MINING DEVELOPMENTS IN SOUTHEASTERN ALASKA.

By THEODORE CHAPIN.

INTRODUCTION.

A considerable advance in both copper and gold lode mining was made in southeastern Alaska in 1915. The development consisted in the opening up of large bodies of gold-bearing ore, in the installation of mining machinery and power-developing plants for its expolitation, and in the resumption of operations in a number of copper mines. This revival of activity was felt throughout the region extending from Ketchikan to Berners Bay.

Juneau, which has long ranked as an important gold producer owing in large part to the production of the Treadwell group of mines on Douglas Island, now bids fair to surpass all previous records in the production of ore. The extensive deposits of low-grade ore that for years have been known to exist on the mainland are now being actively exploited. The opening of the Alaska-Gastineau mill and the breaking of ground for the new mill of the Alaska-Juneau Gold Mining Co., part of an extensive plan of development which will place this company among the principal producers of the region, are notable developments of the year. Other events are the prospecting operations of the Alaska Gold Belt Co. in the Sheep Creek Basin, the formation of the Alaska-Taku Co. with holdings on Taku Inlet and Gastineau Channel, and consolidations and plans for active developments in the Eagle River and Berners Bay district. These activities are the natural response to the successful mining of low-grade ores on a large scale.

The gold produced in southeastern Alaska is won largely from lode mines. The only known productive placer mining in 1915 was in the Porcupine district, where several companies operated with good success. Placer development work, however, was done at Sumdum and on Chichagof Island.

In the Ketchikan district the interest centers largely in copper mining, which was done on a larger scale than in any other year since 1907, the record year of copper production in southeastern Alaska. Several gold mines in this district were productive also.

Interest in the development of marble continues, especially in the southern part of the region. Other nonmetalliferous deposits that have been worked for some time are gypsum and garnets, and in 1915 a small quantity of barite was produced.

The location of the mines and prospects of southeastern Alaska is shown on Plates II and III.

The value of the total mineral output of southeastern Alaska for 1915 was $6,090,571, distributed as follows: Gold, $5,435,586; copper, $302,431; silver, marble, lead, and gypsum, $352,554.

GOLD MINES AND PROSPECTS.

PRODUCTION.

Gold produced in southeastern Alaska, 1914 and 1915.

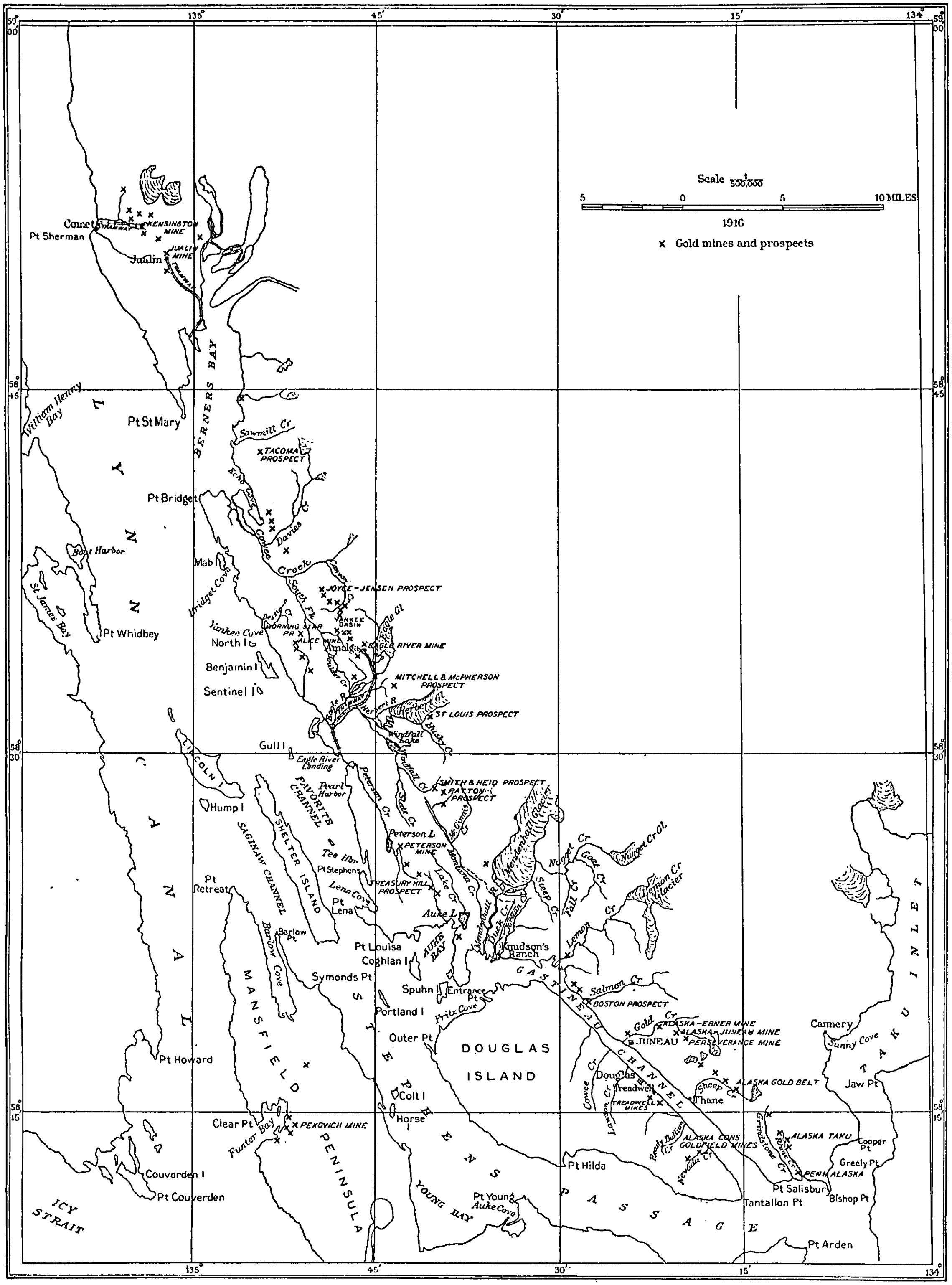
Year.	Ore mined.	Gold.		Silver.		Average per ton.			
		Amount.	Value.	Amount.	Value.	Gold.		Silver.	
						Amount.	Value.	Amount.	Value.
	Tons.	*Fine ounces.*		*Fine ounces.*		*Fine ounce.*		*Fine ounce.*	
1914	1,712,530	201,104.11	$4,157,191	23,767	$13,143	0.117	$2.43	0.014	$0.008
1915	2,989,730	258,963.72	5,353,255	87,953	44,592	.087	1.79	.029	.015

JUNEAU MINING DISTRICT.

DOUGLAS ISLAND.

The Treadwell group of mining companies, comprising the Alaska-Treadwell, Alaska-Mexican, and Alaska-United, operating on Douglas Island, continued their large-scale operations throughout the year. Over 25,000 feet of underground development work was accomplished, of which about equal amounts were in vein matter and in waste. These operations extended over 22 levels but were confined principally to the lower levels. Over 4,300 feet of work was done on the 2,100-foot level in the Treadwell, Mexican, and Seven Hundred Foot mines; extensive development was also continued on the 1,570-foot, 1,750-foot, and 2,200-foot levels. The central shaft was extended to the 2,400-foot level, and development work was started. During January 30 stamps were added to the mill of the Seven Hundred Foot mine, and in October a like addition was made to the Ready Bullion mill, bringing the aggregate number up to 960.

All four mills of the Treadwell group were in nearly continuous operation throughout the year, except in parts of June and July, when an accident to the hoist caused a curtailment of operations at the Treadwell and Mexican mills. A total of 1,650,058 tons of ore was crushed, and 35,502.2 tons of concentrates was saved.



MAP OF THE NORTHERN PORTION OF THE JUNEAU GOLD BELT, ALASKA.

The Alaska Consolidated Goldfield Co. is a new company formed on the reorganization of the Alaska Treasure Gold Mining Co., whose holdings are on Nevada Creek, 4 miles southeast of Treadwell. Development work was resumed in October, 1915, a crew of men being put to work on surface improvements, with the intention of resuming the underground work soon with a larger force. The present developments consist of a mile of underground openings. The first work will be to extend the lower adit and raise to connect with the upper workings.

MAINLAND.

The most notable achievement of the year was the completion of the new Alaska-Gastineau mill at Thane, near the mouth of Sheep Creek. The mill was designed to treat 6,000 tons daily, but tests show that it is capable of handling 8,000 to 10,000 tons. It is a concentrating plant that produces four grades of concentrate for shipment to the smelters. A re-treatment plant is in course of construction. Ore is hauled from the Perseverance mine over an electric railway for more than 3 miles, part of which is through the Sheep Creek adit.

The first unit of the mill was completed in February, and during the year the output gradually increased to nearly the full capacity. During the year an estimated total of about 1,200,000 tons of ore was treated. The average value per ton was somewhat lower than was originally estimated, by reason of a large horse of slate on the fifth level, where high-grade ore was believed to occur. Power for the mill and mine is furnished by the company's hydroelectric plants on Salmon Creek. Another plant, known as the Annex power project, under construction in 1915, will furnish additional power. It is designed to run a 1-300-foot tunnel to tap Annex Lake 100 feet below its surface, thus avoiding the necessity of a dam and outlet. From the mouth of the tunnel a pipe line will carry the water 8,000 feet to the generating plant. The company employs 1,300 men.

The Alaska-Juneau Gold Mining Co. has recently appropriated $2,500,000 to carry out an extensive plan of mine development and improvements, which include the construction of a large mill and power plant, already under way. The plans call for a ball-type mill to be built in four sections, each of which will have a daily capacity of 2,000 tons. It is expected that the first unit will be in operation by January 1, 1917, and that the mill will be completed three months later. The 50-stamp mill built two years ago will eventually be equipped with ball mills. A power plant and oil tanks, equipped with two 5,000-kilowatt turbo generators, will be built near the present site of the Alaska-Juneau offices. This plan of development

obviously involves also extensive underground work to furnish a sufficient supply of ore.

No productive mining was in progress at the Alaska-Ebner mine, and owing to litigation the workings were not open to inspection, but underground development work is being continued.

Development of the holdings of the Alaska Gold Belt Co. is being actively pushed. An adit is being driven in the upper part of Sheep Creek basin to cut the ore body, and if feasible a sea-level working adit will be run later. During the year 2,500 feet of the upper adit was driven and work was continued on power installation and the mill site on Gastineau Channel.

The Alaska-Taku group of claims has recently been located and is now being developed. It comprises 43 lode claims and eight mill sites on Grindstone and Rhein creeks and the divide between these creeks and Sheep Creek. The lode claims adjoin those of the Alaska Gold Belt Co. and extend along the strike of the formations for 4 miles, nearly to the patented claims of the Penn-Alaska Mining Co. on Taku Inlet. Five mill sites cover the camp and power sites at the mouths of Rhein and Grindstone creeks, and two mill sites on Gastineau Channel afford sites for a crosscut adit near sea level. The ore deposits were not examined but are said to be stringer lodes similar in character to the Perseverance lode. The locations cover the main greenstone and slate contact and a considerable part of the overlying black slate.

Mining operations were continued on the Pekovich claims, on Funter Bay, Admiralty Island. The Alaska Gold Mining Co., recently formed to exploit this property, will install new machinery and increase the present output.

The mining property on Windham Bay, including mill sites and water rights, was recently sold to the Alaska Bond & Development Co., which will start work in the spring.

A company was recently formed to take over and develop a group of claims on William Henry Bay. It is announced that work will commence soon.

The development of the Eagle River mine, which has been in progress for a number of years since the old workings were closed, was actively continued in 1915, and a considerable production was also made. Recent work has been directed toward driving an adit at an elevation of 400 feet above the mill and 600 feet below the old mine workings. This was designed to prospect the ground and to serve as a working adit. In places it drifts along the lode and in others cuts across. In addition to stopes 2,600 feet of underground workings have been driven. The adit cuts a wide mineralized zone containing ore bodies of more or less irregular shape. Several ore

bodies have been opened and two stopes removed. The ore consists of quartz with galena, pyrite, arsenopyrite, and pyrrhotite. From the portal the ore is trammed to the head of a 1,200-foot surface tram that leads to the mill. The mill began operations in June.

Assessment work has been kept up on several claims on Montana Basin and Yankee Cove. The old AB claims have been relocated as the Morningstar group and are being developed in a moderate way.

The Peterson mine, on Pearl Harbor, has been developed more or less throughout the year. A 40-foot adit was recently driven on a vein 7 feet in width, composed of irregular masses of banded quartz. This ore contains considerable free gold, one panful of dirt taken from the lode exposed at the face of the adit yielding a long string of colors. Work has also been done on the Cannonball claim. An adit has been driven for 80 feet along a stringer lode of quartz penetrating slate. This lode carries pyrite and arsenopyrite and contains specks of free gold. It strikes east and dips south at a steep angle. Other large veins of quartz occur on the property, but development has not yet been extensive enough to determine their extent or value. The lodes are easily mined and contain considerable free gold that is readily won in a homemade mill. The surface indications are promising enough to justify a thorough investigation of the property.

On Berners Bay the principal developments were in the Jualin mine. During the winter of 1914–15 sampling and examination were carried on preparatory to active operations in the spring. The present openings consist of an adit level nearly a mile in length and workings on the 60-foot, 160-foot, and 310-foot levels, aggregating 13,000 feet. Recent development work consists of a number of raises from the 160-foot level and the extension of all the levels. On the 310-foot level the back and intermediate veins have been reached. A new lode called the "unknown vein" has been opened on the 160-foot level, and two raises have been started to explore it. This lode is northeast of the other ore bodies and has not yet been found on the other levels. The stamp mill started early in summer. The failure of adequate water power during winter and dry seasons has necessitated the enlargement of the present hydroelectric plant and also the erection of an emergency power plant, which in October, 1915, was nearing completion. It is 1½ miles below the mine and comprises four oil engines of 150 horsepower each. Fuel for these engines will be piped part way and hauled by wagons the remainder. At this mine 75 men are employed.

The Kensington, Bear, and Comet properties have been consolidated by the Hayden-Stone interests and are being actively developed. The Kensington adit has been driven 5,000 feet on through the Johnson lode, which has been explored by 1,600 feet of drifts

and crosscuts. It is similar to the Eureka and Kensington lodes but occurs in the greenstone. The adit crosses the granite and greenstone contact 3,200 feet from the portal. A new surface tram has replaced the old switchback between the mine and the coast. Work at present is confined mainly to the Kensington, but the Bear and Comet are included in the general scheme of development. The erection of a 500-ton unit of a flotation mill was planned for the spring of 1916.

The Tacoma group of claims is on one of the tributaries of Sawmill Creek 7,000 feet from Sawmill Cove, at an elevation of about 1,000 feet. The developments consist of several short openings on two or more lodes. The country rock is black slate of the Berners formation, which strikes N. 60° W. and dips steeply northeast. A 70-foot adit has been opened to explore a quartz fissure vein striking east and dipping 75° N. The footwall side of the lode is a large vein of quartz strongly mineralized with pyrite. Its thickness was not determinable, as the adit does not expose the footwall and the vein on the surface is covered with slide material. A 2-foot vein of quartz occurs on the hanging wall of the lode and is separated from the footwall vein by a horse of slate. Overlying the hanging wall is a mineralized zone of slate with many stringers of quartz, forming a stringer lode several feet thick, mineralized with disseminated pyrite. Southwest of this lode on the footwall side, but some distance from it, is a similar stringer lode. An opening has also been made on an 8-foot quartz vein. Slate, country rock, and vein all strike N. 45° W., and a short adit shows the vein to be horizontal at the surface. The vein material is rusty brecciated quartz containing much pyrite.

Considerable prospecting and some development work were done in the vicinity of Auk Bay.

SITKA AND WRANGELL MINING DISTRICTS.

The only productive mining in the Sitka district in 1915 was done at the Chichagof mine, on Klag Bay, on the west coast of Chichagof Island, 50 miles south of Sitka. The mining and milling facilities here have recently been increased by additional stamps, a tube mill, and a new compressor plant. The mine and milling plant were operated continuously throughout the year, and mining has reached the 700-foot level. Shaft sinking was continued on the Fleming gold-copper property, 14 miles from the Chichagof mine.

In the Wrangell district development work was continued by the Olympic Mining Co. on the Helen S. group, on Woewodski Island; on the Berg claims, on Blake Channel, and on the Maid of Mexico mine. The Groundhog properties were sold in the fall, and the new owners began development work, which, it was said, would be carried forward in the spring on a large scale. (See fig. 1.)

KETCHIKAN MINING DISTRICT.

In the Ketchikan district four gold mines were in operation during 1915, and three other properties not classed as mines made a small production. The greater part of the gold produced in this district, however, was derived from the copper ores, all of which carry gold and silver in varying amounts.

PRINCE OF WALES ISLAND.

The old Puyallup mine, on Prince of Wales Island, is now called the Ready Bullion. It is about 1½ miles northwest of Hollis Cove,

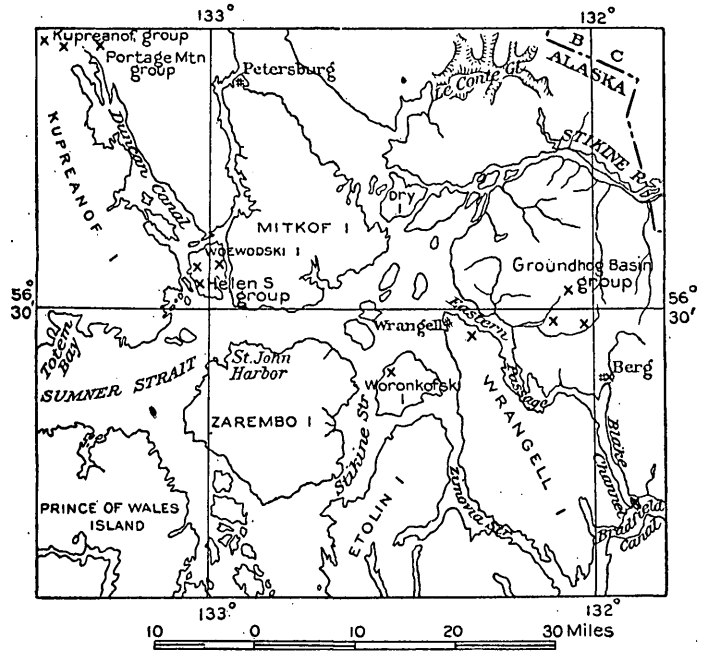


FIGURE 1.—Map showing location of prospects in the vicinity of Wrangell.

with which it is connected by a tramway. The mine is on a narrow vein of quartz inclosed in altered tuffs, slate, and quartzite. The vein is bordered by seams of gouge along two well-defined walls, from which it breaks away easily. The vein where examined ranges in width from 3 to 18 inches, and it is said to be 3 feet wide in places. Its average is about 6 or 7 inches. The hanging wall is stoped out for working space, and the vein matter is broken down and let fall on canvas, care being necessary in extracting the rich ore shoots. The present developments consist of an adit 1,160 feet long, driven along the vein, a 212-foot adit 200 feet above, and a 312-foot adit 70 feet below the long adit. From the portal of the main adit for a distance of 1,000 feet the ore has been stoped above the adit for

a vertical height of 150 to nearly 200 feet, the stopes in places reaching the surface; at 840 feet from the portal a raise extends to the surface.

The mine is equipped with cabins, a blacksmith shop, and a 5-stamp Risdon mill. A Pelton wheel runs the mill, compressor, and electric-light plant. The gold, most of which is caught in the amalgam, is retorted and blocked at the mill; the concentrates are shipped.

Development work was continued during the year at the Crackerjack-Hollis group of claims, adjoining the Ready Bullion on the southwest. The country rock is black slate, having a general strike of about N. 30° W. and a steep southwesterly dip. Several large, persistent veins have been explored by a number of underground workings and surface trenches. Recent work has uncovered an 18-foot lode formed along two porphyry dikes. A prominent feature of these lodes is the marked interrelation of the quartz and porphyry dikes that are so common in this region.

The Dunton mine, also known as the Rogers and previously as the Julia, is on Harris Creek, about 2 miles from Hollis. Development work was continued here throughout the year, but little milling was done, as attention was confined particularly to the underground prospecting, the results of which are reported to be satisfactory. The present workings consist of a 300-foot incline and drifts and stopes on four levels. The property is equipped with a 5-stamp mill driven by power furnished by three water-driven turbines. The country rock is predominantly black slate with a little interbedded graywacke. The lode is composed of quartz stringers penetrating the black slate and ranges from 2 to 8 feet in width. The walls are well defined and the ore breaks away easily. The ore occurs in shoots, and there are barren places in the vein, but the wall rock is said to contain considerable gold.

The Treasure group of claims, on Granite Mountain, was relocated in 1912 as the Last Chance 1, 2, and 3. These claims are on Granite Mountain and may be reached by trail from either Karta Bay or Hollis. At an altitude of 2,400 feet an adit has been driven for about 50 feet in a mass of brecciated granite. Masses of quartz occur here, but the vein in place has not been located. Above the adit the vein has been traced for several hundred feet by surface pits and short adits. In some places it pinches to a mere gouge seam, and in others it swells to 3 feet; the average width is about 18 inches. Outcrops of what appears to be the same vein have been traced for 2 miles. The vein strikes N. 45° W. and dips northeast at varying angles. The vein matter is rusty cavernous quartz with considerable free gold. In places pyrite is abundant, and a little chalcopyrite also occurs. The country rock is granite. It is planned to treat the

ore temporarily in an arrastre, which in September, 1915, was in course of construction. Other veins carrying galena, chalcopyrite, and pyrite and containing both silver and gold have been opened, and considerable ore has been extracted from them, but at present they are not being worked.

An arrastre has also been built on the Snowdrift claim, about 2 miles west of the Crackerjack, at an altitude of 1,650 feet. On this claim a 2-foot stringer vein is being prospected by a short adit driven along the vein. The vein strikes N. 60° E. and dips steeply southeast. The arrastre was constructed to test the ore on this and the Cascade claim, but no gold has yet been produced.

The Valparaiso mine is on Paul Lake, in the vicinity of Dolomi. For the last three years it has made little or no production, but development of power and the mine plant has been carried on actively. The main shaft is 330 feet deep, and drifts on the first, second, and third levels aggregate over 1,600 feet. A drainage adit was recently driven from the shore of the lake to the intersection of the vein on the second level, a distance of 400 feet.

In the vicinity of the Valparaiso mine assessment work is being kept up on the Jumbo, Wellfleet, and Amazon claims. Recent locations are the Standby and Cook claims. The Standby claim, about 1,000 feet north of the cabins of the Golden Fleece mine at the head of James Lake, is being developed on a 3½-foot lode composed of stringers of quartz in silicified limestone. Pyrite is abundant, and in places free gold occurs in lenticular quartz stringers.

The Chicago Kid claim is south of the Golden Fleece, on the shore of James Lake. A shallow opening has been made on a 5-foot vein composed of brecciated limestone cemented with veinlets and masses of quartz carrying pyrite and tetrahedrite. It strikes N. 60° E. and dips 70° SE. At the foot of James Lake are the Fortune, Moonshine, and other claims, located on another breccia lode or vein that strikes N. 60° W. and dips northeast. The country rock is banded blue limestone and schist, and the lode is composed of blocks of limestone and schist with a network of quartz veins carrying disseminated chalcopyrite and pyrite. The developments consist of a number of openings from 50 to 100 feet in length, extending across the lode. The New Era claim, on the southwest shore of James Lake, is on a 30-foot quartz vein carrying disseminated pyrite. An adit extends across the vein, which strikes N. 30° W. and stands about vertical.

Assessment work was continued on Cholmondeley Sound at a number of places, but no gold was produced. Four claims, the Portland, Seattle 1, Seattle 2, and Minnetonka, lie along a mineralized zone extending from Mineral Lake to Dora Lake. The main workings are on the Seattle 1, where a crosscut adit has been driven 200 feet to the vein, which was followed by a 70-foot drift and a 25-foot raise. Open

cuts and surface trenches expose the vein at a number of places. It strikes generally about north and dips east. The country rock is limestone and schist, and the lode is a fissure vein of banded quartz with considerable galena, sphalerite, chalcopyrite, and pyrite carrying gold and silver. The lode varies in width from place to place. The narrowest part noted is in an open cut on the Portland claim, where it crosses the limestone country rock. Here the vein contains considerable calcite. At some places it widens to 9 feet.

Work was also done on the Hope and Moonshine groups, on the South Arm of Cholmondeley Sound, and on several properties on Kitkun Bay.

MAINLAND AND REVILLAGIGEDO ISLAND.

The Sea Level mine, at the head of Thorne Arm, has not been worked for a number of years, although attempts have been made to reopen it. Last year an option was taken on the property, the tram rebuilt, and the mine partly pumped out, when work was discontinued. The adjoining group of claims, the Majestic, Googoo, and Golden Rule, have been relocated as the Googoo 1, 2, and 3, and some development work has been done on them. The vein, which strikes N. 60° E., has been explored for 2,000 feet by a 35-foot shaft and crosscut and several surface cuts. It is composed of white glassy quartz with large crystals and bunches of pyrite, which in places penetrate the wall rock. Rich pockets of fine gold occur in places. One such pocket recently mined in an open cut was profitably extracted with a long tom.

The Gold Standard mine, on Helm Bay, was worked on a lease, and the lessees made several shipments of ore. Adjoining the Gold Standard property is the South Lakeview claim, on an eastward-trending vein dipping north. The vein is 18 to 24 inches wide and is composed of rusty banded quartz with chalcopyrite and a little pyrite. Gold occurs free and in the chalcopyrite and is mostly confined to a pay streak about 3 inches wide. The vein is bordered on both sides by gouge, and cuts greenstone schist striking N. 40° W. and dipping steeply northeast.

Several low-grade ore bodies are being exploited in this vicinity. On the Bay View and West Bay View claims a number of open cuts have disclosed a mineralized zone, which in places is 150 feet across. Its general strike is north, but at the north end of its exposures it swings toward the northwest. It is composed of greenstone schist and more siliceous schist filled with bodies of quartz ranging from mere stringers to some 18 inches thick. The greenstone and schist bordering the quartz contain considerable pyrite, although the quartz itself does not appear to be strongly metalized. Other large low-grade bodies are being opened near by.

Gold lodes associated with deposits of copper and silver occurring in the Salmon River region are described under the head of "Copper mines and prospects" (pp. 96–98).

GRAVINA ISLAND.

The Goldstream mine, on Gravina Island, was unwatered late in the fall of 1915 with the intention of resuming operations, but no productive mining was in progress on Gravina Island. Lodes containing both gold and copper occurring on this island are described below, under "Copper mines and prospects."

COPPER MINES AND PROSPECTS.

GENERAL CONDITIONS.

Kasaan Peninsula and the region adjoining Kasaan Bay were again the center of copper mining in southeastern Alaska in 1915. The Granby Consolidated Mining, Smelting & Power Co. (Ltd.) took over the Mamie and It mines and for a portion of the year produced over 260 tons of ore a day. The Rush & Brown mine was operated throughout the year about as usual. Development work was continued at the Mount Andrew mine, and ore was produced. The Jumbo mine on Hetta Inlet was operated on about the usual scale, and shipments of ore were made also from the Goodro and Cymru properties. The general distribution of copper-bearing lodes is shown on Plate III (in pocket).

PRODUCTION.

Copper, gold, and silver produced from copper mines of southeastern Alaska, 1915.

Ore mined	tons	50,406
Copper:		
Quantity	pounds	1,728,182
Value		[1] $302,431
Gold:		
Quantity	fine ounces	1,321.90
Value		$27,326
Silver:		
Quantity	fine ounces	10,938
Value		[1] $5,545

The copper production was an enormous increase over that of the preceding year, in natural response to the intensified demand and high price. Only two copper mines were operating in 1914, and therefore the production for that year is not published, as it might reveal the output of the individual mines.

[1] Computations based on average price of copper ($0.175) and silver ($0.507) for 1915.

KETCHIKAN MINING DISTRICT.

PRINCE OF WALES ISLAND.

KASAAN BAY AND VICINITY.

The Granby Co. is operating the Mamie and It mines, on Kasaan Peninsula. At the Mamie work preparatory to actual mining was started in December, 1913, and continued for several months. The summer of 1914 was spent in development work, rebuilding the aerial tram, and putting the mine plant into condition for production. On account of the low price of copper the mine was shut down from September, 1914, to the following April, when operations were resumed; the output then averaged 200 tons of ore a day. The aerial tram, which originally extended to the smelter only, now extends to the dock in Hadley Harbor, where the ore is loaded direct into barges and transferred to the company's smelting plant at Anyox, British Columbia.

A new hoist was put in at the shaft, and ore from the main adit level and two lower levels has been mined. The main ore bodies at the Mamie mine are associated with deposits of magnetite, garnet, epidote, and other contact minerals formed along the border of a large mass of dioritic rock intrusive into limestone and altered sediments. Stoping of ore was confined chiefly to large low-grade lenses of copper-bearing magnetite which had been exposed by the old Brown-Alaska Co. but which at that time was of too low grade to extract at a profit. This magnetite has served the purpose of a flux at the Anyox smelter. At the time of visit (September, 1915) about 1,000 feet of development work had been done and 30,000 tons of ore shipped since the Granby Co. took over the property. On the 125-foot level ore has been encountered in a porphyry dike, and a drift on it for 150 feet showed an average width of 8 feet and a copper content of 4 per cent. This ore has served the purpose of raising to commercial grade the low-grade magnetite which it invades.

A contour map with 10-foot contour interval has been constructed on a scale of 50 feet to the inch, and the surface geology has been mapped in considerable detail. A survey has also been made and stakes placed at intervals of 25 feet, preliminary to a magnetic survey of the area adjoining the proved ore bodies in the contact zone. Diamond drilling will be done in the spring. Fifty men are employed at the mine.

The Granby Co. also operates the It mine and adjoining properties. The old workings consisted of a vertical shaft sunk 150 feet to the ore body, a number of vertical workings, and a 1,500-foot adit reaching a vertical depth of 280 feet below the bottom of the shaft, or 530 feet below the surface. The first work of the Granby Co. was to drive an inclined raise from this adit to the bottom of the old shaft.

Considerable ore left around the borders of the old stopes was extracted by starting at the bottoms of the stopes and filling them as they came up on walls of ore. Ore was also discovered in the shaft between the 100-foot and 150-foot levels. In the meantime active prospecting has been carried on along the contacts of quartz diorite dikes and limestone. Work was carried on simultaneously at the Dean claim of the It group, which was purchased outright by the Granby Co. Besides copper, the ore carries notable amounts of gold.

An 8-horsepower gasoline motor is used to haul the ore from the mine to the beach, a distance of three-quarters of a mile, over a surface tramway. Despite the grade on the tram it is considered a success, as high as 150 tons to the shift being hauled to the beach. Ore is shipped to the smelter at Anyox, British Columbia. About 40 men are employed at the mine.

The Goodro mine is near the head of Karta Bay, about half a mile north of the "Salt Chuck." It is entered by an adit 200 feet long, which cuts the ore body 150 feet from the portal. At this point a winze has been sunk for 100 feet, from the bottom of which drifts have been opened along the ore body in both directions. A shaft from the surface opens into a chamber from which a winze also extends down to the adit. From this stope ore was extracted in 1915. The ore trends northeast. It is composed essentially of bornite, with lesser amounts of other copper sulphides, and the country rock is gabbro. Ore from the mine is trammed by hand 300 feet to the ore bins, where the shipping ore is sorted out and trammed to the wharf, to be loaded on barges.

The Leibrant claims are a quarter of a mile west of the Goodro mine. An adit, which at the time of visit was inaccessible, is said to be 100 feet in length, with an 18-foot shaft. It is driven along a vertical fault striking N. 36° E. At the mouth of the adit the country rock is gabbro mineralized with chlorite and epidote. Specimens of similar rock taken from the dump contain considerable quartz with particles of disseminated bornite and chalcopyrite. Other surface openings are close by.

The Mount Andrew mine made several shipments of ore, although the activities of the operators were directed more to the development of the mine than to the production of ore. Prospecting has continued on the Jim, Rico, and Peacock claims, which have been connected with the main workings by an aerial tram. The present developments consist of about 4,000 feet of underground workings and a number of large glory holes and other surface openings. The ore bodies are composed of magnetite-chalcopyrite rock. Besides the ore rich enough in copper to be mined for that metal, there are large bodies of low-grade material that would become valuable for their iron content if facilities were available for magnetic separation.

The Poorman group of claims is on the southwest shore of Kasaan Peninsula, 2 miles northwest of Kasaan, with which it is connected by a trail near the beach. A surface tram 2,500 feet in length connects the workings with the cabins at tidewater. The tram is now in poor repair, but a good trail leads to the workings. The ore bodies, which consist of magnetite with a small copper content, are of interest as possible iron ores. The claims have been prospected by several short adits and open trenches driven in a northeasterly direction. Near the blacksmith shop at the end of the tram is an adit 80 feet long in which a body of magnetite is cut 40 feet from the portal and continues to the face. A few feet to the south a 90-foot adit crosscuts what is apparently the same body of magnetite. At the face a shaft extends 30 feet to the surface and 60 feet below the level of the adit. Another adit 50 feet long is all in magnetite. South of these workings two open trenches, 150 and 60 feet in length, are both entirely in magnetite ore. South of the trenches is a large outcrop of magnetite, and northeast of the shaft for a distance of 500 feet are numerous outcrops and surface pits, indicating a considerable width to the magnetite ore zone. North of the Poorman property are the Kansas and Blackbird claims of the Coleman group.

The Rush & Brown mine has proved the most persistent copper producer in southeastern Alaska. It is on two lodes, known as the magnetite and sulphide ore bodies, which have been worked to the 250-foot level. The magnetite ore body is a contact deposit occurring along the border of intrusive diorite and altered sediments. It has been developed by a glory hole 100 feet deep and by workings on the underground levels. Surface exposures of ore northeast and east of the developed lode indicate either a greater length and width of the ore body than was at first expected or large ore bodies near by that have not yet been explored by the mine workings. These surface exposures are revealed by shallow pits opened through the overburden. Magnetite-chalcopyrite ore occurs in a small pit north of the east end of the glory hole, and similar ore is found in the excavations of the ore bins about 25 feet to the west. (See fig. 2.) Magnetite ore occurs also in a recently opened pit 75 feet east of the glory hole, about in line with the other pits. The size of the body is not evident, as ore occurs across the entire width of the pit, about 11 feet. It is mainly magnetite-chalcopyrite ore, with a little native copper and seams of copper carbonate.

The relation of these outcrops of copper-bearing rock to one another or to the known ore bodies is not evident, but their position indicates either an extension of the old ore bodies or new lodes of considerable size. In either case the probability of an increased area of productive ground is strong. The glory hole and surface pits show ore more or less continuous for nearly 200 feet, and the presence of bodies of

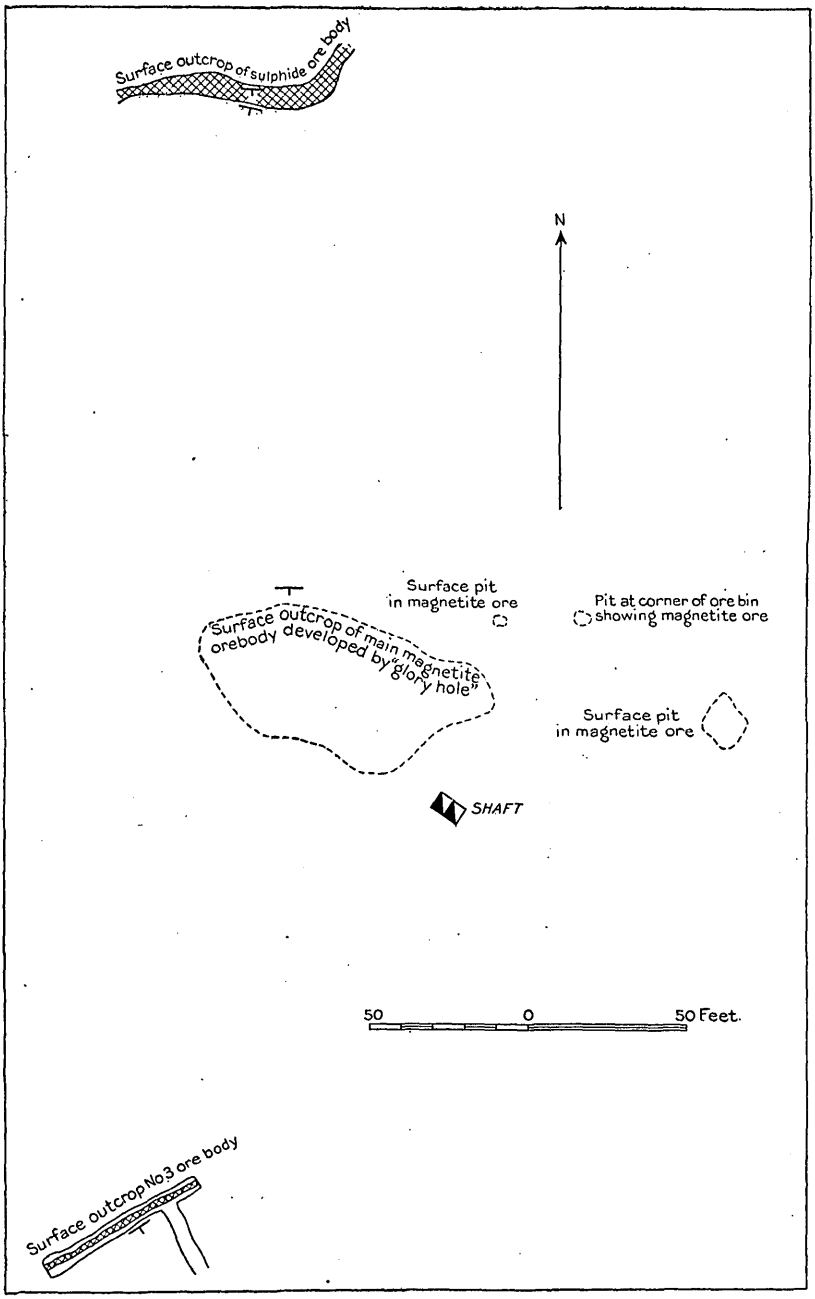


FIGURE 2.—Sketch of surface outcrops of ore bodies, Rush & Brown mine. (From Surveys by U. Rush.)

magnetite southeast of the known lodes has been shown by magnetic surveys.

The sulphide ore body is a shear-zone deposit inclosed in metamorphosed sediments. Chalcopyrite is the principal metallic mineral, and the ore contains subordinate amounts of pyrite, pyrrhotite, and magnetite; the gangue is altered country rock. This lode has been opened to a depth of 250 feet and with increasing depth becomes more more nearly vertical. It is from 4 to 14 feet wide.

Another lode, known as the No. 3 ore body, has been trenched for a short distance at a point 150 feet south of the glory hole. It is a shear-zone deposit composed of veinlets of chalcopyrite, pyrite, and magnetite. This lode has not been opened by underground workings.

LAKE BAY.

The McCullough prospect, near Lake Bay, on the northwest coast of Prince of Wales Island, comprises the Jackson 1 and 2, Horseshoe,

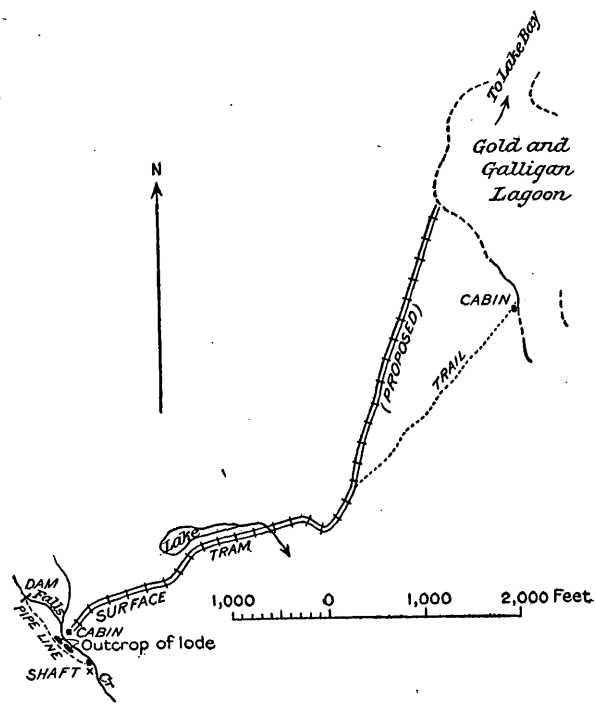


FIGURE 3.—Sketch map showing location of McCullough prospect, Lake Bay.

Lake Bay, and Copper claims, which were located 10 years ago. At that time some prospecting was done and 4 tons of ore was shipped for treatment, the results of which were satisfactory enough to encourage further development. A substantial building houses the hoist,

sawmill, and blacksmith shop. The power house is equipped with an 8-foot Pelton wheel, which develops electric power for the hoist and sawmill.

The claims are about 6,000 feet southwest of the beach of a salt-water lagoon connecting Sweet and Barnes lakes, which empty into Lake Bay. (See fig. 3.) An excellent plank tram has been built part of the way from the mine to the cabin on the lagoon and can be extended at easy grade to the lagoon, which at high tide may be reached from Lake Bay by boats of light draft. The underground developments consist of some caved workings and a well-timbered shaft, which in 1915 was extended to a depth of 61 feet. This shaft was not accessible. The material on the dump is composed of fine-grained graywacke, intricately veined with calcite. This rock is apparently not metallized, but similar rock said to be taken from the lower part of this shaft contains considerable chalcopyrite. The ore body is exposed on the surface at only one place. Here it is a breccia lode, composed essentially of quartz inclosing angular pieces of black slate and argillite and bearing considerable chalcopyrite and pyrite. The size of the ore body is not evident. A caved crosscut is said to extend 35 feet across the lode, the length of which is claimed to have been proved for 300 feet in a northwesterly direction by test pits, now inaccessible. Rock from one of these old workings is black argillite breccia cemented with calcite. The country rock is black slate, argillite, and banded graywacke.

Development work was resumed in 1915 by a crew of men but was not continued throughout the season. Some ore taken from the old workings is ready for shipment.

MOIRA SOUND.

The only productive mining on Moira Sound was at the Cymru mine, on Mineral Lake, three-quarters of a mile from the head of North Arm. The mine is on a lode striking N. 60° W. and dipping about 60° SW., inclosed in limestone. The present workings consist of an inclined shaft opened along the lode for 100 feet and drifts on the 30-foot and 90-foot levels. The lower drift extends southeastward along the vein for 96 feet, and at its end a small stope has been opened. The workings on the upper level are more extensive. A drift extends northwestward from the shaft for 30 feet, and a short crosscut has been driven to cut the vein. Southeast of the shaft the drift extends for 400 feet, and for the greater part of this distance the vein is stoped to the surface. An adit extends from the surface near the shore of Mineral Lake to this level, which it reaches about 60 feet from the shaft. The ore is hoisted through the shaft and trammed to the ore bunkers on tidewater, a distance of about three-quarters of a mile. After lying idle for some time this mine was worked on a lease during the summer of 1915, and some shipments of ore were made. The

mine is equipped with good mine buildings and a substantial wharf and bunkers on tidewater, which are connected with the mine by a tramway.

No mining was done in 1915 at the Niblack mine, but investigations relative to the development of water power were made. Assessment work was continued on the Wakefield group and other claims near by. Workings on the Westcott claim have exposed a body of low-grade ore 120 feet across, inclosed in quartz-sericite schist. The lode is essentially pyrite, with a little chalcopyrite inclosed in a siliceous gangue.

On McLean Arm, 20 miles south of Moira Sound, development work has been in progress for a number of years.

HETTA INLET AND CORDOVA BAY.

The Jumbo mine, which is on Copper Mountain, near the head of Hetta Inlet, was the only productive mine in this vicinity in 1915. The mine is connected by an aerial tram with the company's wharf and ore bunkers at tidewater. The ore bodies are contact deposits containing chalcopyrite-pyrrhotite ore of irregular size and shape, with a footwall of diorite and hanging wall of crystalline limestone, silicified schist, or banded quartzite.[1]

Operations proceeded about as usual in 1915. Shipments of ore were started early in the summer and were maintained throughout the remainder of the year. The present developments consist of 10,000 feet of underground workings. Recent work has proved the large ore bodies to be more extensive than was at first expected.

A prospect near the head of Keete Inlet has been developed recently on a copper-bearing lode striking N. 20° W. and dipping 60° NE. The lode is being opened by an incline, which below the 10-foot level was covered with water and inaccessible at the time of visit. The ore is a shear-zone deposit containing disseminated particles and lenses of chalcopyrite and pyrite in siliceous beds occurring in greenstone schist. On the dump were samples of quartz veins carrying bornite and chalcopyrite, but similar rock was not seen in place. The property is a short distance from tidewater and is equipped with a blacksmith shop and cabins built on a small cove.

The Marion and Ella claims are on the northwest shore of Nutkwa Lagoon, three-quarters of a mile from the head. Nutkwa Lagoon is a body of water 3½ miles long separated from the head of Nutkwa Inlet by a "skookum chuck," which is navigable only at slack tide and then only with a boat of shallow draft. The claim is being developed on a vein trending N. 25° W. and dipping from 85° SW. to nearly

[1] Wright, C. W., Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska: U. S. Geol. Survey Prof. Paper 87, p. 60, 1915.

vertical. It has been followed for 400 feet by an adit, from which a winze has been sunk for 50 feet at a point about 200 feet from the mouth. The ore body is a quartz vein about 6 feet in width, carrying chalcopyrite and a little galena. At the mouth of the adit a schist horse fills about half of the vein, but a short distance from the portal the vein material fills the fissure. An aerial tram leads from the workings to the beach of the lake, a distance of about 200 yards. On the beach are cabins and a blacksmith shop.

The Goodhope claim is half a mile by trail from the head of Hunters Bay, on the west coast of Prince of Wales Island. The ore is magnetite and chalcopyrite, occurring in irregular bunches in greenstone near the contact of granitic rocks. The development work consists of an adit driven for 40 feet northwestward, cutting a lens of ore. A trail connects the workings and blacksmith shop with the beach, half a mile away.

Work on the property of the Alaska Consolidated Mining & Smelting Co. at Coppermount has been suspended temporarily, but application is being made for patent on five claims, and plans for future mine development are being worked out by the engineer in charge.

WEST COAST.

The Big Harbor mine is on the west coast of Prince of Wales Island, on Trocadero Bay, locally known as Big Harbor, though this name is used more specifically for the inner part of the bay. The claims were staked in 1907 by M. Zimmerman and later acquired by the Northland Development Co., the present owners. The company was organized in March, 1908, under the management of A. B. Hill, C. D. Calhoun, and P. A. Tucker. Since that time considerable development work has been done. The mine has not been a steady producer, but small shipments were made in 1912 and 1913. Work was again started in 1915, but no shipments were made. The property consists of 11 claims located along the ore body half a mile from the beach and two mill-site claims at tidewater. The underground developments consist of workings on 3 claims, aggregating 650 feet of adits, crosscuts, and shaft. Cabins have been erected on the beach and at the workings. An aerial tram connects the wharf site with the main workings at a distance of 2,400 feet. The beach claims occupy a sheltered harbor offering no difficulties to wharf construction or the approach of seagoing vessels.

The ore bodies form the hanging wall of a mineralized zone of greenstone several hundred feet wide, within which are shear zones carrying lenses of chalcopyrite ore and stringer lodes. The mineralization was accompanied by intense silification of the country rock, which has affected in greater or less degree the entire zone. This zone strikes N. 60° E. and dips 60° NW., about parallel to the individual lodes

contained within it. The country rock termed greenstone is composed of altered igneous rocks, which beyond the footwall of the lode pass downward into deformed arenaceous and calcareous sediments. On the hanging-wall side the wall rock is greenstone schist, composed essentially of albite with a little sericite, chlorite, calcite, and magnetite. It is evidently an altered lava flow.

On the Northland No. 1 claim an adit has been driven 120 feet to the hanging wall of the lode, drifts extended to the northeast and southwest, and a number of crosscuts driven. An inclined shaft 52 feet long connects this drift with the surface. (See fig. 4.) The relations revealed by these workings and surface outcrops will be briefly set forth. Separated from a well-defined hanging wall by about 4 feet of quartz-sericite rock is a copper-bearing lode composed of schistose greenstone in which occurs lenses of chalcopyrite in a greenstone gangue accompanied by blebs of quartz and a little calcite. One such ore shoot from 2 to 6 feet wide has been stoped out for 40 feet. Another one 4½ feet wide was cut in the adit, and its possible extension was opened in a crosscut at the end of the northeast drift. Southeast of the greenstone is a stringer lode of quartz and silicified greenstone 120 feet in width, and beyond this for a distance of 700 feet across the strike occur a series of stringer lodes which, with the intervening silicified greenstone, form the mineralized zone. These stringer lodes contain disseminated pyrite and chalcopyrite with some gold. The hanging wall is marked by the zone of copper ore. The footwall is not so well defined and is marked only by a decrease in the number of quartz stringers and degree of silicification.

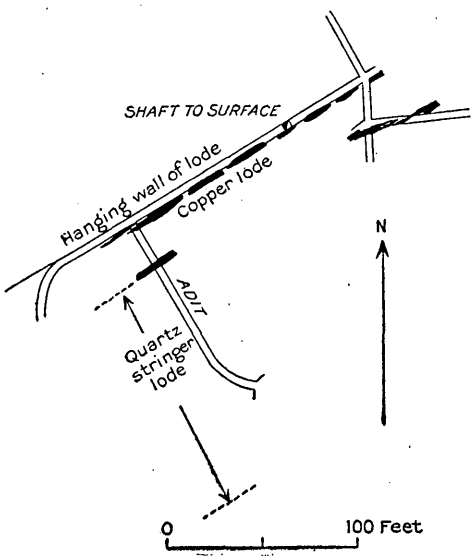


FIGURE 4.—Plan of workings on Northland No. 1 claim, Big Harbor mine.

Other developments consist of workings on Northland Nos. 2 and 3 claims. A shaft on the end line between the two claims has been driven for 117 feet and crosscuts extended at 30 and 80 feet below the adit, which cuts the shaft 17 feet from the surface. This adit for its entire distance is in rock similar to the disseminated sulphide ore exposed in the adit of the main workings. The lower part of the shaft was not accessible at the time of visit. Chalcopyrite ore on the dump was said to have come from the shaft.

The mine at present is being exploited solely for the copper content of the ore. It is suggested, however, that the stringer lodes should be thoroughly prospected for gold-bearing portions.

The Nancy claim is about 2 miles up the creek that enters the head of Trocadero Bay. The country rock is greenstone with interbedded argillite and conglomerates. Shallow surface workings along the stream show a shear zone about 25 feet wide composed of silicified greenstone impregnated with pyrite and chalcopyrite. Within this shear zone are more definite ore lodes separated by horses and barren places. Near the center of the shear zone is a vein of pyrite about 18 inches thick bordered on both sides by seams of gouge and inclosed in greenstone with disseminated pyrite and chalcopyrite. Within the shear zone are other masses of silicified greenstone in which lie stringers of quartz carrying pyrite and chalcopyrite. One such lode, apparently in place, is a foot in thickness. Other brecciated masses are too much faulted and crushed to show their relations. About 100 yards up the creek this lode is again exposed for a distance of 150 feet. At this place it is a quartzose lode with much pyrite and chalcopyrite, averaging about 6 feet in thickness. The lode strikes N. 70° E. and dips 45° NW.

DALL ISLAND.

Considerable prospecting has been done in a mineralized zone said to extend from Sea Otter Harbor, on the west coast of Dall Island, to the head of Coco Harbor, on the east coast. On the ridge south of Sea Otter Harbor two adjacent groups of claims in limestone are being developed. Prospecting has also been done on Coco Harbor.

GRAVINA ISLAND.

Prospecting and development work has been continued by Sanford & Lhote on a group of claims on a mineralized zone extending from Dall Bay to Seal Cove, on the south end of Gravina Island. The Sanford claim, a short distance from Dall Bay, is being developed by a shaft opened on a shear zone in green chlorite schist. On the Algonquin 2 claim a shear zone in schistose greenstone is being prospected by several open cuts. The lode is essentially quartz carrying chalcopyrite. It is about 50 feet wide where exposed and strikes N. 30° E. Another vein that crosses the main lode at a sharp angle occupies a fracture zone and is composed of banded quartz and specular iron. The north end of this group of claims lies in an area of granitic rocks, light-colored intrusives composed essentially of quartz and feldspar and in places porphyritic. Here the lode averages about 50 feet in width. It has been traced for 1,500 feet by open cuts. The gaugue is quartz with stringers of specularite and carries chalcopyrite and a

little bornite. Smaller parallel veins 8 to 10 feet in width border the main lode in places.

Adjoining the patented claims of the Victory Copper Mining Co. on Seal Cove are the Tiernan and Lhote groups of claims, comprising the Anthony, Lizzie L., and Deer Lodge 1, 2, and 3. These claims have been held for a number of years without active development but are now being prospected by surface trenching with a view of developing several large bodies of low-grade ore recently uncovered. Four or five almost parallel and nearly vertical main lodes strike about N. 20° W. Where exposed by surface trenches they range in thickness from 30 to 75 feet and have an aggregate thickness of over 200 feet. The quartz lodes are inclosed in greenstone and carry disseminated pyrite, chalcopyrite, and specular hematite. Besides the copper content the ore is said to carry gold.

Assessment work was also continued on a group of claims on the west coast of Gravina Island, on the cove directly across the island from the head of Dall Bay.

MAINLAND.

SALMON RIVER DISTRICT

General features.

No extensive copper mining is done on the mainland of the Ketchikan district, and little prospecting has been carried on except in the Salmon River basin, where a number of claims have been located and a small production has been made by the selective mining of high-grade deposits.

The term Salmon River district is here used for the Alaskan part of the Salmon River basin. It joins the Salmon River mining district of British Columbia. Salmon River is a large stream entering Portland Canal 2 miles from its head on the American side. The main part of the stream lies within Alaskan territory but is joined near the international line by tributaries from British Columbia. (See fig. 5.)

The ore deposits of the Salmon River district and the adjoining Bear River district on the Canadian side were discovered in 1898, during the rush to Dawson. The position of the international boundary was for a time in doubt and many of the locations then made in what was supposed to be Alaska proved later to be in British Columbia. With the opening of the property of the Portland Canal Mining Co. in the Bear River district in 1907, Portland City was laid out on the tide flat at the mouth of Salmon River, during a short-lived boom which retarded the development of the region.

The best-developed mineralized area of the Salmon River basin lies in British Columbia, but this area is accessible through Alaskan

territory, and the recent construction by the Dominion Government of a trail to the upper part of the district has stimulated interest and made more accessible the entire region, including the Alaskan district, where a number of promising claims have been located.

The principal source of Salmon River is Salmon Glacier, a large ice stream crossed by the international boundary near its foot. Its principal tributaries are Texas Creek, issuing from Texas Glacier on the Alaskan side, and Cascade Creek, which lies almost entirely in British Columbia and flows into Salmon River near the boundary. Fish Creek, another tributary, enters Salmon River 5 miles above its mouth. Salmon River occupies a flat-bottomed glaciated valley between high mountains that rise to altitudes of 5,000 feet and show precipitous cliffs and rugged topography.

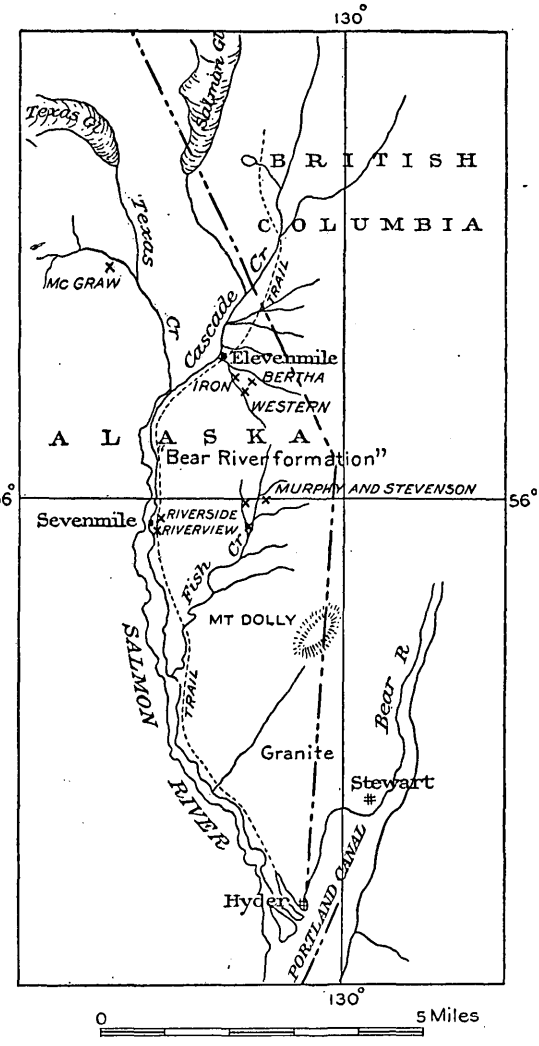


FIGURE 5.—Sketch map showing location of claims on Salmon River and geologic relations.

Up to altitudes of 3,000 feet the hills are timbered with hemlock and spruce of good grade, in quantity adequate for all mining and building needs. Hemlock is the more abundant. The possibilities for developing water power, though not examined in detail, are regarded as sufficient for the needs of the district.

An option on the Big Missouri group of claims and other properties on the Canadian side has been taken recently by the Alaska-Gastineau Mining Co. The erection of the contemplated reduction plant for the development of these large deposits and the provision of rail-

road facilities between tidewater and the international line would further stimulate prospecting on the American side. The name of Portland City has recently been changed to Hyder, and a post office has been ordered established. The Salmon River district may be reached by boat to Hyder and thence by trail. At present no regular boat service is maintained, but passenger-carrying boats make occasional trips, and boats for charter are always available. The distance is about 155 miles from Ketchikan and 135 miles from Prince Rupert, British Columbia.

Geology.

The Salmon River basin lies on the east border of the Coast Range. On the Canadian side the mineralized parts of the district occur for the most part in the "Bear River formation," a series of massive and fragmental greenstones said by McConnell [1] to include "fine, medium, and coarse volcanic breccias or agglomerates, tuffs, bands, and areas of massive porphyrites, and occasional argillaceous bands." This same formation extends to the American side of the district and for the most part incloses the mineral deposits. Prominent members are green fragmental tuffs, fine-grained aphanitic flows, and diorite porphyry with feldspar crystals set in a dense dark groundmass, volcanic breccias, black argillites, and crystalline schists. The "Bear River" rocks are invaded by masses of quartz diorite and associated granitic rocks, members of the Coast Range intrusive series. Along the contact narrow tongues of the granitic rocks have penetrated the "Bear River formation," and isolated masses occur within it.

Ore deposits.

Ore deposits of two types occur in this district—disseminated deposits of low metallic content and veins carrying shoots of very high-grade ore. The disseminated deposits have not been exploited sufficiently to determine their extent or value. One such deposit appears to be roughly tabular in shape but without definite outline, merging gradually into the country rock. At other places the mineralization is of even more diffused nature. The vein deposits occupy fissures and zones of brecciation. Those examined range in width from a few inches to 6 or 8 feet. The gangue is quartz. Galena, the most abundant sulphide, is accompanied by chalcopyrite, tetrahedrite, sphalerite, pyrite, and pyrrhotite. The occurrence of rich seams of sulphide ore penetrating the quartz gangue, a common feature of the vein deposits, is evidence of more than one period of mineralization. An older system of quartz veins containing chalcopyrite and pyrite is believed to be connected genetically with the Coast Range intrusive rocks. The

[1] McConnell, R. G., The Salmon River district: Canada Geol. Survey, Dept. Mines, Mem. 32, pp. 63, 64, 1913.

sulphide enrichment is regarded as belonging to a later period of mineralization in which some of the quartz veins were reopened and enriched by sulphides of lead, antimony, and copper, in part gold and silver bearing.

The production of this district has so far been slight. At one prospect a ton of high-grade galena ore was sacked ready for shipment. At another property a small shipment is reported. The lack of transportation facilities has discouraged the exploitation of any properties except those carrying high-grade ore.

Prospects.

A group of claims extending from Sevenmile, on Salmon River, to Fish Creek, has been located, but only two of them have been developed. On the Riverside claim a tunnel 100 feet above the river flat has been driven for 140 feet along a strong fissure vein. The vein averages about 4 feet in width but pinches to 18 inches and in places widens to 6 feet. Both walls are well defined. The wall rock is somewhat altered but contains little gouge. The vein filling is quartz with abundant sulphides. Pyrite is the most abundant along the hanging wall and occurs in solid bunches and in disseminated particles associated with chalcopyrite. On the footwall galena is the most plentiful sulphide. The country rock is crystalline schist. On a parallel lode of much the same character the Riverview claim is being developed. The vein strikes N. 60° W. and dips about 60° NE. An adit has been driven for 17 feet, exposing a vein that varies from 1 foot to 4 feet in width. At the mouth of the opening it is 2 feet wide on the roof and widens to 4 feet on the floor of the adit. At the face it is from 12 to 18 inches in width. Although the vein swells and narrows from place to place, the walls are well defined.

At Elevenmile a little prospecting has been done, and several claims have been located. On the Elevenmile and Iron claims a number of open pits have exposed an iron-stained lode that follows a brecciated zone filled with veins of quartz carrying chalcopyrite, sphalerite, and galena. Stringers of sulphides form shoots of very rich ore with high silver content. On the Iron claim a ton of this high-grade ore has been sacked ready for shipment. The lode strikes northeast and dips steeply northwest. On the hillside above Elevenmile, at an altitude of 1,500 feet, the Bertha and Western claims are being developed on a northeastward-trending lode. One surface cut shows the lode to be at least 15 feet in width. It consists of silicified schistose green tuff of the "Bear River formation," with disseminated pyrite, chalcopyrite, galena, and sphalerite. A number of claims have been staked on a zone of disseminated deposits exposed along Salmon River at Eightmile and Ninemile but only a little work has been done.

Some promising fissure lodes have been located by Murphy & Stevenson on Fish Creek and its tributary Skookum Creek, where more than the necessary amount of assessment work has been done. Near the mouth of Skookum Creek an adit was driven for 25 feet along a fissure that had been traced by surface trenches for 2,000 feet. The vein is 4½ feet wide, strikes N. 40° E., and dips about 55° SE. The quartz gangue carries galena, chalcopyrite, tetrahedrite, sphalerite, and pyrite in veinlets and irregular patches. It is being exploited mainly for its gold and silver content.

Near the head of Skookum Creek, at an altitude of 1,600 feet, a fissure vein has been opened by an adit 320 feet in length and several crosscuts and inclines. The gangue is quartz. Metallic sulphides present are tetrahedrite, chalcopyrite, galena, sphalerite, and pyrite in blebs and veinlets penetrating the quartz, and the richest ore occurs in veinlets of tetrahedrite and galena. The country rock is porphyry and schistose tuff of the "Bear River formation." The lode strikes N. 55° W. and dips 45° SW. At the portal it is about 18 inches wide. At 70 feet from the portal only a part of the vein is exposed, as the ore has been removed to a wall within the vein. At this place the vein is 3 feet wide plus an unknown width in the wall of the adit. At various places portions of the vein said to be very rich have been stoped out. At 300 feet from the adit mouth the lode is abruptly cut by a vertical fault trending nearly perpendicular to the lode and short drifts along the fault plane in both directions had not shown the position of the faulted lode. Samples of ore said to come from a near-by prospect, which was not visited, contain particles of free gold in a siliceous gangue.

Several claims have been staked on Texas Creek. The ore bodies are reported to be quartz veins carrying seams of tetrahedrite penetrating granite and pegmatite. Little work has been done in this locality.

MISCELLANEOUS OPERATIONS.

No metals other than those won from the mines operated for their gold and copper content were produced in southeastern Alaska in 1915, but promise of future output is given by a number of prospects, including some on lodes carrying silver, lead, zinc, antimony, and molybdenum. A notable amount of lead produced at the Perseverance and Alaska-Juneau mines is obtained from the galena concentrates. Silver-lead deposits occur at the head of Cholmondeley Sound, on Eastern Passage, on Coronation Islands, and on Whiting River. The Groundhog Basin property lies between the Coast Range and Eastern Passage, in a mineralized belt of slate and schist penetrated by dikes of acidic porphyry and aplitic rock and mineralized by galena, zinc blende. pyrite and chalcopyrite carrying gold and

silver in varying amounts.[1] This property changed hands in 1915 and work was started toward its development.

A small output has been made from the silver-lead deposits of the Moonshine and Hope groups, near the head of South Arm of Cholmondeley Sound. No productive mining was in progress in 1915, but some development work was continued. The only workings accessible when examined were surface cuts. The ore bodies exposed consisted of irregular masses of galena, epidote, and garnet, all replacement deposits in limestone and evidently connected with fissure veins. A small production has been also obtained from galena deposits occurring on Coronation Island, on the west coast of Prince of Wales Island, but these workings were idle in 1915.

Claims are reported to have been located recently on the south side of Whiting River 10 miles from its mouth, on silver-bearing galena ore occurring in a quartz vein 6 to 8 feet in width. Samples of the ore said to be taken from this lode are composed esssentially of galena carrying a notable amount of silver.

On Salmon River near the head of Portland Canal a number of claims exploited as copper properties contain rich silver-bearing lodes. On the Elevenmile and Iron claims, at Elevenmile, is an iron-stained lode following a brecciated zone filled with veins of quartz carrying chalcopyrite, zinc blende, and galena. Where the galena predominates this sulphide forms stringers of very rich silver ore. On the Iron claim a ton of this high-grade ore was sacked ready for shipment. Another copper lode in this vicinity is the fissure vein at the head of Skookum Creek, described with the copper deposits. The metallic sulphides present are tetrahedrite, chalcopyrite, galena, zinc blende, and pyrite in blebs and veinlets penetrating the quartz gangue. Among these are silver-bearing veinlets composed essentially of tetrahedrite and galena, rich enough to be mined and the ore sorted for shipment.

The lodes of this region carry more or less zinc blende. Where this mineral occurs in small amounts it is considered a detriment, as it introduces metallurgic difficulties in its treatment. There are now being exploited, however, in the Salmon River district of British Columbia large lodes containing sulphides of zinc, lead, and copper carrying gold and silver, in which zinc is the principal valuable metallic constituent. A large body of ore carrying 14 per cent of zinc and lesser amounts of gold and copper was recently reported to have been discovered on Tracy Arm.

The discovery of molybdenite-bearing lodes in the vicinity of Skagway was recently announced.[2] Blocks of granitic rock contain-

[1] Wright, F. E. and C. W., The Ketchikan and Wrangell mining districts, Alaska: U. S. Geol. Survey Bull. 347, 1908.

[2] Alaska and Northwest Min. Jour., vol. 7, p. 98, 1915.

ing molybdenite found in the vicinity of Mile 6 on the White Pass Railway led to the discovery of the lodes in place. The vein, known as the Combination lode, is said to crop out 3,000 feet north of Denver station. It is composed of white quartz and is inclosed in "granite gneiss traversed by diorite dikes." A mile and a half north of this lode is the Combination No. 12 lode, a 50-foot ledge of quartz-feldspar pegmatite impregnated with molybdenite.

The region north of the east fork of Skagway River extending from Mile 6 eastward for 8 miles is said to contain molybdenite-bearing float. Molybdenite lodes are known in British Columbia at Lake Bennett, where several veins have been opened.

NONMETALLIC PRODUCTS.

MARBLE.

The marble quarry of the Vermont Marble Co., at Tokeen, was operated as usual. This company has recently opened a quarry on claims bonded from Woodbridge & Lowery. The new camp, known as Skyrus, is on the west shore of Red Bay, on the north end of Prince of Wales Island.

Interest in the development of marble properties continues, especially in the Ketchikan district. The Alaska Marble Co. did considerable development work on its claims at Calder, also some prospecting on Dry Pass, with satisfactory results.

Marble prospecting has been continued at other places on Dall Island, Long Island, and Revillagigedo Island, and some commercial marble of very good grade has been located. These marble deposits will be described in more detail in a forthcoming bulletin.[1]

Assessment work is being continued by Lhote, Ickis, and others on marble deposits near the head of Waterfall Bay, on the west coast of Dall Island. The property comprises 20 claims, including the Eurus, Marble Heart, St. Augustine, and Marble Bay groups. The claims are on the steep hillside only a short distance from the head of the bay.

The geology of the region is simple. South of the bay the rock is limestone. The dominant color is blue to black, but the marmarized portions are lighter. Schistose greenstone overlies the limestone with apparent conformity; it contains conglomerate beds and occupies the north shore of the bay. The contact extends about N. 75° E. from the cabin at the head of the bay. Both limestone and greenstone beds stand nearly vertical but dip northwest at high angles except where they are overturned. The best marble noted occupies a belt of varying width along the greenstone contact. At one

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

locality the outcrop has a measurable width of 400 feet, besides a considerable thickness of semicrystalline limestone. The marble has been exposed by surface stripping for several hundred feet from the head of the bay. At an altitude of 220 feet the following section is exposed:

Section of marble on Waterfall Bay 300 feet from cabin.

Greenstone.	Feet.
Bluish-gray marble (occasional outcrops only)	300 (?)
Blue and white mottled marble	4
Dike	½
Thin-bedded white marble, with black specks and white mica	4
Pink-mottled white marble	13
Blue and white mottled marble, base concealed.	

The finest commercial marble in this section is the 13-foot bed of pink-mottled white marble. The upper and lower parts of the bed are even-textured, medium to fine grained white marble, mottled with a very delicate pink tint and veined with irregular threadlike veinlets of yellow. In the central part of the bed the pink color is more pronounced and the rock contains much white mica, a combination that produces a handsome rock.

A short distance beyond this point, at an altitude of 400 feet, the following section is exposed:

Section of marble on Waterfall Bay 600 feet from cabin.

Schistose greenstone.	Feet.
Bluish-gray marble, in part mottled and veined with black	300
Fine-grained white marble with brown veinlets carrying mica and pyrite	26
White marble with green patches and brown veinlets	7
White marble with brown and green veinlets carrying mica and pyrite, fine-grained, with few large crystals of calcite	9
White and pink marble with green areas	11
Fine-grained white marble with pyrite in tiny veinlets and disseminated in particles	16
Quartz schist containing pyrite	1
White marble with pyrite and much chlorite in tiny stringers and veinlets	10
Dike	2
Concealed	15
Blue limestone with beds of white marble and schistose beds, grading downward into fossiliferous limestone.	

The beds of white and pink marble with mottled green areas are very handsome and are susceptible of a high polish except where the green minerals predominate. The greater part of the bed is white and pink marble, composed of nearly pure calcite of very fine grain, the individual minerals averaging about 0.05 millimeter in diameter. The base and top of the bed are variegated with green areas which,

combined with the pink-mottled white rock, give a very striking effect. Under the microscope the green areas are seen to be sericite, quartz, and chlorite; the white and pink rock is essentially calcite. The thick mass of bluish-gray marble at the top of the measured sections contains beds of ornamental marble of commercial value. These beds are black and white, mottled in very intricate pattern, and bluish white with black veinlets. This rock takes a smooth polish.

Marble crops out at several places along the south shore of the bay between the cabin and the greenstone contact. Near the cabin an opening has been made on a bed of fine-grained, even-textured white marble carrying flakes of white mica. Another commercial marble on this bay is a fine-grained black variety that takes a good polish. The polished surface shows a black field with white-mottled areas and irregular veinlets of white calcite that give it a pleasing appearance.

Marble deposits occur at a number of places on the east coast of Dall Island. Near the head of View Cove a stream that enters from the southwest flows in a gorge following joint planes in the marble. This stream was traversed from the beach for half a mile, and for that distance the beds strike about northwest, directly across the course of the stream, and stand nearly vertical. Most of the marble seen is pearl to gray in color, mottled and veined with white. At one locality occurs a 4-foot band of yellow marble with a green stripe, and bordering it is white marble, mottled with yellow. The yellow marble takes a good polish and has a warm, soft tone. Associated with these beds is a little bluish-black marble. A polished specimen shows a black field variegated with dark-gray areas and tiny veinlets of white calcite.

Marble was also noted on the northwest side of Coco Harbor, half a mile from the head. Where it crops out along the beach it is evidently faulted against gray limestone. Back from the beach the outcrops are too few to determine its relations accurately. The marble is white to gray. Much of it is very fine grained and pure white, and some parts are coarsely crystalline, with large flashing crystals of calcite. Pyrite is not abundant but was noted in places as veinlets and disseminated particles.

Marble claims are held at a number of other localities on Dall Island, but they were not visited in 1915.

Deposits of marble have recently been located near the northwest end of Long Island, 3 to 4 miles north of Howkan, on two small bays known locally as Waters and Gotsongni bays. At this locality the brush is very thick along the shore and outcrops are few, making prospecting difficult, but the physical conditions favor the exploitation of the deposits. The shore of the island rises abruptly from

the beach, the timber is plentiful and of an exceptionally good grade, and the deposits occur on sheltered harbors which afford easy access to boats.

On Waters Bay three claims, the Lily, Long Island, and White Cloud, have been located, and assessment work has been done on them. Most of the marble exposed has a bluish-white field with white-mottled areas and blue-black stripes. Under the microscope the rock is seen to be composed essentially of twinned calcite crystals ranging in size from 0.25 to 0.7 millimeter, inclosed in a network

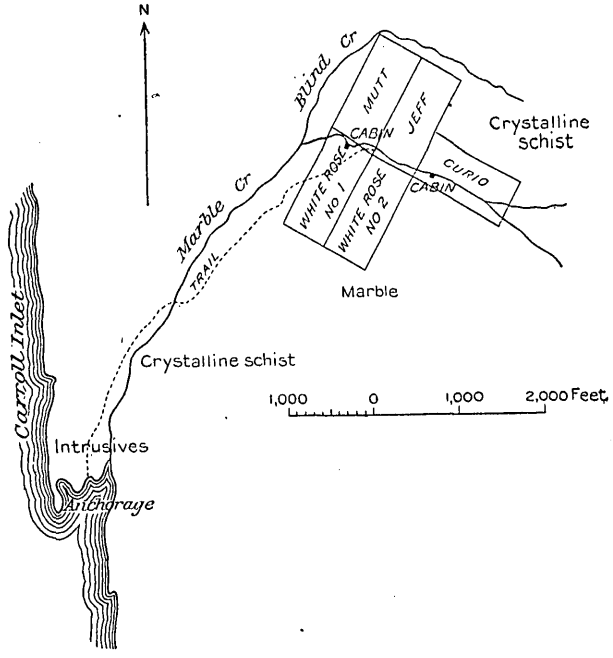


FIGURE 6.—Sketch map of Dickinson & Bell marble claims, on Carroll Inlet.

of finely granular calcite averaging about 0.05 millimeter in diameter and forming with the large calcite crystals an intersertal fabric. The large calcite crystals are bent and fractured. They are evidently crushed fragments around which the fine-grained calcite has recrystallized. The black stripes are composed of opaque particles of carbonaceous material, probably graphite. Associated with the striped marble are beds of medium-grained white marble of even texture and also beds of blue-clouded white marble with yellow patches. This rock takes an excellent polish.

On Gotsongni Bay marble occurs on the east shore three-quarters of a mile from the head. On the beach are outcrops of coarse-grained, even-textured white marble. A short distance back from the beach and separated from the white marble by a brush-concealed area is a large body of bluish-white marble with black stripes. The rock

is medium grained and even textured. It takes a good polish and is apparently free from quartz.

A deposit of white marble is being developed near Carroll Inlet by G. E. Dickinson and B. Bell. The claims are located on Marble Creek, a stream entering a cove on Carroll Inlet from the east about 10 miles from its head. From this cove a trail leads to the claims, a distance of about 1½ miles. (See fig. 6.) The rock is exposed by surface cuts at several places and along Marble Creek for half a mile, the width covered by the claim locations. For this distance the rock shows little variation. It consists of white crystalline marble of even texture and of very fine grade. No analysis was made of the rock, but to judge from its slight effervescence with acid it is probably dolomite.

Timber suitable for cabins and other construction work grows on the claims. The fall of 300 feet between the claims and beach in a distance of 1½ miles offers no serious difficulty in tram construction.

BARITE.

A deposit of barite recently discovered in the Ketchikan district is now being exploited. It occurs on Lime Point, the south end of the peninsula between Hetta and Nutkwa inlets, on the west coast of Prince of Wales Island. The country rock is semicrystalline blue-weathering white limestone, interbedded with talc schist. The limestone has a general northerly strike and dips about 80° W. An opening has been made along the deposit for 100 feet, exposing a body of barite about 30 feet wide. It is roughly tabular in shape and stands nearly vertical, conforming to the bedding of the inclosing limestone. The barite appears to be a replacement of the limestone. It is a finely crystalline white rock containing practically no visible impurities. Some of the barite was shipped to San Francisco and tested with satisfactory results.

GYPSUM.

Details regarding the operations of the Pacific Coast Gypsum Co. at Gypsum, Chichagof Island, are lacking, but it is reported that the mine was operated on about the usual scale.

GARNETS.

The mine of the Alaska Garnet Mining & Manufacturing Co. on Stikine River near Wrangell was operated part of the year. The garnets are almandite, the iron-magnesium variety $(Fe, Mg_3)Al_2(SiO_4)_3$. The best stones are used for gems and the waste material for foundry powder. A shop for the sale of gem garnets from the mine is maintained on the wharf at Wrangell.

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 powers 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, central district engineer of the Forest Service, made a reconnaissance of water-power sites in southeastern Alaska 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, 1916, and is here published by courtesy of the Forester.

[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 reconnaissance in south-central Alaska, with a section on southeastern Alaska by J. C. Hoyt: U. S. Geol. Survey Water-Supply Paper 372, 1915.

Developed water powers in southeastern Alaska Jan. 1, 1916, 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
Sitka region:			
Sitka Wharf & Power Co		350	
Chichagof Mining Co		500	
Miscellaneous plants		150	
			1,000
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	4,000		
Salmon Creek plant, No. 2	4,000		
Annex Creek plant	5,000		
		13,000	
Alaska Electric Light & Power Co		1,000	
Miscellaneous plants		1,000	
			28,800
Skagway region			100
			35,100

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. IV):

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.
Cowie and Davies creeks, Berners Bay.
Lemon Creek, near Juneau.[2]
Carlson Creek, Taku Inlet.[3]

[1] Gaging station maintained in 1909 by Porcupine Gold Mining Co.
[2] Gaging station being maintained by mining company of Juneau.
[3] Gaging station being maintained by Alaska-Gastineau Mining Co. of Juneau.

Turner Lake outlet, Taku Inlet.[1]
Speel River, Speel River project, Port Snettisham.[2]
Grindstone Creek, north shore of Stephens Passage.[2]
Rhein Creek, north shore of Stephens Passage.[2]
Long Lake outlet, Speel River project, Port Snettisham.[3]
Crater Lake outlet, Speel River project, Port Snettisham.[2 3]
Tease Lake outlet, Speel River project, Port Snettisham.
Sweetheart Falls Creek, south arm of Port Snettisham.[4]
Port Houghton, Stephens Passage.
Farragut Bay, Frederick Sound.
Mill Creek, near Wrangell.[4]
Bradfield Canal, upper end of Cleveland Peninsula.
Smugglers Cove, southeast shore of Cleveland Peninsula.
Helm Bay, southeast shore of Cleveland Peninsula.
Shelockham Lake outlet, Bailey Bay.[4]
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.[4]
Kasnyku Bay, east coast.
Green Lake outlet, Silver Bay, west coast.[4]
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.

Admiralty Island.

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

Kosciusko Island.

Davidson Inlet.

Prince of Wales Island.

Karta River, Karta Bay.[4]
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.[4]
Beaver Falls, George Inlet.

---

[1] Gaging station maintained in 1908 and 1909 by Alaska-Treadwell Gold Mining Co.
[2] See list of miscellaneous measurements at end of report.
[3] Gaging station maintained since January, 1913, by the Speel River project of Juneau.
[4] Gaging station maintained by Geological Survey.

White River, George Inlet.
Creek, east shore near head of Carroll Inlet.[1]
Fish Creek, Thorne Arm.[2]
Gokatchin Creek, Thorne Arm.[1]
Ketchikan Creek, at Ketchikan.[2]

Annette Island.

Tamgas Harbor.

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.

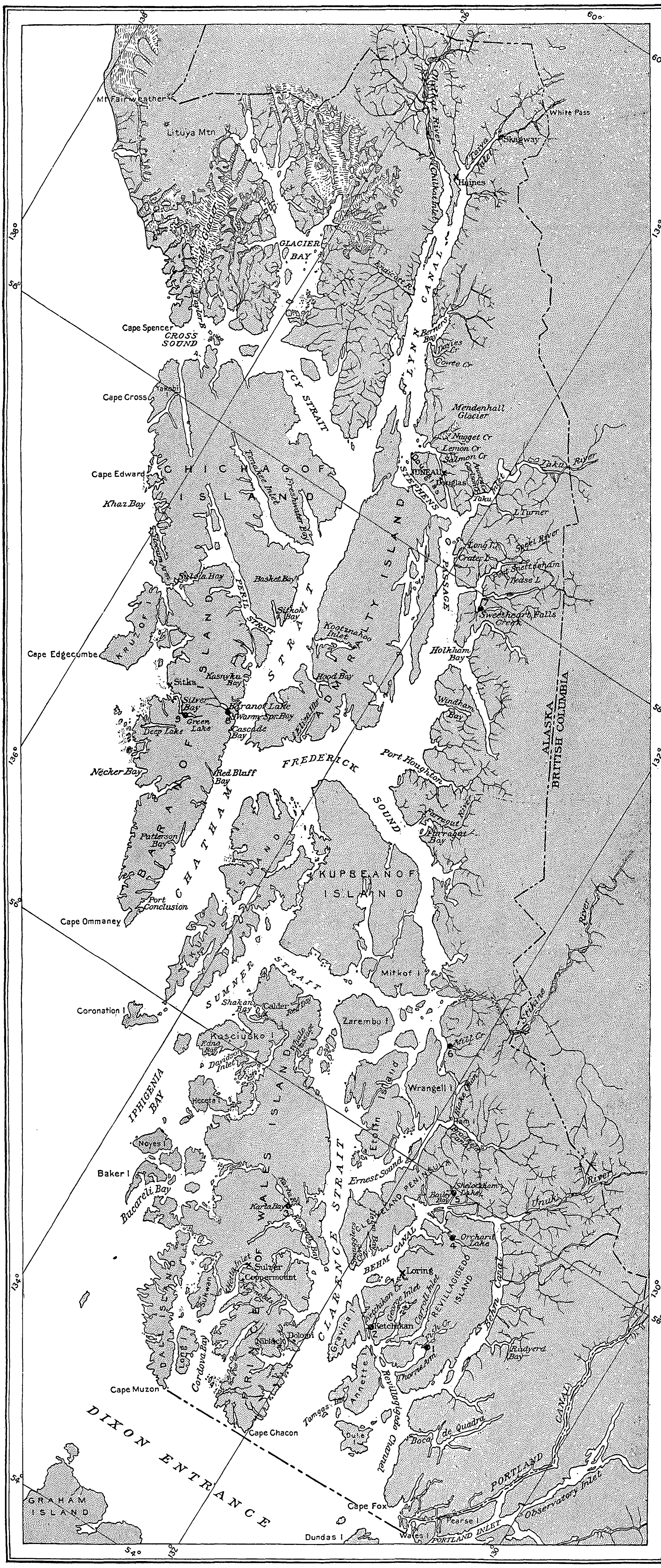
The practicability of a water-power site depends on (1) the quantity of water available, (2) the fall, and (3) the possibility of storing water. Information in regard to fall and storage can be obtained by surveys at any time, but the volume and distribution of flow can be determined only by observations 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 of the year. 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 nine gaging stations, as shown by the following list, and indicated by corresponding numbers on Plate IV. 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. Karta River at Karta Bay, Prince of Wales Island (July 16, 1915).
4. Orchard Lake outlet at Shrimp Bay, Revillagigedo Island (May 28, 1915).
5. Shelockham Lake outlet at Bailey Bay (June 4, 1915).
6. Mill Creek on mainland near Wrangell (June 17, 1915).
7. Sweetheart Falls Creek near Snettisham (July 31, 1915).
8. Baranof Lake outlet at Warm Spring Bay, Baranof Island (June 28, 1915).
9. Green Lake outlet at Silver Bay, near Sitka (Aug. 22, 1915).

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.

[1] See list of miscellaneous measurements at end of report.
[2] Gaging station maintained by Geological Survey.



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.

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 Mr. 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.

Assistance in measuring streams in the vicinity of Speel River has been furnished by W. P. Lass. The gage readings for Ketchikan Creek were furnished by J. C. Barber, manager of the Citizens Light, Power & Water Co., of Ketchikan.

STATION RECORDS.

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 February 29, 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 180 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 coarse gravel and bowlders; 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.

WINTER FLOW.—Discharge relation affected by ice.

ACCURACY.—Results apparently good, as control is permanent and rating curve fairly well defined.

The combined area of Little Salmon Lake at elevation 180 feet, and Salmon Lake at elevation 185 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.

Discharge measurements of Karta River at Karta Bay during the period July 1, 1915, to Feb. 29, 1916.

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

[a] Discharge relation affected by ice.

Daily discharge, in second-feet, of Karta River at Karta Bay for the period July 1, 1915, to Feb. 29, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1		48	150	540	1,920	1,020	206	30
2		46	200	385	1,340	1,330	172	29
3		44	300	290	1,000	1,540	152	29
4		44	400	285	987	1,330	138	29
5		44	510	305	1,000	1,390	128	27
6		44	350	296	834	1,980	121	27
7		118	283	258	631	1,860	112	26
8		356	278	416	489	1,100	106	26
9		695	253	650	375	720	106	24
10		1,200	215	643	316	517	103	22
11		1,080	180	750	299	387	103	21
12		1,170	160	750	278	305	100	32
13		1,170	138	882	1,090	253	100	172
14		1,130	125	1,000	1,680	215	100	132
15		987	115	2,120	1,400	206	97	278
16	88	695	109	3,000	960	351	97	580
17	88	524	103	1,960	870	375	94	679
18	83	419	100	1,240	843	475	88	566
19	76	328	91	1,150	671	601	83	608
20	74	268	88	1,490	653	852	81	679
21	69	220	81	1,310	987	987	74	566
22	74	184	78	1,010	852	915	71	447
23	76	156	76	1,000	843	738	66	363
24	76	135	71	1,050	746	679	60	334
25	71	121	74	960	655	531	54	328
26	66	112	120	1,170	531	426	48	299
27	64	97	197	1,170	440	433	44	273
28	60	88	360	1,620	432	363	39	253
29	58	81	830	1,460	789	305	32	224
30	54	88	770	1,050	754	268	30	.....
31	52	135	.....	1,350	.....	238	30	.....

NOTE.—Discharge determined from a rating curve well defined between 60 and 1,600 second-feet. Discharge July 1–15 estimated as 95 second-feet on basis of discharge measurement and climatic records. Sept. 1–6 and Sept. 23 to Oct. 18, gage clock not running; discharge estimated from maximum and minimum stages indicated by recording pencil and from comparison of hydrograph for this station with that for Fish Creek near Sea Level, Alaska. Jan. 8 to Feb. 16, discharge estimated because of ice, from climatic records and one discharge measurement.

Monthly discharge of Karta River at Karta Bay for the period July 1, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July	.....	52	82.5	5,070	B.
August	1,200	44	382	23,500	A.
September	830	71	227	13,500	C.
October	3,000	258	1,020	62,700	C.
November	1,920	278	822	48,900	B.
December	1,980	206	732	45,000	B.
January	206	30	91.5	5,630	C.
February	679	21	245	14,100	B.
The period	.....	.....	.....	218,000	

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 February 29, 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 (approximate discharge, computed from an extension of the rating curve, 3,700 second-feet); minimum stage recorded, 0.50 foot February 11 (discharge, 21 second-feet).

WINTER FLOW.—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.—Results apparently good, as control is permanent, rating curve fairly well defined, and gage-height record nearly unbroken.

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 Feb. 29, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 20	G. H. Canfield	1.48	328	Oct. 13	G. H. Canfield	2.53	1,120
July 10	do	1.01	118	Jan. 26	do	.64	42
Sept. 13	Hoyt and Canfield	1.04	129				

Daily discharge, in second-feet, of Fish Creek near Sea Level, for the period May 19, 1915, to Feb. 29, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1		270	143	84	127	632	1,010	660	158	34
2		312	134	78	150	455	1,070	804	143	31
3		324	134	73	250	346	780	764	134	31
4		384	130	69	590	329	660	668	124	30
5		425	127	67	700	362	639	625	114	28
6		413	124	69	569	351	583	780	107	27
7		401	124	73	425	334	455	772	102	26
8		548	124	152	334	488	413	569	91	25
9		507	124	340	285	764	285	425	84	23
10		407	120	1,190	235	756	230	334	76	22
11		351	117	1,720	190	876	199	265	73	22
12		312	117	1,470	174	876	178	217	71	35
13		285	112	1,620	143	1,030	340	178	69	204
14		255	104	1,170	124	1,120	455	154	67	190
15		250	99	1,060	117	2,510	527	154	65	488
16		285	96	892	124	3,160	455	158	65	1,110
17		296	91	632	130	1,950	500	204	64	1,170
18		270	84	474	130	1,230	534	250	64	740
19	362	245	82	378	127	999	488	290	62	576
20	340	270	78	307	117	1,320	455	329	60	724
21	356	660	76	250	112	1,520	494	395	58	604
22	356	716	117	204	101	1,220	407	462	55	488
23	334	541	178	170	96	884	362	437	51	407
24	307	413	204	140	91	732	318	425	48	351
25	285	340	194	127	94	668	270	340	45	302
26	290	285	170	104	166	812	226	285	41	260
27	334	245	147	101	235	945	226	340	40	230
28	362	199	127	107	445	1,120	260	275	38	204
29	351	178	112	104	945	1,170	312	226	38	174
30	307	158	96	96	900	884	520	204	37	.....
31	275	.....	91	96	.....	772	.....	182	35	.....

NOTE.—Discharge determined from a rating curve well defined between 40 and 1,500 second-feet. Sept. 6–12, gage clock not running, and Nov. 23 to Dec. 1, Jan. 2–5, Feb. 7–11, Feb. 18–29, paper not feeding; discharge estimated from maximum and minimum stages indicated by recording pencil and from climatic records.

Monthly discharge of Fish Creek near Sea Level for the period May 19, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 19–31	362	275	328	8,460	A.
June	716	158	352	20,900	A.
July	204	76	122	7,500	A.
August	1,720	67	433	26,600	A.
September	945	91	274	16,300	A.
October	3,160	329	988	60,800	B.
November	1,070	178	455	27,100	B.
December	804	154	393	24,200	A.
January	158	35	73.5	4,520	B.
February	1,170	22	295	17,000	C.
The period				213,000	

SHELOCKHAM LAKE OUTLET, BAILEY BAY.

LOCATION.—In latitude 56° 00′ N., longitude 131° 36′ W. on mainland near outlet of Shelockham 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.—Not measured.

RECORDS AVAILABLE.—June 1, 1915, to February 29, 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 falls forms an excellent and permanent control for the gage. At extreme high stages, the lake has another outlet about 200 feet to left of main outlet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 6.5 feet (estimated) October 15 (discharge, 2,440 second-feet); minimum flow, estimated from gage record and climatic data 8 second-feet February 11.

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

ACCURACY.—Rating curve well defined; results apparently fair.

Shelockham 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 sources of the tributary streams. Therefore, as there is little natural storage, after a heavy rainfall the run-off 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 during April, May, and June.

Discharge measurements of Shelockham Lake outlet at Bailey Bay during the period June 1, 1915, to Feb. 29, 1916.

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

[a] Measurement made from boat at cable site.

Daily discharge, in second-feet, of Shelockham Lake outlet at Bailey Bay for the period June 1, 1915, to Feb. 29, 1916.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1	325	91	24	.....	.....	480	94	33	10
2	310	91	21	.....	.....	334	222	28	10
3	300	89	20	.....	.....	248	268	27	10
4	295	85	18	.....	.....	258	245	25	10
5	278	91	18	.....	.....	241	200	25	9
6	265	102	22	.....	.....	191	250	24	9
7	312	109	39	.....	.....	144	280	23	9
8	352	96	.....	.....	.....	104	187	21	9
9	270	86	.....	.....	.....	81	125	20	9
10	222	75	.....	.....	.....	64	88	20	8
11	216	64	.....	.....	.....	57	66	18	8
12	216	55	.....	.....	.....	51	50	18	19
13	206	50	.....	.....	.....	86	41	18	107
14	185	44	.....	33	.....	175	39	17	172
15	198	41	.....	75	2,220	179	35	17	393
16	255	36	.....	94	1,030	158	44	16	407
17	227	34	.....	99	510	156	50	15	183
18	187	31	.....	96	347	177	56	15	120
19	158	28	.....	80	250	154	59	17	227
20	258	27	.....	72	338	127	66	18	450
21	448	27	.....	.....	379	121	89	18	325
22	325	43	.....	.....	325	110	101	17	216
23	232	57	.....	.....	262	91	91	14	136
24	179	60	.....	.....	320	97	83	14	96
25	166	55	.....	.....	339	102	66	13	63
26	158	47	.....	.....	580	88	56	12	55
27	131	42	.....	.....	450	81	60	12	51
28	113	37	.....	.....	620	69	52	12	48
29	102	32	.....	.....	456	68	42	11	45
30	94	28	.....	.....	288	64	40	11	.....
31	.....	26	.....	.....	292	.....	39	11	.....

NOTE.—Discharge determined from a rating curve well defined above 25 second-feet. June 1-3, discharge estimated; Aug. 8 to Sept. 14 and Sept. 21 to Oct. 4, gage clock stopped; discharge estimated by comparison of hydrograph for this station with that for station at Orchard Lake outlet; Jan. 23 to Feb. 29, ice in gage well; discharge estimated from climatic records at Ketchikan and from comparison of hydrograph for this station with that for Orchard Lake outlet.

Monthly discharge of Shelockham Lake outlet at Bailey Bay for the period June 1, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	448	94	233	13,900	A.
July	109	26	57.4	3,530	A.
August	.....	.....	128	7,870	C.
September	.....	.....	100	5,950	C.
October	2,220	.....	401	24,700	B.
November	480	51	145	8,630	A.
December	280	35	103	6,330	A.
January	33	11	18.1	1,110	B.
February	450	8	111	6,380	D.
The period	.....	.....	.....	78,400	

BARANOF LAKE OUTLET AT WARM SPRING BAY, 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 February 29, 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, bowlders, 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 (approximate 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.

WINTER FLOW.—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.—Rating curve well defined, control permanent and not affected by ice in winter; results apparently good.

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 Feb. 29, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 28	Canfield and Drake.....	2.70	608	Sept. 28	Canfield and Gardner....	4.05	1,700
Sept. 4	Canfield and Peterson...	2.78	621	Dec. 9	G. H. Canfield.....	1.79	255
27	Canfield and Gardner...	3.12	833	Feb. 13	.....do.....	.35	28.5

Daily discharge, in second-feet, of Baranof Lake outlet at Baranof for the period June 28, 1915, to Feb. 29, 1916.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1	.....	725	615	400	650	433	125	70	28
2	.....	820	525	1,000	485	375	185	64	28
3	.....	788	477	1,000	437	405	361	56	28
4	.....	788	453	640	900	497	525	52	28
5	.....	1,100	453	497	892	453	473	50	28
6	.....	1,480	477	425	548	335	525	46	28
7	.....	1,050	636	457	495	269	473	42	28
8	.....	788	867	453	695	222	335	40	28
9	.....	695	2,100	405	586	185	248	40	28
10	.....	615	3,000	357	505	161	208	39	28
11	.....	568	.....	326	725	141	163	40	28
12	.....	640	.....	305	755	125	133	39	28
13	.....	668	.....	397	926	200	112	39	27
14	.....	695	.....	616	764	299	101	39	27
15	.....	668	.....	890	1,050	296	94	39	34
16	.....	695	.....	788	755	269	114	39	39
17	.....	695	.....	615	615	284	118	40	41
18	.....	640	.....	485	485	255	119	40	62
19	.....	640	.....	445	389	215	131	40	102
20	.....	640	.....	525	378	212	195	38	145
21	.....	695	.....	525	305	266	190	37	137
22	.....	725	.....	425	255	235	179	36	120
23	.....	695	.....	344	304	220	161	35	107
24	.....	640	.....	430	615	190	161	33	90
25	.....	615	.....	920	568	167	141	33	80
26	.....	695	.....	1,100	453	147	120	32	73
27	.....	788	.....	890	405	122	116	31	66
28	590	820	.....	1,420	545	119	102	30	62
29	590	890	.....	1,480	525	125	90	30	57
30	640	855	.....	1,000	385	122	88	29	.....
31	.....	725	.....	.....	344	.....	80	28	.....

NOTE.—Discharge determined from a rating curve well defined below 800 second-feet. Aug. 11 to Sept. 3 gage clock stopped; discharge estimated by comparison of hydrograph at this station with those for other Alaska stations, from climatic data, and from minimum stage indicated by recording pencil. Aug. 11–31 estimated 886 second-feet. Jan. 20 to Feb. 13 water frozen in well; discharge estimated from climatic records and discharge measurement of Feb. 13.

Monthly discharge of Baranof Lake outlet at Baranof for the period June 28, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June 28–30	640	590	607	3,610	
July	1,480	568	759	46,700	A.
August	3,000	.....	910	56,000	C.
September	1,480	305	652	38,800	A.
October	1,050	255	572	35,200	A.
November	497	119	245	14,600	A.
December	525	80	199	12,200	A.
January	70	28	40.2	2,470	B.
February	145	27	55.3	3,180	B.
The period	.....	.....	.....	213,000	

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, and arm of Behm Canal, 46 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 28, 1915, to February 29, 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. Gage heights May 29 to August 10 referred to old datum; August 11 to February 29, 1916, to new 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 and is probably permanent.

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

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

ACCURACY.—Results apparently good. Rating curve for new datum well defined for all stages; position of curve for old datum estimated by means of the new curve; three discharge measurements made before dam went out.

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 Shelockham 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 during the period May 28, 1915, to Feb. 29, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 29	G. H. Canfield	2.88	444	Oct. 16	G. H. Canfield	7.58	5,280
July 8	Canfield and Gardner	1.96	248	16	do	6.78	4,270
Aug. 7	Gardner and Williams	.90	145	17	do	5.22	2,720
Sept. 15	Hoyt and Canfield	[a] 1.40	341	Jan. 20	do	− .34	36
16	do	1.71	428				

[a] Datum of gage lowered 2 feet Sept. 15 previous to making discharge measurement.

Daily discharge, in second-feet, of Orchard Lake outlet at Shrimp Bay for the period May 28, 1915, to Feb. 29, 1916.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1		362	271	170	159	640	1,260	320	122	29
2		362	271	161	239	406	1,000	974	118	28
3		373	280	151	488	299	710	1,130	116	28
4		422	263	145	610	372	710	930	112	27
5		450	263	135	570	478	690	690	108	25
6		495	271	134	453	385	630	975	103	24
7		580	263	146	374	336	551	944	98	23
8		620	252	240	310	806	460	611	94	22
9		528	242	792	257	1,280	412	403	88	22
10		480	227	3,480	208	930	382	299	84	21
11		480	219	4,700	188	1,400	382	232	79	20
12		495	209	2,550	180	1,260	368	192	75	62
13		480	202	1,980	159	1,520	570	157	70	150
14		436	196	1,200	161	1,300	710	138	65	240
15		450	193	1,250	317	4,140	532	124	60	781
16		800	194	1,020	427	4,990	421	135	54	1,040
17		700	197	616	368	2,430	444	142	48	672
18		580	191	418	329	1,170	551	174	43	478
19		480	183	334	276	830	460	208	41	726
20		465	178	272	232	1,260	412	283	37	1,130
21		700	176	228	202	1,320	525	434	36	780
22		680	262	198	178	1,010	444	450	36	570
23		545	385	178	155	880	346	403	36	418
24		465	373	159	138	930	344	354	35	336
25		410	318	150	232	955	336	290	35	301
26		410	271	142	354	1,570	294	235	35	272
27		350	248	136	385	1,260	241	232	34	239
28	465	308	224	133	1,010	1,840	204	214	34	212
29	450	280	208	126	1,720	1,480	218	174	33	184
30	422	271	195	133	1,090	951	239	157	32	.....
31	373	.....	183	198	.....	805	.....	140	30	.....

NOTE.—Discharge May 28 to Aug. 10 determined from a rating curve well defined below 2,000 second-feet, and Aug. 11 to Feb. 29, from a well-defined rating curve, except as follows: Float resting in bottom of well Aug. 22 to Sept. 2; discharge estimated from precipitation records and slope of hydrographs for periods prior to Aug. 22 and after Sept. 2. Counterpoise caught Nov. 3-16; discharge estimated from climatic records and minimum stage indicated by the recorder. Ice in well, Jan. 3 to Feb. 13; discharge estimated from climatic records and one discharge measurement.

Monthly discharge of Orchard Lake outlet at Shrimp Bay for the period May 28, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 28-31	465	373	428	3,400	
June	800	271	482	28,700	B.
July	385	176	239	14,700	B.
August	4,700	126	699	43,000	B.
September	1,720	138	392	23,300	B.
October	4,990	299	1,270	78,100	A.
November	1,260	204	495	29,500	C.
December	1,130	124	392	24,100	A.
January	122	30	64.2	3,950	D.
February	1,130	20	306	17,600	B.
The period	.....	.....	.....	266,000	

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 February 29, 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 once daily between 7 and 8 a. m. 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 year (June 9 to December 31), 7 feet August 10 (discharge, 2,140 second-feet); minimum stage recorded, 0.28 foot September 24 (discharge, 34 second-feet).

1909–1915: Maximum stage recorded, 8.2 feet December 2, 1911 (discharge, 2,700 second-feet); minimum stage recorded, 0.28 foot September 24, 1915 (discharge, 34 second-feet).

WINTER FLOW.—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 above gage but causes very little diurnal fluctuation. During low water the flow is increased by water from the reservoir.

ACCURACY.—Results apparently fair. Control is well defined, but the conditions for making discharge measurements are poor. The rating curve is defined by discharge measurements only to gage height 3.0 feet but is extended to gage height 8.2 feet.

COOPERATION.—Gage read by the Citizens Light, Power & Water Co.

Discharge measurements of Ketchikan Creek at Ketchikan during the period June 9, 1915, to Feb. 29, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 9	G. H. Canfield.....	1.15	145	Oct. 30	Canfield and Wyckoff..	1.58	232
July 17	Canfield and Drake....	.60	64	Jan. 15	Canfield and Gardner..	.35	38
Sept. 12	Hoyt and Canfield.....	.43	63	27	G. H. Canfield.....	.44	50
Oct. 27	Canfield and Wyckoff..	2.82	522				

NOTE.—Discharge measurements include either measured or estimated flow of Schoenbar Creek.

Daily discharge, in second-feet, of Ketchikan Creek at Ketchikan for years ending Sept. 30, 1910–1912, and July, 1915, to February, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1909–10.												
1	.....	635	77	54	77	40	146	155	255	266	300	213
2	.....	518	77	54	224	44	98	155	277	234	1,320	164
3	.....	300	60	54	155	70	90	174	255	213	635	137
4	.....	200	50	44	174	100	80	174	234	244	323	184
5	.....	200	49	77	323	130	70	244	234	369	255	164
6	.....	121	44	70	193	160	60	260	193	369	203	155
7	.....	84	44	49	121	190	44	288	193	277	193	213
8	.....	70	44	59	91	200	70	213	518	244	203	105
9	.....	59	40	59	85	213	105	184	492	266	164	98
10	.....	49	40	80	84	270	77	234	323	277	137	98
11	.....	44	44	244	60	323	44	234	277	323	121	77
12	.....	44	44	105	49	442	105	288	277	865	121	77
13	.....	44	64	77	45	323	121	417	442	1,690	137	77
14	.....	44	266	60	44	288	98	266	544	635	213	64
15	.....	44	288	50	40	320	277	417	442	346	213	64
16	.....	44	203	40	40	369	210	417	467	234	213	70
17	.....	44	129	137	36	518	155	266	442	203	213	174
18	.....	44	98	70	36	520	137	255	277	193	213	234
19	.....	44	77	60	38	518	105	203	255	184	137	244
20	.....	44	54	50	40	369	121	234	277	184	121	193
21	.....	44	50	49	40	266	160	266	277	193	121	155
22	.....	44	49	45	36	213	203	255	300	467	121	193
23	.....	44	44	44	36	137	277	266	255	417	105	146
24	.....	44	40	40	36	160	137	266	300	288	91	121
25	.....	44	40	36	36	193	121	255	288	442	91	193
26	.....	100	40	49	36	137	137	312	300	234	91	164
27	.....	193	40	113	38	113	174	492	266	288	155	164
28	.....	300	40	64	40	91	203	442	255	213	137	234
29	.....	200	77	224	.....	137	164	417	277	234	417	467
30	.....	105	64	98	.....	121	146	369	323	234	442	635
31	.....	.....	54	70	.....	155	.....	300	.....	203	277	.....
1910–11.												
1	417	121	77	288	40	60	70	121	288	288	155	174
2	795	346	64	417	40	50	64	174	266	266	164	184
3	635	244	54	442	40	50	64	288	224	244	155	129
4	467	155	54	467	40	40	64	312	193	234	155	121
5	442	244	54	277	80	40	64	244	288	266	155	121
6	369	146	54	234	80	40	64	184	266	277	146	98
7	312	121	54	121	80	40	64	121	224	277	155	91
8	635	137	64	91	80	40	64	121	369	266	137	98
9	417	105	64	91	80	40	59	346	323	277	121	91
10	323	98	64	91	80	60	49	323	234	288	121	91
11	213	64	77	91	70	60	49	213	1,040	266	121	91
12	146	64	442	91	70	150	49	174	900	203	121	91
13	467	442	224	91	60	200	54	164	518	193	121	98
14	417	467	467	90	60	200	54	155	369	193	105	492
15	346	244	900	90	50	180	244	234	323	203	105	346
16	244	277	830	80	40	170	213	255	312	213	98	323
17	164	312	492	80	40	160	70	346	266	244	98	213
18	417	193	1,240	60	80	146	121	255	255	255	98	346
19	1,440	105	760	50	80	137	346	213	244	255	98	255
20	665	369	518	50	60	98	795	442	213	255	98	213
21	727	417	255	40	50	84	727	300	224	213	91	174
22	417	369	224	40	50	91	213	213	224	234	91	137
23	369	346	255	40	120	121	174	174	224	1,120	91	129
24	234	255	312	40	100	91	164	193	213	695	91	174
25	213	105	255	40	80	91	146	213	213	417	91	193
26	234	98	266	40	80	77	121	234	224	255	84	224
27	1,120	91	203	40	80	84	105	213	277	193	121	184
28	1,820	64	193	40	70	121	105	193	266	174	174	266
29	544	64	492	40	.....	105	105	346	266	164	174	193
30	369	54	518	45	.....	121	121	346	266	164	146	146
31	203	.....	255	45	.....	84	.....	381	.....	155	164	.....

Daily discharge, in second-feet, of Ketchikan Creek at Ketchikan, for years ending Sept. 30, 1910–1912, and July, 1915, to February, 1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
1911–12.									
1	137	121	570	91	277	77	174	91	193
2	121	155	2,700	91	213	77	105	84	174
3	105	121	1,480	84	155	64	121	146	155
4	213	137	518	77	129	64	105	203	121
5	277	155	300	77	121	64	155	244	129
6	393	105	213	77	105	54	164	323	121
7	346	105	442	77	105	54	121	255	137
8	277	105	417	77	174	54	98	164	105
9	174	91	234	70	234	54	91	155	113
10	174	77	255	64	300	54	98	146	84
11	155	64	442	64	312	54	70	155	77
12	155	64	518	64	393	49	77	184	105
13	121	64	323	64	467	49	64	213	113
14	155	54	277	64	544	49	77	244	113
15	213	54	255	64	570	44	77	234	105
16	137	121	164	64	164	44	84	203	105
17	155	255	193	64	137	44	77	193	105
18	121	277	213	64	121	44	77	174	113
19	323	113	203	64	105	44	64	184	105
20	193	113	193	84	105	44	64	184	105
21	155	105	234	417	300	44	64	193	105
22	121	213	224	323	174	44	64	174	113
23	121	442	203	174	121	44	64	174	91
24	121	393	174	193	121	44	64	155	91
25	121	300	121	417	155	40	64	174	91
26	105	224	105	234	121	44	64	193	84
27	105	213	98	213	91	193	91	184	84
28	105	174	98	255	91	105	121	137	77
29	105	213	91	224	64	64	77	121	77
30	91	277	91	213	.....	91	137	155	77
31	91	.....	91	417	.....	105	.....	174	.....

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1915–16.								
1	83	58	325	69	234	492	80	40
2	83	58	518	54	203	518	72	40
3	80	60	544	77	213	492	69	40
4	77	54	213	213	288	417	66	40
5	85	44	115	105	346	288	66	40
6	83	41	77	83	277	346	60	40
7	105	64	85	64	193	234	57	40
8	193	442	99	266	184	164	54	40
9	137	369	77	174	155	111	51	40
10	121	2,140	60	155	105	99	47	40
11	99	795	54	266	99	83	43	40
12	83	492	48	266	77	58	40	80
13	77	518	44	760	518	54	40	200
14	72	277	42	300	442	60	40	570
15	69	1,600	54	1,320	300	62	40	417
16	64	300	46	900	518	105	40	137
17	64	121	42	369	300	88	40	120
18	60	99	41	467	300	155	40	100
19	60	69	41	234	224	164	40	100
20	60	62	39	635	184	193	40	100
21	58	46	38	695	277	193	40	100
22	193	46	36	417	234	213	40	100
23	105	46	34	255	174	193	40	100
24	77	44	34	277	193	193	40	100
25	64	41	64	288	174	155	40	100
26	64	41	56	288	137	99	45	80
27	62	41	41	277	90	94	48	80
28	60	41	56	467	100	83	45	80
29	60	41	77	492	244	83	40	80
30	58	41	83	234	91	80	40	.....
31	58	255	.....	277	.....	80	40	.....

NOTE.—Discharge determined from a rating curve fairly well defined between 40 and 800 second-feet. 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, Feb. 17 to Mar. 3, and Mar. 5–7, 1916.

Monthly discharge of Ketchikan Creek at Ketchikan for years ending Sept. 30, 1910–1912, and July, 1915, to February, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1910–11.				
November	635	44	126	7,500
December	288	40	75.2	4,620
January	244	36	75	4,610
February	323	36	80.5	4,470
March	518	40	230	14,100
April	277	44	131	7,800
May	492	155	281	17,300
June	544	193	317	18,900
July	1,690	184	349	21,500
August	1,320	91	241	14,800
September	635	64	176	10,500
The period				126,000
1911–12.				
October	1,820	146	503	30,900
November	467	54	204	12,100
December	1,240	54	316	19,400
January	467	40	121	7,440
February	120	40	67.1	3,730
March	200	40	97.8	6,010
April	795	49	153	9,100
May	442	121	241	14,800
June	1,040	193	317	18,900
July	1,120	155	282	17,300
August	174	84	124	7,620
September	492	91	183	10,900
The year	1,820	40	219	158,000
1912–13.				
October	393	91	167	10,300
November	442	54	164	9,760
December	2,700	91	369	22,700
January	417	64	146	8,980
February	570	64	206	11,800
March	193	40	61.3	3,770
April	174	64	92.4	5,500
May	323	64	181	11,100
June	193	77	109	6,490
The period				90,300
1915–16.				
July	193	58	84.3	5,180
August	2,140	41	268	16,500
September	544	34	103	6,130
October	1,320	54	347	21,300
November	518	77	224	13,300
December	518	54	182	11,200
January	80	40	47.8	29,400
February	570	40	106	6,100
The period				109,000

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, 1905.

RECORDS AVAILABLE.—July 31, 1915, to February 29, 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 (approximate discharge, computed from an extension of the rating curve, 2,100 second feet); minimum flow, estimated from discharge measurement and climatic data, 15 second-feet February 11.

WINTER FLOW.—Discharge relation not seriously affected by ice.

ACCURACY.—Results apparently excellent for stages below 2 feet, those for higher stages only approximate, as the rating curve is extended by estimation.

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 Feb. 5, 1916.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1908.	*Feet.*	*Sec.-ft.*	1909.	*Feet.*	*Sec.-ft.*	1911.	*Feet.*	*Sec.-ft.*
July 31	1.95	520	Nov. 13	1.07	195	Feb. 5	[a] 0.33	17.8
Aug. 29	1.49	329	Dec. 14	.53	82			

[a] Discharge relation affected by ice.

Daily discharge, in second-feet, of Sweetheart Falls Creek near Snettisham for the period July 31, 1915, to Feb. 29, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1	.....	478	298	825	180	105	55	22
2	.....	412	595	545	188	140	50	21
3	.....	361	1,060	424	234	145	48	21
4	.....	335	955	585	280	136	48	19
5	.....	328	661	639	260	124	49	19
6	.....	328	495	466	240	134	47	18
7	.....	324	412	380	220	161	43	18
8	.....	316	335	346	200	132	42	18
9	.....	335	284	284	180	106	45	18
10	.....	453	247	324	160	87	47	18
11	.....	535	222	530	140	94	47	18
12	.....	955	202	617	130	87	45	18
13	.....	1,740	194	717	188	82	46	18
14	.....	1,940	247	922	270	81	43	18
15	.....	1,740	432	1,460	247	82	42	20
16	.....	1,460	612	1,160	205	82	39	23
17	.....	890	606	825	170	87	38	26
18	.....	622	510	545	165	99	38	29
19	.....	482	515	400	140	105	36	33
20	.....	400	722	316	130	97	34	36
21	.....	354	922	257	143	99	31	40
22	.....	316	666	211	138	108	30	45
23	.....	291	474	180	124	116	29	56
24	.....	284	453	158	114	99	29	54
25	.....	354	678	147	105	86	29	47
26	.....	420	825	147	101	82	29	36
27	.....	384	678	151	97	90	28	29
28	.....	354	922	163	94	79	26	29
29	.....	335	1,500	194	87	69	25	32
30	.....	328	1,300	180	99	70	25	.....
31	525	305	.....	158	.....	65	23	.....

NOTE.—Discharge determined from a rating curve well defined between 70 and 600 second-feet. Nov. 5-11, gage clock not running; discharge estimated. Jan. 19 to Feb. 29, discharge estimated because of ice, from one discharge measurement and climatic records.

Monthly discharge of Sweetheart Falls Creek near Snettisham, for the period July 31, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 31			525	1,040	
August	1,940	284	586	36,000	B.
September	1,500	194	601	35,800	B.
October	1,460	147	460	28,300	A.
November	280	87	168	10,000	B.
December	161	65	101	6,210	A.
January	55	23	38.3	2,360	B.
February	56	18	27.6	1,590	D.
The period				121,000	

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.—48 square miles (measured on U. S. Coast and Geodetic Survey chart No. 8200).

RECORDS AVAILABLE.—June 17, 1915, to February 29, 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 bowlders 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 very sensitive control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 8.0 feet October 16 (approximate discharge, computed from extension of rating curve, 3,160 second-feet); minimum stage recorded, 0.02 foot February 11 (discharge, 15 second-feet).

WINTER FLOW.—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.—Records apparently fair. The rating curve is well defined to a stage of 2.5 feet, above which it is extended by estimation and the recorded discharge is only approximate.

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 19, 1915, to Feb. 29, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 19	Canfield and Allen	2.54	477	Feb. 1	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				

Daily discharge, in second-feet, of Mill Creek near Wrangell for the period June 17, 1916, to Feb. 29, 1916.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1	.....	418	421	421	575	299	125	69	21
2	.....	469	370	610	370	273	376	62	19
3	.....	492	325	1,810	294	299	525	57	18
4	.....	466	294	1,310	510	400	454	55	18
5	.....	510	278	770	645	430	340	54	18
6	.....	575	355	558	415	325	253	54	17
7	.....	454	451	492	286	236	370	51	17
8	.....	394	610	406	427	294	340	45	16
9	.....	394	870	355	610	142	219	43	15
10	.....	325	1,610	309	475	128	156	41	14
11	.....	291	1,510	268	850	118	128	41	14
12	.....	331	1,560	236	810	109	110	42	20
13	.....	376	1,910	236	1,240	153	100	40	22
14	.....	385	1,310	409	1,110	286	87	42	26
15	.....	349	1,460	872	2,120	312	87	40	72
16	.....	358	850	830	2,620	243	82	40	253
17	662	373	540	592	1,480	190	90	37	205
18	575	355	540	492	715	194	105	36	168
19	492	340	460	379	575	190	120	32	376
20	525	358	394	400	540	170	135	32	715
21	645	409	355	698	510	212	150	30	412
22	525	510	325	492	475	212	164	30	263
23	451	525	320	343	445	160	144	29	200
24	424	492	340	312	415	139	124	29	170
25	445	454	385	790	385	137	107	28	168
26	469	525	409	715	355	130	98	28	160
27	397	610	331	510	325	118	97	27	140
28	349	610	312	830	325	107	88	25	124
29	346	558	340	1,460	325	102	83	25	109
30	382	525	355	1,040	299	114	80	24	.....
31	.....	463	394	.....	299	.....	74	22	.....

NOTE.—Discharge determined from a rating curve well defined below 600 second-feet. Gage not working properly Oct. 5 to Nov. 2 (paper not feeding); discharge estimated from maximum and minimum stages indicated by recorder, from comparison of hydrograph for this station with those for Orchard Lake outlet and Sweetheart Falls Creek, and from climatic records. Dec. 18–21 (paper wound on drum and clock stopped), discharge interpolated. Water frozen in well Jan. 23 to Feb. 11; discharge estimated from one discharge measurement and climatic records.

Monthly discharge of Mill Creek near Wrangell, for the period June 17, 1915, to Feb. 29, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June 17–30	662	346	478	13,300	A.
July	610	291	442	27,200	A.
August	1,940	278	647	39,700	B.
September	1,780	236	632	37,600	B.
October	2,620	286	672	41,300	D.
November	430	102	207	12,300	B.
December	525	74	175	10,800	B.
January	69	22	39.0	2,400	B.
February	715	14	131	7,540	B.
The period	.....	.....	.....	192,000	

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 February 29, 1916.

GAGE.—Stevens water stage recorder on right bank at outlet of lake, reached by a 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 STAGE.—Maximum stage recorded during period, 8.15 feet at midnight October 15; minimum stage, estimated from known stage January 15, and climatic data, −1.5 feet February 4.

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

Data insufficient for estimate of daily and monthly discharge.

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 70 acres.

Discharge measurements of Green Lake outlet at Silver Bay, near Sitka, during the period Aug. 22, 1915, to Feb. 29, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Aug. 22	G. H. Canfield	[a] 2.39	259	Dec. 6	G. H. Canfield	2.15	261
Nov. 22	do	1.18	136	Feb. 16	do	.47	96

[a] A tree top lodged on the control caused backwater of 0.2 foot at gage.

Daily gage height, in feet, of Green Lake outlet at Silver Bay, near Sitka, for the period Aug. 22, 1915, to Feb. 29, 1916.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.
1		2.50	4.09		0.31		16		5.51	4.55		0.10	0.50
2		5.52	2.85		.98		17		3.88			.15	.12
3		4.75	2.78		1.90		18		3.18			.42	1.32
4		3.24	4.07		2.27		19		2.76			.72	2.42
5		2.47	6.00		1.80		20		3.70			1.40	2.39
6		2.12	3.56		2.00		21		3.54			.98	1.43
7		2.05	2.37		2.25		22	2.40	2.64		1.25	.83	.90
8		1.93	2.73		1.50		23	2.50	1.98		.97	.85	.58
9		1.79	3.04		.90		24	2.59	2.00		.82	.56	.41
10		1.60	2.60		.55		25	2.78	5.30		.67	.27	.40
11		1.50	5.28		.33		26	3.12	6.80		.55	.18	.36
12		1.46	5.12		.19		27	2.72	4.60		.40	.22	.32
13		2.50	6.10		.08		28	3.07	4.16		.27	.17	.22
14		5.37	5.88		.05		29	3.48	7.25		.24	.22	.08
15		7.30	6.40		.05	0.50	30	3.60	5.80		.26	.02	
							31	2.96				.00	

NOTE.—No gage records Oct. 17 to Nov. 21; gage clock stopped. Water below bottom of well Jan. 1 to Feb. 14; gage read −0.70 foot Jan. 15.

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
Aug. 3	Crater Lake outlet	Port Snettisham	Gaging station at outlet of Crater Lake, Speel River project.	2.49	397
4	Long Lake outlet	Speel River	Gaging station at outlet of Long Lake, Speel River project, on mainland.	2.82	981
1916.					
Jan. 11	Unnamed Creek	Carroll Inlet	1 mile upstream from beech, on east shore and 1 mile from head of Carroll Inlet, Revillagigedo Island.	.....	64
26	Gokatchin Creek	Thorne Arm	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.	.....	24
4	Crater Lake outlet	Port Snettisham	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	Low tide at mouth of stream between Point Salisbury and Point Bishop north shore Stephens Passage, 11 miles southeast of Juneau.	.....	3.2
7	Rhein Creek	....do....	....do....	.....	1.6