 second-feet).

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 150 second-feet; extended from 150 to 208 second-feet. Gage read to hundredths generally once every other day except October 5, 1914, to February 7, 1915, when it was read only twice a week. Daily discharge for days when gage was read ascertained by applying gage height to rating table. Discharge for other days determined by interpolation or by comparison with records of flow for streams in adjacent drainage basins. Results fair.

Discharge measurements of Sherman Creek at Kensington mine during the period Sept. 9 to Dec. 31, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Sept. 9	G. H. Canfield	0.62	19.1	Oct. 13	J. A. Wilcox	0.85	43
Oct. 12	J. A. Wilcox	1.58	145	Nov. 9	G. H. Canfield	.44	10.4
12	.....do	1.19	89				

Daily discharge, in second-feet, of Sherman Creek at Kensington mine for the period Aug. 17, 1914, to Dec. 31, 1916.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1914.						1914.					
1		33	18	23	8	16		18	30		12.0
2		33	18	22	6.6	17	39	17	20		6.0
3		31	14	20	6.6	18	31	16	15		6.0
4		31	21	18	6.6	19	23	16	17		6.0
5		34	23	17	6.6	20	34	15	19		5.9
6		31	24	15	6.6	21	27	14	21		6.0
7		27	25	14	6.2	22	21	44	23		6.0
8		23		15	5.7	23	27	75	23		12.0
9		34		23	5.3	24	34	31	60		6.0
10		56		21	5.2	25	70	34	60		5.0
11		31		19	5.2	26	39	38	23		5.0
12		31	47	18	5.1	27	48	34	25		5.0
13		27	128	17	5.0	28	56	40	32	14	4.8
14		22	128	16	5.0	29	47	31	25	12	4.6
15		18	50	14	5.0	30	33	18	24	10	4.4
						31	33		23		4.2

Daily discharge, in second-feet, of Sherman Creek at Kensington mine for the period Aug. 17, 1914, to Dec. 31, 1916—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915.												
1	5.0	5.0	3.5	22	12	37	22	28	37	50	20.0	7.9
2	10.0	4.7	4.4	26	11	40	24	31	50	70	26.0	8.8
3	26.0	4.4	5.3	44	30	43	26	24	63	90	28.0	10.0
4	26.0	4.3	5.8	63	50	46	24	17	44	73	31.0	11.0
5	15.0	4.2	6.2	76	56	50	23	17	26	56	24.0	9.5
6	8.8	4.1	16.0	90	63	48	20	17	22	46	18.0	8.0
7	10.0	4.0	26.0	72	56	47	18	17	18	37	14.0	9.0
8	11.0	4.0	22.0	43	50	39	18	17	17	28	11.0	10.0
9	12.0	4.0	18.0	32	44	31	18	36	16	18	11.0	8.5
10	14.0	4.4	22.0	22	37	34	20	56	16	18	11.0	7.0
11	12.0	4.7	26.0	36	37	37	22	56	15	18	10.0	7.0
12	10.0	4.4	20.0	50	37	46	24	56	14	61	8.8	7.0
13	5.9	4.2	13.0	66	50	56	26	120	14	104	13.0	7.0
14	9.0	4.1	13.0	83	63	60	26	180	16	156	18.0	7.0
15	11.0	4.0	13.0	70	56	63	26	120	17	208	16.0	6.6
16	13.0	3.8	18.0	56	50	51	26	63	18	142	13.0	6.2
17	18.0	3.7	22.0	48	48	39	26	53	18	76	13.0	6.6
18	12.0	3.7	49.0	40	46	36	26	43	28	49	13.0	7.0
19	9.0	3.7	76.0	36	44	33	26	37	37	22	14.0	7.5
20	7.0	3.6	90.0	31	43	35	28	31	27	20	16.0	8.0
21	6.0	3.5	104.0	26	42	37	29	28	17	18	17.0	7.5
22	6.0	3.5	68.0	22	40	30	26	26	54	17	18.0	7.0
23	6.0	3.5	31.0	20	38	22	23	22	90	16	17.0	6.4
24	5.9	3.5	28.0	18	37	22	24	18	110	14	16.0	5.9
25	5.5	3.5	26.0	18	44	23	24	18	133	13	14.0	5.6
26	5.1	3.4	30.0	17	50	22	26	18	118	13	13.0	5.3
27	4.7	3.3	33.0	15	44	20	28	47	104	13	11.0	5.3
28	4.8	3.4	31.0	13	37	28	30	76	90	14	8.8	5.3
29	4.9	......	29.0	12	34	37	31	54	76	16	7.9	5.3
30	5.1	......	24.0	12	31	30	28	31	63	14	7.0	5.3
31	5.3	......	18.0	......	34	......	24	34	......	13	......	5.0
1916.												
1	4.7	2.8	4.7	5.3	80	83	......	......	37	......	14.0	8.8
2	5.0	2.8	4.6	5.3	97	90	......	......	34	......	11.0	7.0
3	5.3	2.8	4.4	7.0	76	97	......	......	31	......	11.0	6.2
4	5.3	2.8	4.2	8.8	56	82	......	......	31	......	11.0	5.3
5	5.3	3.0	4.0	10.0	39	67	......	......	31	......	10.0	5.3
6	5.3	3.3	3.8	11.0	22	62	......	56	28	......	8.8	5.3
7	5.3	3.0	3.5	10.0	22	68	......	53	26	......	7.9	5.3
8	5.0	2.8	3.5	10.0	22	56	......	50	24	......	7.0	5.3
9	4.7	2.8	3.5	12.0	20	54	......	45	23	16	7.0	5.0
10	4.4	2.8	3.5	13.0	18	58	......	40	......	22	7.0	4.6
11	4.0	3.0	3.5	11.0	16	63	......	70	......	63	6.2	4.3
12	4.0	3.3	3.4	8.8	15	113	......	101	......	148	5.3	4.0
13	4.0	3.8	3.3	13.0	19	163	......	101	......	43	8.2	10.0
14	3.8	4.4	3.3	17.0	23	128	......	101	......	63	11.0	16.0
15	3.5	4.2	3.3	12.0	38	94	......	70	63	47	186.0	11.0
16	3.5	4.0	3.3	7.6	54	90	......	40	70	31	134.0	5.3
17	3.5	34	3.3	7.3	76	86	......	40	76	37	83.0	7.0
18	3.5	63	3.3	7.0	97	78	......	40	83	43	66.0	6.4
19	3.5	50	3.3	7.3	84	70	......	55	90	53	50.0	5.7
20	3.4	37	3.3	7.6	70	70	......	70	90	63	36.0	5.3
21	3.3	25	3.3	9.3	63	70	......	54	90	70	22.0	4.6
22	3.2	13	3.2	11.0	56	73	......	37	104	76	18.0	4.0
23	3.1	12	3.1	14.0	54	76	......	64	118	80	13.0	4.0
24	3.0	10	3.1	16.0	53	97	......	90	126	83	12.0	4.0
25	2.8	8.5	3.1	20.0	53	118	......	72	133	70	11.0	4.0
26	2.8	7.0	3.1	23.0	53	104	......	54	112	56	10.0	4.0
27	2.8	6.4	3.1	45.0	56	90	......	46	90	70	8.8	......
28	2.8	5.9	3.1	67.0	58	83	......	37	76	83	8.8	......
29	2.8	5.3	3.1	65.0	65	76	......	32	40	52	8.8	......
30	2.8	......	4.2	63.0	72	60	......	28	30	22	8.8	......
31	2.8	......	5.3	......	78	......	......	32	......	18	......	......

NOTE.—Discharge estimated, because gage was not read, by comparison with records of flow for streams in adjacent drainage basins, as follows: Oct. 8-11 and Nov. 16-27, 1914, 20 second-feet; July 1-31, 50 second-feet; Aug. 1-5, 48 second-feet; Sept. 10-14, 45 second-feet; Oct. 1-8, 29 second-feet; and Dec. 27-31, 1916, 5 second-feet.

Monthly discharge of Sherman Creek at Kensington mine for the period Aug. 17, 1914, to Dec. 31, 1916.

Drainage area, 3.65 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.
1914.						
August 17-31	70	21	37.5	10.3	5.74	1,120
September	75	14	30.1	8.25	9.20	1,790
The period						
1914-15.						
October	128	14	32.8	8.99	10.36	2,020
November			18.3	5.01	5.59	1,090
December	12	4.2	6.05	1.66	1.91	372
January	26	4.7	9.81	2.69	3 10	603
February	5.0	3.3	3.95	1.08	1.12	219
March	104	3.5	28.7	7.86	9.06	1,760
April	90	12	39.3	10.8	12.05	2,340
May	63	11	42.4	11.6	13.37	2,610
June	63	20	38.1	10.4	11.60	2,270
July	31	18	24.6	6.74	7.77	1,510
August	180	17	44.9	12.3	14.18	2,760
September	133	14	45.6	12.5	13.95	2,710
The year	180	3.3	28.0	7.67	104.06	20,300
1915-16.						
October	208	13	48.5	13.3	15.33	2,980
November	31	7.0	15.3	4.19	4.68	910
December	11	5.0	7.21	1.98	2.28	443
January	5.3	2.8	3.85	1.05	1.21	237
February	63	2.8	11.3	3.10	3.34	650
March	5.3	3.1	3.57	.978	1.13	220
April	67	5.3	17.5	4.79	5.34	1,040
May	97	15	51.8	14.2	16.37	3,190
June	163	54	83.6	22.9	25.55	4,970
July			50	13.7	15.79	3,070
August	101	28	55.4	15.2	17.52	3,410
September	133		62.7	17.2	19.19	3,730
The year		2.8	34.2	9.37	127.73	24,800
1916.						
October	148		49.7	13.6	15.68	3,060
November	186	5.3	26.7	7.32	8.17	1,590
December	16		5.89	1.61	1.86	362
The period						5,010

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements in southeastern Alaska, 1915–16.

Date.	Stream.	Tributary to or discharging into—	Locality.	Gage height.	Discharge.
1915.				*Feet.*	*Sec.-ft.*
July 14	Reynolds Creek	Copper Harbor	Just above stream entering from right near tidewater, three-fourths mile from Coppermount, Prince of Wales Island.		15
1916.					
Jan. 11	Swan Creek	Carroll Inlet	1 mile upstream from beach, on east shore and 1 mile from head of Carroll Inlet, Revillagigedo Island.		64
26	Gokatchin Creek	Thorne Arm	Channel at low tide at mouth of creek one-fourth mile east of Sea Level, Revillagigedo Island.		18
Feb. 4	Long Lake outlet	Speel River	New gaging station below Second Lake, Speel River Project (Inc.).		24
4	Crater Lake outlet	Port Snettisham	Channel at low tide at mouth of stream from Crater Lake, Speel River project.		5
5	Speel River	do	Tide flats at Speel Point during low tide, one-half mile from cabins of the Speel River project.		150
7	Grindstone Creek	Stephens Passage	Channel at low tide at mouth of stream between Point Salisbury and Point Bishop, north shore Stephens Passage, 11 miles southeast of Juneau.		3.2
7	Rhine Creek	do	do		1.6
Mar. 10	Myrtle Lake outlet	Moira Sound	Channel at low tide at mouth of creek, 1 mile east of Niblack, Prince of Wales Island.		50
Apr. 6	Gokatchin Creek	Thorne Arm	Same location as on Jan. 26		100
May 9	Rhine Creek	Stephens Passage	Same location as on Feb. 7	0.90	19.3
June 1	Rust Lake outlet	Khaz Bay	Channel at low tide at mouth of creek, 500 feet below power house of Chichagof Mining Co., Chichagof Island.		265
12	Rhine Creek	Stephens Passage	Same location as on Feb. 7	2.28	78
Aug. 4	Gokatchin Creek				88
Sept. 3	Bear Lake outlet	Taku Harbor	Outlet of Bear Lake, 2 miles upstream from tidewater at cannery, 22 miles southeast of Juneau.		8.6
8	Davies Creek	Cowee Creek	½ mile above Cowee Creek, at Berners Bay, mainland.		99