MINING IN SOUTHEASTERN ALASKA.

By Adolph Knopf.

INTRODUCTION.

The condition of the mining industry of southeastern Alaska during 1909, gaged by the production of gold, silver, and copper, remained substantially the same as in 1908. But in other respects the year marked a considerable advance. The main line of development consisted in the initiation of large enterprises designed to exploit extensive low-grade ore bodies and in the continuous improvement in the power-producing facilities of the large mines already in operation, notably at the Treadwell group and at the Perseverance mine. The final settlement of the protracted litigation that involved a large number of valuable properties at Berners Bay will allow the development of that important district. The building of the government trail from Juneau to Eagle River and the new strikes at Auk Bay have served to stimulate the interest of the prospector in the Juneau gold belt. All these facts point to a considerable activity during 1910.

GOLD MINES AND PROSPECTS.

PRODUCTION.

The following table gives the tonnage of gold ore mined in southeastern Alaska in 1907 and 1908 and its content of precious metals. According to preliminary estimates, the production for 1909 was about 20 per cent greater than that for 1908.

Production of gold ore in southeastern Alaska.

Year.	Ore mined.	Gold.		Silver.		Average value per ton.
		Amount.	Value.	Amount.	Value.	
	Tons.	*Ounces.*		*Ounces.*		
1907	1,206,639	132,300	$2,734,885	22,203	$14,653	$2.28
1908	1,475,516	161,975	3,348,312	31,834	16,872	2.28

JUNEAU DISTRICT.

DOUGLAS ISLAND.

The only productive properties on Douglas Island are the four mines of the Treadwell group. A large proportion of the gold in the ore milled is locked up in the sulphurets, amounting to as much as 46 per cent in the concentrates of the Alaska-Treadwell mine, and investigations, which have now been in progress for some time, were therefore instituted to devise a method of recovery that would render shipment of the sulphurets to the smelter at Tacoma unnecessary. The investigations, involving a process of tube milling to 200-mesh, followed by amalgamation and cyanidation, have now reached the stage of an experimental 10-ton plant. Two buildings large enough for the installation of a 100-ton plant have been constructed.

The cost of power is being steadily reduced from year to year. A central power plant to generate electric power is under construction, and two steam turbines, direct connected to two 750-kilowatt generator units, will be installed. The water rights on Sheep Creek were acquired and the water will be used to generate hydro-electric energy, which will be transmitted across Gastineau Channel by cable. The Ready Bullion dam, which is designed to furnish 500 horsepower for the Mexican and Ready Bullion mills, is nearing completion and will have a storage capacity of seventy days.

At the Alaska-Treadwell, which is the deepest mine of the Treadwell group, the shaft has been sunk a distance of 300 feet and a station cut out at the 1,800-foot level. From the shaft station on the 1,450-foot level, which is at that point 181 feet in the foot-wall country rock of the lode, the main crosscut has been driven to the hanging wall of the ore body and the ore has been developed by drifts and raises. The ore on the 1,450-foot level has been found to be as good as or even better than any other in the history of the mine. The ore mined during the year came principally from the 1,050-foot, 1,250-foot, and 1,450-foot levels, and in part from the higher levels.

The main shaft of the Seven Hundred Foot mine has now attained a total depth of 1,303 feet. Shaft stations were cut at the 1,050-foot and 1,250-foot levels and connect with the corresponding levels of the Treadwell mine.

At the Alaska-Mexican mine the shaft has been sunk 330 feet deeper, giving it a depth of approximately 1,450 feet, and ore was partly developed on the 1,210-foot level. The ore sent to the mill during the year was derived principally from the 990-foot level.

The Ready Bullion shaft has now been sunk a distance of 1,985 feet along the incline. The ore milled during the year was taken mainly from the 1,350-foot and 1,500-foot levels. Shaft stations have been cut on the 1,650-foot and 1,800-foot levels, and ore has been partly developed on the 1,650-foot level.

At Nevada Creek the Alaska Treasure Consolidated Mines Company employed a force of 25 men in driving a double-track tunnel 3,000 feet long to undercut an ore body at a depth of 700 feet. The deposit exposed on the surface is described by Spencer[a] as a mineralized greenstone cut by veinlets of albite, accompanied by pyrite, galena, sphalerite, and chalcopyrite.

GOLD CREEK MINES.

The two mines operating on Gold Creek are situated on the slopes surrounding Silverbow Basin at the head of the stream. They are working on large low-grade deposits consisting mainly of black slate that is cut by short irregular stringers and veins of quartz carrying sufficient values to make ore of the whole mass of slate and quartz.

Operations for the season were commenced at the Perseverance mine on May 28. A crew of 80 men was employed, and the 100 stamps were kept dropping during the summer and fall months. The main development work has consisted in extending the stopes 500 feet along the trend of the lode, and this work will be continued during the winter months. An increase of the power facilities has been under contemplation for a number of years, and some progress toward this end has been accomplished during the last year. A producer-gas power plant has been partly installed on the shore of Gastineau Channel, and poles for the electric transmission line have been put in place.

Mining was resumed at the Alaska-Juneau mine, the mainland property controlled by the management of the Treadwell group, early in June. Thirty men were employed, and the 30-stamp mill was kept in continuous operation. About 4,000 tons of ore were milled per month. The ore was extracted partly from open pits and partly from a "glory hole." The practice of sorting the ore, whereever feasible, was begun this year, and the mill returns show that the value of the ore was thereby doubled over that of previous years.

The Ebner and Hallam properties were taken over by a holding company known as the California and Nevada Copper Company. Several men were employed on surface work, such as the construction of trails and the stripping of ore bodies. Thorough sampling to serve as a guide to future development was in progress during the latter half of the year.

At the Nowell placer, in Silverbow Basin, mining was carried on by a lessee employing a force of six men. The large amount of bowlders and a long tail race with insufficient grade to dispose of the tailings hampered the profitable exploitation of the placer.

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[a] Spencer, A. C., The Juneau gold belt, Alaska: Bull. U. S. Geol. Survey No. 287, 1906, p. 92.

BERNERS BAY REGION.

GENERAL STATEMENT.

The term Berners Bay region is usually applied to the long tapering peninsula lying between Berners Bay and Lynn Canal. This peninsula is the most important mining region north of Juneau. The geologic features have been briefly described by Spencer,[a] whose studies were of a hasty reconnaissance character. The writer was engaged during a part of the summer of 1909 in a detailed study of the geology of the region and the new facts elicited by that investigation are believed to deserve presentation here in summary form. A detailed report is in preparation.

GEOLOGY.

A formation consisting preponderantly of slates and graywackes occupies the largest part of the Berners Bay area. Some metamorphosed andesites (greenstones) and quartz porphyry schists are associated with it, but are of negligible importance. The slates are mainly black clay slates but include some of green and, to a less extent, some of red color. The graywackes are intimately interstratified with the slates in beds ranging from a few inches to 8 feet in thickness and are commonly gray or greenish gray. They are roughly schistose and in the thicker beds nearly massive.

These rocks have been profoundly folded and closely compressed, and the axes of folding have also been acutely folded and in places pitch vertically. In consequence of this severe folding of the axes it happens that at many places closely adjacent strata show an angular discordance of strike. Ordinarily this would be taken to indicate a fault of some magnitude, but in the shore cliffs, where the geologic relations are perfectly exposed, that feature can be seen to be due to the vertical attitude of appressed folds. Subsequent to the complex folding of the rocks a cleavage was induced in them, commonly coinciding with the stratification and trending N. 75° W. (magnetic). In places, such as in the arches of folds standing on edge, the cleavage trends conspicuously across the bedding.

Some fossil leaves were found embedded in the slates on the east side of Berners Bay and were submitted to F. H. Knowlton for determination. He reports that they indicate a Jurassic or Lower Cretaceous age, with the probability in favor of their being Jurassic.

A series of ancient lavas, mainly of basaltic character, form a belt trending northwest from Berners River to Lynn Canal. They make up the mountainous mass known as the Lions Head and the pre-

[a] Spencer, A. C., The Juneau gold belt, Alaska: Bull. U. S. Geol. Survey No. 287, 1906, pp. 134–137.

cipitous peaks flanking Lynn Canal. Brown, red, and greenish blue are the prevailing colors of these old volcanic rocks. They are conspicuously spotted with greenish-yellow amygdules of epidote, and as this is their most prominent feature, they might be called epidotic amygdaloids. Sporadically the amygdules carry a small amount of chalcopyrite.

Some rhyolite dikes and sills are associated with the amygdaloids, in places cutting across the bedding and in places lying between the volcanic sheets. They range in thickness from a few feet to 100 feet. They are dense-textured rocks of light color and weather white on exposed surfaces.

The granular intrusive rocks are represented mainly by diorites. The most important of these, because the larger number of the valuable ore bodies so far discovered lie within the area underlain by it, is a grayish rock composed of plagioclase feldspar, hornblende, and biotite and ranging in texture from rather finely granular to coarsely granular. This rock occupies the drainage basin of Johnson Creek and the upper part of that of Sherman Creek. A small area of heavy, dark, nearly black rock, composed mainly of hornblende, is associated with this variety of diorite near Berners River.

The northeastern portion of the Berners Bay region is composed of a quartz diorite gneiss having a marked tabular structure parallel to that of the cleavage of the slates and graywackes. Mineralogically the gneiss corresponds closely to the diorite already described, but it differs from that rock in having a gneissic or schistose structure and an invariably fresher appearance. The quartz diorite gneiss is undoubtedly the earlier intrusive, but its component minerals have not been subjected to attack and destruction by vein-forming solutions, and to this immunity it owes its contrast to the diorite that incloses the main ore bodies. Near its contact with the andesites the gneiss takes on a peculiar appearance. Numerous white feldspars are embedded in a black foliated groundmass consisting of biotite and hornblende. Farther from the contact the amount of biotite diminishes and the rock assumes a more normal aspect. It maintains its petrographic character and gneissic structure for many miles to the southeast.

ORE DEPOSITS.

The ore bodies of commercial value are deposits of gold ore. They have been classified by Spencer into three varieties, on the basis of their mode of occurrence in the country rock. These three varieties are (1) fissure veins, (2) stockworks or fracture zones in the diorite, and (3) lodes occurring along the contacts of intrusive bodies of diorite. To these might be added a fourth variety—stringer lodes in slate. Although no ore bodies of demonstrated value have so far been discovered in the slates, there is no inherent improbability of the existence of paying lodes. An enormous amount of quartz veining has affected the slates and graywackes, but it must be confessed that the amount of metallization visible is nearly insignificant.

MINES AND PROSPECTS.

Mining activity, other than a small amount of prospecting, was at a standstill in the Berners Bay region during 1909. The final settlement of the litigation in which many of the properties near Comet have been involved for a number of years seems to be assured, and a period of large development work and productivity may be expected in the immediate future. The Jualin mine, on Johnson Creek, has been idle during the year. It is stated that during 1910 a shaft is to be sunk in the hanging-wall country rock of the lode, and the levels below the working tunnel are to be unwatered.

The developments in the Berners Bay mining region up to 1906 were described by Wright,[a] and as no changes have taken place since that date, repetition here is unnecessary.

In the mining belt extending southward from Berners Bay to Juneau the Eagle River mine continued to be the only productive property. The 20-stamp mill was kept operating during the greater part of the year and a large amount of underground development work was done. The ore extracted came mainly from level 1, which is the working tunnel of the mine. During the year a tunnel has been commenced 485 feet below level 1 and is projected to crosscut the ore-bearing zone at this increased depth.

At the head of Canyon Creek, a tributary of Cowee Creek, development work was continued on the E Pluribus Unum and other claims. It is planned to sled in a small prospector's mill during the spring of 1910. This will be used to crush the ore mined from a rich shoot on the surface and will thus assist in the preliminary development of the property.

On Peterson Creek work was continued during the year on the Prairie and contiguous claims, mainly in the construction of trails.

Considerable excitement was created locally in the early part of the spring by the discovery of quartz stringers carrying free gold in the vicinity of Auk Bay. Many locations were made and some work was done. Prospecting is carried on under difficulties, inasmuch as the region is covered with a heavy mat of moss and vegetation. Exposures of rock are almost lacking, and owing to the small amount of development work accomplished little can as yet be said of the value of the new discoveries.

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[a] Wright, C. W., Lode mining in southeastern Alaska: Bull. U. S. Geol. Survey No. 284, 1906, pp. 32-34.

A large number of prospects are scattered along the mineral belt between Juneau and Berners Bay, but on most of them little more was done than the fulfillment of the annual assessment requirements.

Little interest was manifested during the year in the prospects located on the southern extension of the Juneau gold belt. The Crystal mine, at Port Snettisham, continues to be the only productive property. A crew of ten men was employed and the 5-stamp mill was steadily operated.

Some work has been done on a prospect known as the Lost Charlie Ross, which is situated 8 miles up Whiting River at an altitude of about 3,000 feet. This locality is well back in the great granitic mass that forms the core of the Coast Range. The ore body is reported to be 4½ feet thick and 100 feet long and consists of quartz-carrying galena, arsenopyrite, sphalerite, and pyrite. The distribution of the minerals is said to be bunchy. An assay of a streak of solid mineral 11 inches wide on the foot wall of the deposit gave a return of $21.60 in gold and 50 ounces in silver to the ton and 40 per cent of lead. A tunnel which is planned to undercut the ore body at a depth of 150 feet has been driven for a distance of 70 feet.

Developments have continued during the year at Limestone Inlet, and some new work has been undertaken near Bishop Point, at the entrance of Taku Inlet.

SITKA MINING DISTRICT.

Active operations continued during the year on the De Groff and Mills properties, on the west coast of Chichagof Island. At the De Groff mine the capacity of the milling plant, which consisted of four stamps, was enlarged by the addition of an edge-runner mill. Some difficulty was encountered in the separation of the gold from the ore on account of failure to amalgamate, but sea water was substituted in the batteries and a high extraction was obtained.

KETCHIKAN MINING DISTRICT.

Near Hollis, on Twelvemile Arm, a 5-stamp mill, built so that an additional battery of five stamps can readily be added, was installed on the Julia claim, on Harris Creek. A dam has been built and sufficient water power to run the property was developed. A depth of 170 feet on the vein has been attained and enough ore is said to have been blocked out to pay for the installation of the plant and for further exploration work.

Little interest was taken during the year in other gold prospects in the Ketchikan district, the principal mining activity in the district concerning itself chiefly with copper properties in which the gold values are only incidental.

COPPER MINES AND PROSPECTS.

GENERAL STATEMENT.

The financial depression of 1907 and the severe fall in the price of metals dealt a heavy blow to the copper-mining industry of southeastern Alaska, and a notable curtailment in the production immediately ensued. It is, however, an exceedingly encouraging feature that in spite of those handicaps a number of prospects have since that time entered the ranks of producing mines. During 1909 ore was shipped from four mines, all of which are situated on Prince of Wales Island, in the Ketchikan mining district.

Most of the copper mines and prospects of southeastern Alaska are located on primary deposits of contact-metamorphic origin, commonly situated near the contact of limestone with intrusive dioritic rocks. The ore occurs in highly irregular masses and lenses embedded in the limestone and consists of auriferous chalcopyrite associated with iron oxides and sulphides, calcite, and various silicates, principally andradite garnet. On account of the erratic distribution of ore in these deposits, a large amount of exploration work is necessary to keep development in advance of extraction. They form a type of ore body that is comparatively rare in other parts of the world as a commercial producer of copper. They do not conform in shape or other peculiarities to the commonly accepted ideas concerning lodes and prove puzzling features to those engaged in their exploitation. The greatest depth attained upon them in the Ketchikan district is approximately 250 feet. It is therefore interesting to learn that on Texada Island, in the Gulf of Georgia, a copper deposit of this type is being profitably mined at a depth of 1,000 feet.

PRODUCTION.

The production of copper ore in southeastern Alaska during 1907 and 1908 is shown in the subjoined table. The output for 1909, as shown by preliminary estimates, is about 10 per cent less than that for 1908.

Production of copper ore in southeastern Alaska.

Year.	Ore mined.	Copper.		Gold.		Silver.		Average value per ton.
		Amount.	Value.	Amount.	Value.	Amount.	Value.	
	Tons.	*Pounds.*		*Ounces.*		*Ounces.*		
1907	79,982	4,758,814	$951,761	3,384	$69,960	44,196	$29,143	$13.14
1908	43,215	3,260,399	430,372	2,213	46,310	24,648	13,063	11.10

KETCHIKAN MINING DISTRICT.

KASAAN PENINSULA.

Early in April work was commenced on the Goodro mine, which is situated half a mile from the head of a tidal slough known as the Salt Chuck, at the upper end of Kasaan Bay. A wharf, ore bins, 3,850 feet of tram (in part gravity and in part horse tram), and bunk houses were constructed and the shipment of ore was commenced. The ore is lightered out of the Salt Chuck on barges at high tide and loaded upon a dismantled sailing vessel lying at the head of Kasaan Bay. When laden with 2,000 to 3,000 tons of ore, the hulk is towed to the smelters at Ladysmith or Tacoma.

The ore consists of a heavy green dioritic rock containing much biotite and, as the main copper-bearing mineral, scattered particles of bornite, with which are associated sporadic blebs of chalcocite and chalcopyrite. This deposit is unlike any other yet discovered in southeastern Alaska. A force of 22 men was employed, and approximately 35 tons of ore was mined daily. The ore was derived partly from an open cut 15 feet high and 30 feet wide on the apex of the deposit and partly from a large chamber stoped out at the end of a tunnel 90 feet long, driven 94 feet below the outcrop. The ore obtained from the lower level is said to run 2 per cent higher in copper than that from the surface cut; the difference may be due to the greater prevalence of the richer sulphide—chalcocite—in the lower level.

The It mine, at which active development work commenced in 1908, has been a steady producer during 1909, and development and exploration work have been continued. A compressor plant has been installed on the beach and a gasoline hoist has been installed in the adit level. An incline was put down here and approximately 250 feet of development work has been done on the level 50 feet below the adit level. Two ore bodies were encountered and 50 tons of ore and waste are hoisted daily. The ore is sorted and a product comparatively high in copper and gold is shipped to the smelter at Ladysmith, on Vancouver Island.

The Mount Andrew mine, which was formerly worked under a lease held by the Brittania Smelting Company, has resumed operations under the management of the proprietary corporation, the Mount Andrew Iron and Copper Company. A crew of 25 men was employed. Work was commenced in March and a daily output of 50 tons of shipping ore was maintained. During the winter months only such ore as is extracted in the development work will be shipped. Exploration has been continued on the working level and large reserves, carrying 2½ per cent of copper, have been developed, but only the ore running 4 per cent is extracted at present. An incline from the working level has been sunk 100 feet; at 68 feet drifts have been run in both directions and are planned to crosscut the ore body known as No. 4, which was a large rich mass of ore continuous from the surface down.

The Mamie and Stevenstown mines, which adjoin the Mount Andrew property on the northeast, and the smelter at Hadley were idle during 1909.

The Rush & Brown mine was not operated, but late in the year some ore was shipped that had been broken in previous years.

HETTA INLET.

The Jumbo mine, the property of the Alaska Industrial Company, is the only mine on Hetta Inlet from which ore was being shipped during 1909. The ore consists of chalcopyrite in a gangue of well-crystallized garnet and calcite, with which are associated in extremely variable amounts pyrrhotite, pyrite, molybdenite, specular hematite, epidote, and other silicates. According to the present developments the ore-bearing zone, in which masses of ore are scattered in a highly erratic manner, is approximately 500 feet long, 500 feet wide, and of unknown depth. During 1909 considerable ore was extracted between level 2 and the surface. On level 4, which is 262 feet below level 2, the drifts now aggregate 800 feet, and a raise of 127 feet has been put through to level 3. With the completion of this raise, level 4, whose portal is situated just behind the upper terminal of the aerial tramway, became the main working level of the mine. Considerable ore has also been encountered on this level, but owing to the nature of contact-metamorphic deposits the actual tonnage can not be computed in advance of extraction.

Eight claims, situated a short distance northwest of the Jumbo mine, were leased by the Alaska Industrial Company to the Tyee Copper Company. The cupriferous magnetite bodies adjoining the diorite contact were prospected by a combination of diamond drilling, tunneling, and careful plotting of the surface geology. Nine holes aggregating 700 feet were put down. In one of the tunnels, which is situated at an altitude of 2,000 feet, a body of chalcopyrite-pyrrhotite-garnet ore 10 feet thick was encountered.

At the various other mines and prospects situated in the vicinity of Hetta Inlet no important developments are to be recorded.

OTHER PROPERTIES.

The Niblack mine, on the east coast of Prince of Wales Island, owing to litigation, has been idle during the year. The machinery has been sold by the lessees and removed.

At Seal Bay, on the south end of Gravina Island, 700 feet of the projected 2,000-foot tunnel have been driven on the War Eagle property. This tunnel was started late in the summer of 1908 and is expected to crosscut certain ore bodies that are exposed on the surface.

A small amount of development work is reported to have been done on the Veta group, at Mallard Bay, near the south end of Prince of Wales Island. The deposit, which carries values in copper and gold, is said to be 20 feet wide, though not all of this width is of sufficient grade to make ore. A depth of 30 feet has been attained on the lode and 78 feet of drifts and crosscuts have been driven.

It is reported that three men were employed during the summer on the Yellowstone group of claims, at Sea Otter Harbor, on the west coast of Dall Island. They are said to have succeeded in uncovering a number of parallel lodes of auriferous chalcopyrite-pyrrhotite ore at an altitude of 2,400 feet.

CONCLUSIONS.

The principal mineral resources of southeastern Alaska are gold, silver, copper, marble, and gypsum. Of these, silver is obtained as an incident to the production of gold. The output of gold is maintained chiefly by the Juneau district and owing to the preponderant production of the Treadwell group of mines far exceeds that of the other metals in value. Copper is produced in the Ketchikan district only. Some gold is associated with the copper ores, averaging 40 cents per unit of copper.

THE OCCURRENCE OF IRON ORE NEAR HAINES.

By Adolph Knopf.

INTRODUCTION.

Deposits of iron ore of commercial value have recently been reported to occur near Haines, in southeastern Alaska. The writer spent one day in July, 1909, in examining them, and the results of that examination are embodied in the following notes.

Iron ores have as yet attracted little attention as possible mineral resources of Alaska. Some deposits on Prince of Wales Island, in the Ketchikan district, form, perhaps, an exception to this statement. The economic features of these ores have recently been discussed by C. W. Wright,[a] who states that "at the copper mines of Prince of Wales Island a considerable tonnage of magnetite, carrying from 0.5 to 1.5 per cent of copper, has been developed which can not be profitably mined as a copper ore. However, if there were a market for the iron in these ores the copper could be readily separated mechanically and the deposits mined with profit."

The recent installation of a steel plant and small blast furnace near Port Townsend, in Washington, and the successful inauguration of electric smelting in Shasta County, Cal., are industrial developments likely to stimulate interest in all possible sources of iron ore along the Pacific coast.

Haines is situated in latitude 59° north, on Portage Cove, a small embayment of Chilkoot Inlet, the eastern channel at the head of Lynn Canal. Steamers plying the inside passage between Seattle and Skagway call regularly at Haines.

GEOLOGIC FEATURES.

The rocks outcropping in the vicinity of Haines are coarsely crystalline diorites and gabbros, which represent various modifications of a single intrusive mass of deep-seated origin. They are particularly well exposed along the shores of Chilkoot Inlet from Battery Point, 4 miles south of Haines, to a point 2 miles north of Haines,

[a] Conservation of mineral resources: Bull. U. S. Geol. Survey No. 394, 1909, p. 191.

where they come into contact with a series of greenstones. Extending northwestward, they form the mountainous ridge lying between Chilkoot and Chilkat inlets.

The rock mass exposed along the shore north of Haines is a remarkable occurrence geologically. Specimens collected from the finest-textured portions show a rock composed of a coarsely crystalline aggregate of feldspar, hornblende, and pyroxene, throughout which are scattered some visible grains of magnetite. The dark minerals (the hornblende and pyroxene) make up half the bulk of the rock. When examined microscopically the rock is found to consist of an allotriomorphic granular assemblage of plagioclase feldspar (bytownite), hornblende, and augite. Magnetite and apatite are present as accessory constituents in unusually large amounts. From this normal type of rock, which would be termed a gabbro, abrupt variations in texture and mineral composition are encountered. In places the cliffs for hundreds of feet are composed solidly of formless hornblende individuals 6 inches long by 3 inches broad. Commonly this hornblende rock contains more or less grayish-green augite admixed with it and is ramified by coarse white feldspathic dikelets or blotched by masses of gabbro. In places it even forms a breccia cemented by such material. Locally the hornblendite contains numerous lumps and particles of magnetite, which can easily be recognized by the characteristic bluish tarnish that they assume upon weathered surfaces. At no point along the shore, however, has the segregation of magnetite proceeded far enough to yield a solid body of iron ore, or even a body of ore of commercial grade.

Near Fort Seward, which is situated just west of Haines, the rock exposed consists of a coarsely granular aggregate of pyroxene, hornblende, and black mica (biotite). Mica-bearing modifications of the gabbro occur at other points farther inland and have led to some prospecting for mica deposits. It is to be noted, however, that the black iron mica (biotite), in contradistinction to the other two micas, muscovite and phlogopite, has little commercial value.

On the northwestern extension of this belt of basic plutonic rocks carrying disseminated magnetite is situated the property of the Alaska Iron and Steel Company. The work done here consists of a tunnel approximately 100 feet long, situated at an altitude of 300 feet, 2 miles distant from Haines by a well-built government road. The rocks occurring in the vicinity of the mouth of the tunnel are poorly exposed on account of the thick growth of vegetation. On the dump occur a variety of hornblende-augite rocks. One of the most striking types consists of a rock in which large lustrous crystals of black hornblende are embedded in a finely granular matrix of grayish-green pyroxene. From this sort of rock there are variations in structure and granularity, and some of these carry appreciable quantities of magnetite.

The magnetite-bearing facies constitute the ore rock. In the most favorable specimens a maximum content of 30 per cent of magnetite, or, roughly, 20 per cent of metallic iron, is attained, but the existence of an ore body of this grade has not yet been demonstrated. The magnetite in the ore rock occurs as particles one-eighth to one-fourth inch in diameter scattered through a granular matrix of pyroxene and hornblende. Owing to the metallic-like reflections from cross-fractured hornblende the eye is prone to overestimate the magnetite content of the ore. When examined under the microscope the ore shows, in addition to the features already described, a small amount of apatite, indicating a certain content of phosphorus.

Some of the material was submitted to the chemical laboratory of the Geological Survey for determination of its titanium content. The coarse particles were separated magnetically, ground to 100-mesh, and the magnetite again removed magnetically. Chase Palmer reports that the product contains 3.91 per cent of TiO_2. This determination therefore indicates that the concentrated iron-ore product is not likely to contain prohibitive quantities of titanium.

CONCLUSIONS.

The iron ore occurring near Haines consists of primary magnetite sparsely disseminated in a basic igneous rock composed of pyroxene and hornblende. An ore of this character would require fine crushing and concentration. A study of producing iron-ore properties where the adoption of such processes was necessary will therefore furnish valuable data for an analysis of the commercial possibilities of the Alaskan iron-ore deposits. Many factors enter into the problem, but hardly need discussion at this time. At Lyon Mountain, N. Y., where crushing, drying, and electromagnetic concentration are necessary, the lowest-grade iron ore treated contains 34 per cent of metallic iron.[a] This is far above that of the highest-grade rock so far found at Haines. Geologically it is possible that richer bodies of magnetite may occur as segregations in the basic granular rocks that form the ridge extending northwestward from Haines. A magnetic survey of the area underlain by these rocks would undoubtedly prove a quicker and more economical way to test this possibility than the driving of expensive prospect tunnels.

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[a] Eng. and Min. Jour., 1906, p. 916.

A WATER-POWER RECONNAISSANCE IN SOUTHEASTERN ALASKA.

By John C. Hoyt.

INTRODUCTION.

The territory covered by this report (see fig. 1) includes that portion of southeastern Alaska extending southward from White Pass for a distance of about 350 miles. Detailed investigations of water-power resources were made in three districts of this area—Ketchikan, Juneau, and Skagway. Data were also obtained at Sitka and other points and from conversation with persons familiar with the country.

From Ketchikan the plants of the local power company, the New England Fish Company, and the Metlakatla Fish Company, at Beaver Falls and Sulzer, were visited. The undeveloped possibilities at Hadley, Kasaan Bay, Cholmondeley Sound, Georges Arm, Carroll Inlet, Unuk River, and about Sulzer were investigated also.

From Juneau the developments of the Treadwell Company on Douglas Island, of the Perseverance and other companies in Silverbow Basin, and of the Amalga Company at Eagle River were visited. The conditions in Taku Inlet, including Turner Lake, were investigated and information was obtained in regard to Endicott River and the streams between Juneau and Eagle River.

At Skagway the local power plant and the plant of the Chilkat Fish Company were visited, and a trip was made over White Pass and another to Haines, from which the Porcupine Creek district was visited.

At Sitka data were obtained in regard to Chichagof Island in Klag Bay.

GENERAL TOPOGRAPHIC FEATURES.

Southeastern Alaska comprises a narrow strip of mainland and a series of islands separated from one another by a network of channels and straits. Both the mainland and the islands are indented with many bays, fiords, and inlets, which, with the other natural conditions, practically cut off all travel except by boat.

With the exception of small areas of flat lands along the larger rivers and at places along the coast, the entire area is mountainous.

The mountains rise abruptly from the shore line and reach a maximum elevation varying from 4,000 feet in the southern part of the area to 7,000 feet in the northern part. Owing to this topography, the streams, with the exception of a few of the larger rivers which come through the mountains from the interior, have small and precipitous

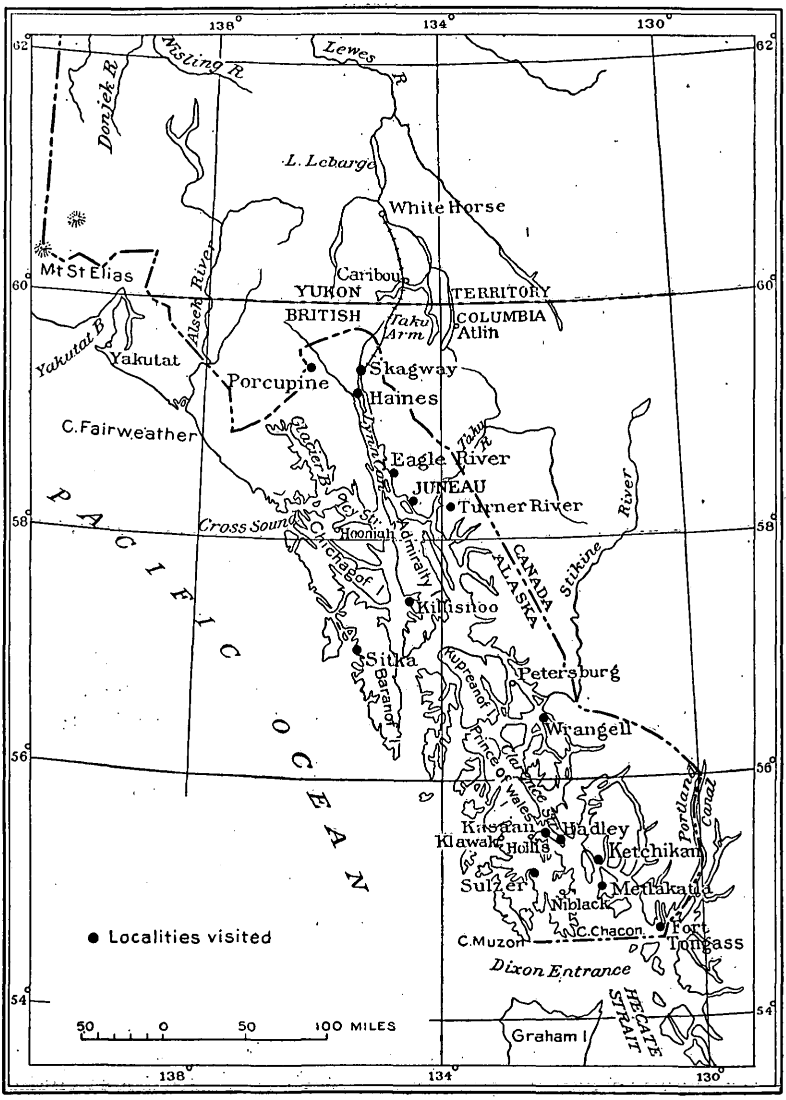


FIGURE 1.—Map of southeastern Alaska.

drainage areas. Their courses are short and they have a large fall; in fact, many of the streams are made of a series of cataracts.

In the northern part of the area most of the streams head in the glaciers which cover a large portion of the country. In the lower southern part of the area many of the streams head in small lakes which occur a short distance back from the shore line in the hanging valleys that are characteristic of this area. Most of the streams flowing from these lakes are precipitous, and many of them empty into the ocean with a cataract at the shore line. These lakes afford excellent opportunities for storage, as the topography near them is such that a dam can usually be constructed for raising their water level. The most successful powers already developed depend on such storage during a large part of the year, and further development in this region will depend on the availability of such lakes.

GEOLOGY.

In general there is over the underlying rock of the country but a small depth of soil; hence the facilities for ground-water storage are exceedingly scanty. The underlying rock of the islands and of the mainland up to the foothills is limestone, slate, and schist; in the remainder of the area it is granite.

At the mouths of some of the larger rivers there are alluvial flats and glacial deposits, but the coast is, except in a few places, rocky and steep.

CLIMATE.

As shown in the following tables, the climate is similar to that of the extreme northwestern part of the United States. The last frosts occur not much later than the 1st of May and the first frosts do not come until early in September. The number of growing days, therefore, averages about 180.

The winter temperature ranges from 10° to 20° above zero; the summer temperature ranges from 70° to 80°, with occasional extremes between 85° and 90°.

Precipitation varies considerably in different portions of the area. Along the west coast and in the area along Dixon Entrance, which is exposed to the direct winds from the Pacific, it is rather high, ranging from 130 inches a year at Fort Tongass to 88 inches at Juneau. In passing inland it decreases and at Skagway is only 21 inches.

A disagreeable feature of the country is the large number of rainy days, which averages about 200, except in the vicinity of Skagway, where it is less than 100. With few exceptions the rains are gentle and mostly in the form of mist. Notwithstanding the great precipitation, it dries off quickly after showers, a fact which indicates that the humidity is low.

Temperature and precipitation in southeastern Alaska.[a]

Month.	Fort Tongass (1 year,[b] 16 months—June, 1868, to September, 1870).				Fort Wrangell (2 years, 40 months—May, 1868, to August, 1882).			
	Temperature (°F.).		Precipitation.		Temperature (°F.).		Precipitation.	
	Maximum.	Minimum.	Inches.	Number of days over 0.01 inch.	Maximum.	Minimum.	Inches.	Number of days over 0.01 inch.
January	47	6	12.92	18.5	47	−4	6.07	17.6
February	45	23	10.79	21.5	58	2	8.11	20.0
March	59	−2	8.21	17.5	54	−10	2.89	12.6
April	60	33	9.57	19.0	64	24	4.11	16.6
May	70	38	7.70	15.5	78	35	3.71	18.6
June	75	43	6.66	10.3	86	38	3.56	13.7
July	91	52	10.58	16.6	82	44	3.69	15.8
August	81	47	6.71	9.6	84	43	3.07	14.3
September	67	38	17.66	19.3	73	38	6.63	17.2
October	58	37	14.11	20.0	67	31	7.36	13.2
November	51	32	15.46	27.0	53	4	11.27	17.8
December	47	24	13.33	19.0	52	−3	10.41	22.5
Year			133.10	213.8			70.88	199.9

Month.	Killisnoo (16 years, 43 months—May, 1881, to December, 1902).				Juneau (2 years, 39 months—June, 1881, to February, 1897.)			
	Temperature (°F.).		Precipitation.		Temperature (°F.).		Precipitation.	
	Maximum.	Minimum.	Inches.	Number of days over 0.01 inch.	Maximum.	Minimum.	Inches.	Number of days over 0.01 inch.
January	52	−2	5.98	18.0	50	−4	10.61	18.1
February	50	−10	4.96	14.9	50	−4	4.85	11.2
March	52	−2	4.04	15.0	50	10	6.62	18.7
April	63	15	3.50	11.0	63	13	5.25	15.0
May	76	24	3.38	12.3	71	26	7.36	16.7
June	76	33	2.36	9.9	82	38?	4.99	14.6
July	84	38	4.19	11.7	88	38	5.59	15.5
August	81	36	4.90	16.5	82	38	7.53	15.6
September	69	27	7.79	19.3	85	31	12.19	18.4
October	60	25	7.92	22.3	66	20	10.05	19.8
November	53	1	5.16	16.9	60	−1	10.47	18.4
December	54	1	4.81	17.6	45	1	8.16	19.8
Year			58.97	185.4			93.06	201.8

[a] Brooks, A. H., Geography and geology of Alaska: Prof. Paper U. S. Geol. Survey No. 45, 1906, pp. 158-170.

[b] The records were not continuous, and the number of years given indicates simply the number of continuous twelve-month periods covered.

Temperature and precipitation in southeastern Alaska—Continued.

Month.	Skagway (31 months—November, 1898, to December, 1902).				Sitka (17 years, 44 months—November, 1867, to December, 1902).			
	Temperature (°F.).		Precipitation.		Temperature (°F.).		Precipitation.	
	Maximum.	Minimum.	Inches.	Number of days over 0.01 inch.	Maximum.	Minimum.	Inches.	Number of days over 0.01 inch.
January	42	− 4	0.90	7.5	51	− 2	12.17	16.8
February	44	− 9	.57	2.5	54	− 3	7.47	15.9
March	63	−10	.64	3.0	65	− 1	6.70	18.0
April	61	16	2.39	10.5	70	19	5.61	16.2
May	79	25	.77	4.7	80	28	4.11	16.1
June	90	34	.60	5.0	80	33	3.31	13.6
July	92	39	1.73	5.7	87	35	3.55	14.9
August	80	32	1.51	8.5	82	39	5.84	16.8
September	76	30	3.47	13.5	74	32	9.67	19.5
October	60	16	3.22	12.0	67	25	11.96	21.7
November	51	7	2.17	8.0	59	5	9.80	19.5
December	57	− 4	3.78	11.7	59	7	7.88	18.9
Year			21.75	92.6			88.10	207.9

Dates of freezing in southeastern Alaska.[a]

Station and year.	Last killing frost.	Last frost.	First frost.	First killing frost.	Growing days.
Fort Tongass:					
1868			Nov. 6	Dec. 19	
1869		Mar. 19	Sept. 29	Dec. 17	210
1870		Mar. 14			
Fort Wrangell:					
1869			Sept. 20	Oct. 15	
1875	Mar. 14	Apr. 20	Oct. 5	Oct. 29	229
1876	Apr. 30	June 5	Sept. 14	Oct. 29	182
1882			Oct. 2	Oct. 8	
Juneau:					
1889			Nov. 18		
1890		Mar. 29	Oct. 6		191?
1891		May 2	Sept. 20		141?
1895			Sept. 10	Sept. 19	
1899			Sept. 4		
1900				Sept. 22	
Skagway:					
1899		May 9		Sept. 4	117?
1900	Apr. 9				
1902		July 7	Aug. 27		50?
Killisnoo:					
1884			Sept. 13		
1885			Sept. 28	Oct. 12?	
1888			Oct. 15		
1891		May 6	Sept. 27		143
1892		Mar. 31	Oct. 14		197
1893		May 2	Oct. 18		169
1895			Sept. 3	Sept. 12	
1897			Sept. 27		
Sitka:					
1868		Apr. 21			
1869			Sept. 19		
1870			Oct. 19		
1871				Oct. 31	
1872				Oct. 7	
1873	May 27		Nov. 5		162
1881		May 8			
1900	June 1		Aug. 25	Oct. 1	122
1901				Nov. 1	

[a] Brooks, A. H., Geography and geology of Alaska: Prof. Paper U. S. Geol. Survey No. 45, 1906, pp. 171-172.

VEGETATION.

Owing to the mild temperature, the long days in summer, and the heavy precipitation, the vegetation in southeastern Alaska is very luxuriant. Except where the soil is too shallow or the slopes too rocky, the whole area is covered with dense forests of spruce, cedar, and hemlock, and is in the national forests. Among this timber there is a heavy undergrowth of devils club, berries, and other small plants. In the southern part of the area trees vary in diameter up to 6 feet and grow up the slopes to the mountain tops. Toward the north the size of the trees diminishes, the undergrowth is not so heavy, and the timber does not extend to the top of the mountains, which are either small or glacier covered.

Much of the forest is overmature and defective timber is common, but in coves and gullies for several miles back from the coast there are many fine stands of spruce and cedar which have never been injured by fire or cutting.

The logging practice now in vogue takes only the best spruce trees which can be felled into the water or on slopes where they can be skidded in by hand. Of course it is difficult to log in a mountainous country, but much timber can be logged in southeastern Alaska with no more difficulty than attends many operations in the Pacific Coast States, if modern methods are introduced.

So far only the spruce has been used for saw timber, but both spruce and hemlock are undoubtedly good pulp woods. The few sawmills now operating in southeastern Alaska obtain their timber from the national forests, but the supply of timber is much greater than is required by local needs. The Forest Service is desirous of increasing the timber sales, and the present price of stumpage is low—only $1 a thousand board feet. Full information on this subject can be obtained from the forest supervisor at Ketchikan.

Aside from the native growth, garden truck, berries, and the hardy grains and grasses can be raised in all parts of this area. Strawberries, raspberries, and huckleberries grow both wild and cultivated and are of most excellent quality. Grasses and grains are difficult to harvest and cure owing to the large amount of rain.

The areas suitable for agriculture are small and are expensive to bring under cultivation. Agriculture is carried on with difficulty on account of the swampy condition of the ground, which is hard to work with horses unless well drained.

GENERAL CONDITIONS OF RUN-OFF.

The run-off from the streams in this area results principally from direct rainfall, melting snow, and melting glaciers. In view of the large rainfall, the excellent forest cover, and the glacial areas, the general deduction would be that this section should have many large streams with an abundant and well-sustained run-off. This, however, is not the case, as the catchment areas are small and, although the total yield per square mile is considerable, the streams are not large and they fluctuate very rapidly.

The forest effects are principally offset by the steep slopes and shallow soil, which afford but little ground storage. The streams respond very quickly to the rainfall and their volume drops with equal quickness as soon as it ceases to rain. Frequently they are reduced from a maximum to a minimum flow within a few days. This is illustrated in the hydrograph (Pl. II) of Porcupine Creek near Haines, in the northern part of the area. This stream has a drainage basin of 34 square miles and heads in a large glacial area.

In many places, owing to the steep slopes, there are no well-defined streams but instead the water runs down the mountain side in many small channels, some on the surface and others between the soil and the rock. In some of the developments the water is obtained by contour ditches which bring the water together from these streams.

Most of the large glaciers terminate at elevations but little above sea level and are therefore practically of small value as a source of water supply for the development of power. The smaller glaciers are beneficial only during the summer months, as their water is cut off early in the fall by the frosts. It is probable that many of the extreme variations in the glacier-fed streams are due to the making and breaking of ice jams which raise and hold back the water.

The streams which head in lakes have a much better sustained flow and are practically the only ones in the area which are of much value for power, as any large development must depend on storage both for the winter months and during dry parts of the summer.

The principal defect in the water supply, so far as the production of power is concerned, is the extreme low flow during the winter months. On the smaller streams, which have no storage, there is practically no flow in winter, and even on the streams having lake storage the flow is extremely low, as shown in the records for Turner River (fig. 2), which empties into Taku Inlet near Juneau. This stream has a drainage area of 66 square miles and heads in Turner Lake, which offers excellent facilities for storage. A portion of the area is also covered with glaciers. The scantiness of the winter flow is due largely to the meager amount of storage capacity in the ground, which freezes to bed rock, thus holding back the water.

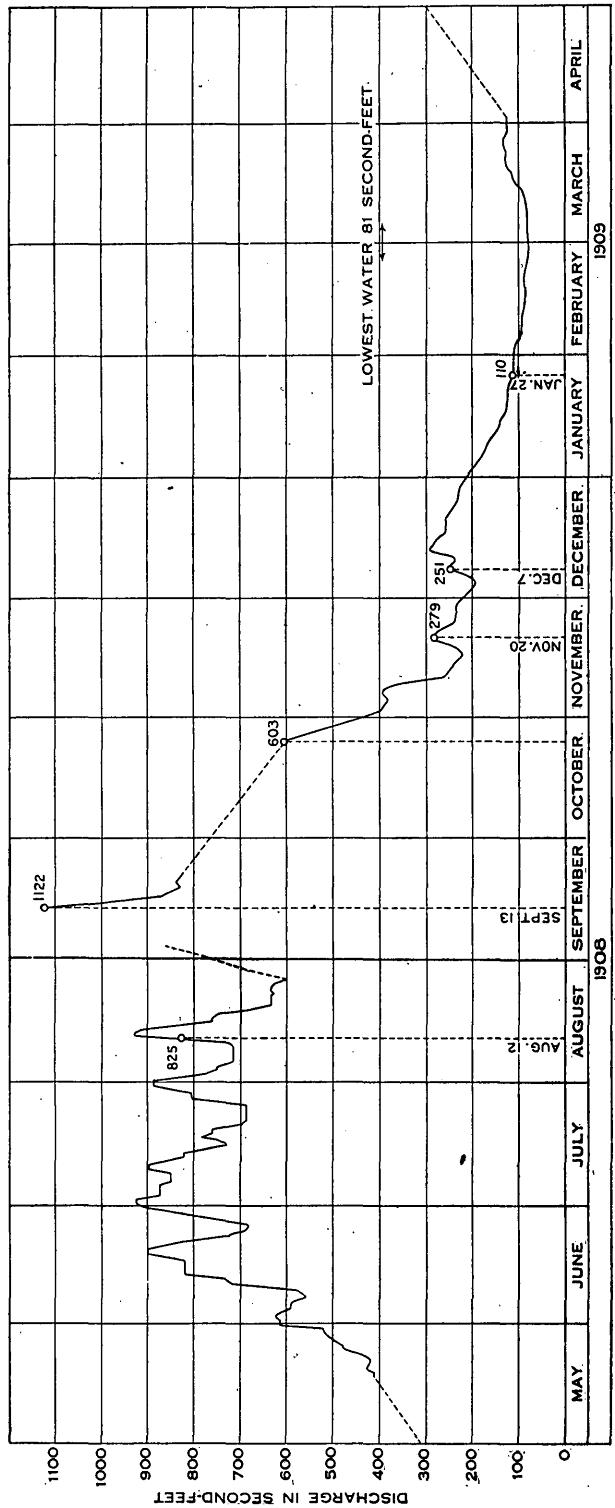
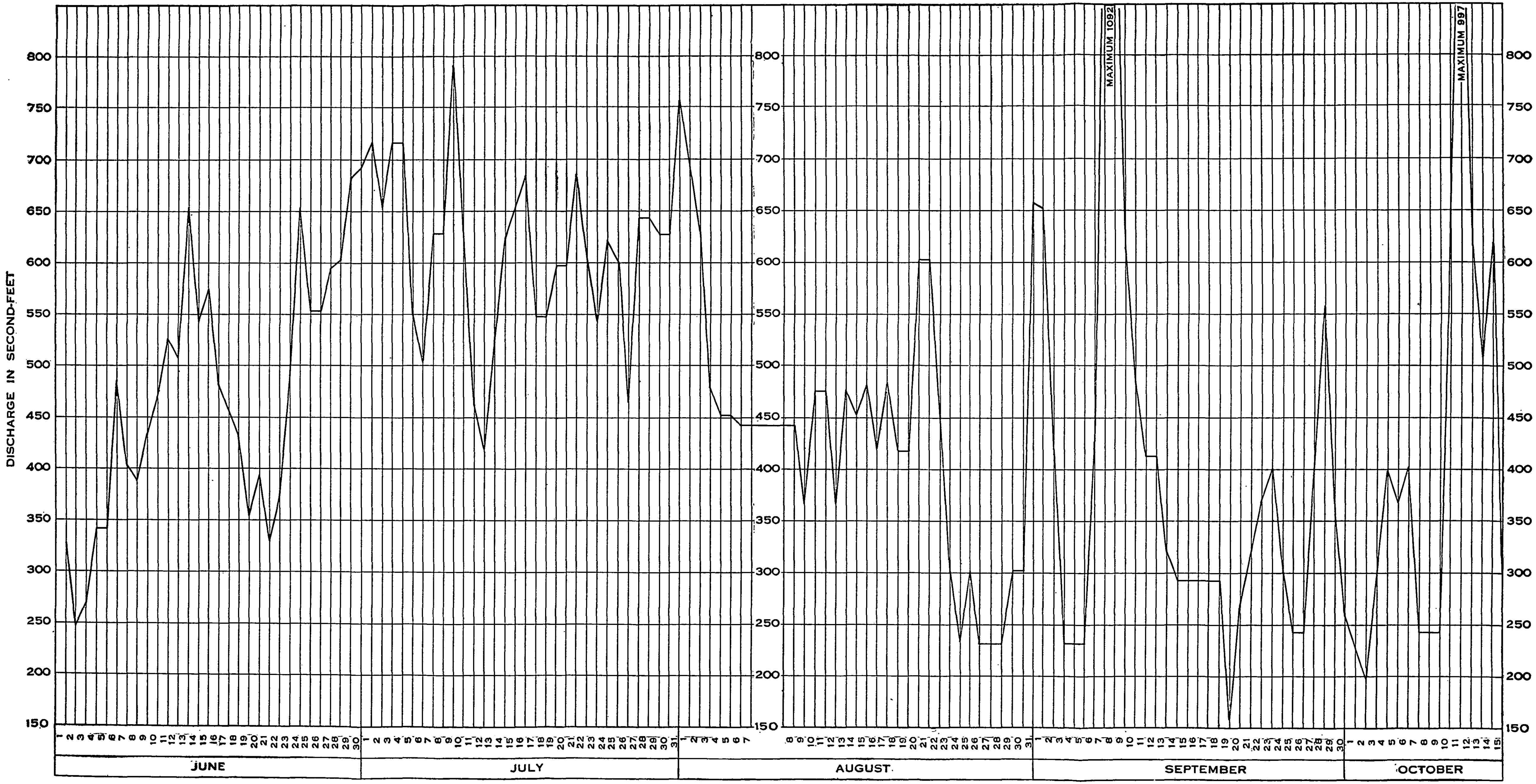


FIGURE 2.—Hydrograph of Turner River. From records furnished by the Alaska Treadwell Gold Mining Company.



HYDROGRAPH OF PORCUPINE CREEK.

From records furnished by Porcupine Gold Mining Company.

INDUSTRIAL CONDITIONS.

With the exception of a few towns along the shore and scattered mining camps and fisheries, southeastern Alaska is very sparsely settled. The only ready means of transportation is by boat. Aside from the regular steamers which run from Seattle and other ports, each town has a local service connecting it with adjoining towns and camps by gasoline launches.

There are practically no roads and the country back from the shore line is almost inaccessible. The building of government roads, which is now under way, will be a great help to the development of the country.

The two well-developed industries are fishing and mining. The larger part of the fishing is for the salmon canneries. An icing plant has just been established at Ketchikan. The mines are principally quartz mines yielding gold and copper.

Next to fishing and mining comes lumbering, which at present is but little developed and is confined to shingle mills and a few small sawmills that meet the local demands. Agriculture, owing to the small amount of suitable land available, will always be of very minor importance.

The success and future development of both the mining and the lumbering interests depend wholly on their ability to get cheap power. Most of the mines so far opened have been in the Juneau belt and are in ore of low grade, large amounts of which must be cheaply handled in order to make them profitable. The best paying mines owe their successful operation to the presence of cheap power in their immediate vicinity, and their future development will depend on the procuring of further cheap power. This is a vital question with the older companies, and they are investigating every possible source of power. The fishing industry demands only a small amount of power during the canning season. This can readily be obtained at small expense in the vicinity of the plants.

In developing the timber resources it will be possible to produce cheap steam power by the use of sawmill waste as fuel. The ultimate development, however, for both lumber and pulp will be through the establishment of mills at accessible power sites.

The future development of electro-chemical processes may open a new industry for this region. In its present stage, however, there is no field in Alaska for this industry.

Practically the whole area here considered is included in the Tongass National Forest; therefore the conditions governing the national forests will, in a large measure, regulate the development of the timber and other resources of this country.

POWER POSSIBILITIES.

As shown in the subjoined table, there were 102 water wheels in southeastern Alaska in 1908, developing 16,319 horsepower. This table is based on a special water-power census taken by the United States Census Bureau, and the amounts are made up from statements received from power owners in the various sections. These figures have not been verified, but it is believed that they are somewhat large, as they probably give the maximum development, and this can be maintained only during a small portion of the year. Most of the plants have but little power during the winter months.

In considering the development of the water powers in southeastern Alaska the possibility of developing power from lignite and coal deposits in that region must be taken into account. When these deposits are opened fuel will probably be available at a comparatively low cost on account of the ease of water transportation, and steam power may be produced much more cheaply and will be more reliable than the water power.

A great drawback to water-power development in this region is the difficulty of transmission. The country, as already stated, is cut by numerous channels, has a rough topography, and is covered with dense forests. Therefore transmission lines are difficult and expensive to construct, and this practically prohibits development at sites where the power can not be utilized at the point of development. In view of these difficulties, the possibilities at the present time for large power development in southeastern Alaska are not great, and such projects should be closely scrutinized as to their feasibility both from an engineer's standpoint and from that of an investor.

The opening of new mining districts and the development of the timber interests in this region will create a more widely distributed demand for power and enable the utilization of sites which at the present time can not be considered as available. As already stated, the success of any large water-power development, to be run during the entire year, will depend on the possibility of adequate storage. The meager topographic data available indicate that there are probably many lakes throughout the region which will offer excellent storage facilities.

Developed water power in Alaska, 1908.

Owner.	Location of plant.	Number of wheels.	Horse-power.	Character of industry.
Porcupine Gold Mining Co	Porcupine Creek	2	50	Placer mining.
Columbia Canning Co	Haines	3	70	Cannery.
Nugget Creek Mining Co	do	2	24	Mining.
Columbia Canning Co	Leonard Creek	3	25	Salmon cannery.
Shakan Salmon Co	Shakan Creek	4	150	Do.
Cahoon Creek Placer Co	McKinley Creek	2	100	Placer mining.
Union Iron Works	Gold Creek	1	8	Machine shop.
Hydraulic Pipe and Boiler Works	Juneau	1	8	Pipe and boiler works.
Finn & Young	Shakan	1	25	
William Duncan	Metlakatla	2	53	Sawmill and salmon cannery.
R. G. Ketchum	Kupreanof Island	1	50	Barrel factory.
Alaska Industrial Co	Jumbo Creek	1	150	
Do	Sulzer	1	30	Mining.
American Gold Mining Co	Sheep Creek	3	80	Do.
Yukon Publishing Co	Skagway	1	3	Newspaper.
Home Power Co	Lake Dewey	1	125	Light and power.
New England Fish Co	Lake Whitman and Coal Creek.	2	1,100	Fish freezing and ice making.
J. P. Jorgenson & Co	Juneau	1	25	Lumber.
Ebner Gold Mining Co	Gold Creek	4	4,000	Quartz mining.
Alaska Perseverance Mining Co	Silverbow Basin	8	880	Mining.
Alaska-Juneau Gold Mining Co	do	2	500	Do.
F. H. Partridge	Hoonah	2	15	Sawmill.
Alaska Copper Co	Lake Creek	4	300	Smelter and sawmill.
A. Murray	Douglas	2	5	Wood turning, etc.
Juneau Iron Works	Juneau	1	6	General repairs.
Treadwell group	Douglas Island	37	6,297	Gold mining.
Alaska Water, Light and Telephone Co.	Solomon Gulch	1	350	Light and power.
Seward Light and Power Co	Resurrection Bay	1	150	Do.
Citizens' Light, Power and Water Co.	Ketchikan Creek	2	240	Do.
Alaska Electric Light and Power Co.	Gold Creek	5	1,000	Do.
Tanana Electric Co	Chatanika	1	500	Do.
Chichagof Gold Mining Co	Clay Bay	1	150	Do.
		102	16,319	