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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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T H E

GEOLOGY AND MINERAL RESOURCES

OF A PORTION OF THE

COPPER RIVER DISTRICT, ALASKA

BY

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AND

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craft for a distance of several miles. The skipper, Mr. Axel Englund, entertained the party at his home, and it arrived at Orca on the following day, the 16th of October.

Trip to Port Valdes and Seattle.—At Orca the party found Mr. Louis Torstensen, who had come for it with his 30-foot sloop *Foe*, at the instance of Mr. Schrader. Leaving two men at Orca, Messrs Witherspoon, Spencer, Charles Rae, and the skipper sailed on the 19th to connect the most westerly station of the Coast and Geodetic Survey with the work which the topographers had carried out at Port Valdes in the summer. In order to do this signals had first to be placed along the coast for a distance of about 40 miles, from Knowles Head to Rocky Point, and afterwards these points were occupied as triangulation stations. Since there was danger of being becalmed, it was not considered safe to try to return to Orca, but to catch the outgoing steamer at Virgin Bay. It was therefore necessary to traverse the line of survey three times. Several attempts were made to cross Valdes Inlet, but at no time was the water sufficiently smooth to allow a landing on the north shore. It was therefore decided first to complete, if possible, all the work between Knowles Head and Rocky Point, and then to close the line by crossing the rough water in a native boat, or bidarka. This plan was finally followed, and on November 3 Mr. Witherspoon crossed the inlet with two native men and succeeded in closing the circuit of about 450 miles from Valdes to Copper and Chitina rivers, down the Copper to the ocean, and from the mouth of the Copper around to Valdes. Owing to the lateness of the season it would have been impossible to complete this line had it not been for the work of the Coast and Geodetic Survey between Copper River and Knowles Head.

November 3 and 4 were spent by the geologists in visiting the copper deposits of Landlocked Bay, and later, while waiting for the steamer, opportunity was afforded for studying the copper deposits at the Gladhaugh mine.

After waiting a week at Ellamar, a post-office which had recently been established at Virgin Bay, the steamer *Bertha* was sighted on November 11, and on this vessel the party embarked the same evening and proceeded to Orca, where Mr. Schrader and his party were found waiting. They all left at once and arrived at Seattle on the 21st, after an absence of nearly six months.

TRAILS.

Copper River route.—The Copper River Valley has been a route of travel for the natives passing between the interior of the Copper River region and the coast for many years. It was traveled in 1885 by Lieutenant Allen, who ascended as far as Taral and wintered there

before continuing his journey northward to Tanana, Yukon, and Koyukuk rivers. In 1884 Lieutenant, now Captain, Abercrombie ascended Copper River to the vicinity of Miles Glacier. In 1891 Dr. Hayes, of the U. S. Geological Survey, and Lieutenant Schwatka crossed Skolai Pass from White River and descended the Chitina and Copper to the ocean.

During the summer of 1898 an attempt was made by many prospectors to reach the interior by means of Copper River, but of the several hundred men who attempted to pull their outfits up the stream in boats there were only a very few who reached Taral, and these spent practically the entire summer in the effort. During the same season many who had built boats on Klutina and Upper Copper rivers descended the lower river in them, and all but a few reached the coast in safety.

In winter there are always high winds in the lower part of the river, against which it is almost impossible to make headway, and the difficulties encountered in ascending Copper River during the late winter before the breaking up of the ice, or later, when it is necessary to employ boats, make it impossible to suppose that it will ever become a practicable way of reaching the Copper Basin. It will, however, always be available for those who wish to move rapidly in getting out of the country, since the difficulties it presents for boating are not insurmountable, the principal one being a portage of about 3 miles at the rapids just above Miles Glacier.

Valdes Glacier route.—The main traveled route from the coast to the interior during the season of 1898 was the one leading from Valdes by way of Valdes Glacier to Klutina River and descending along that stream to Copper Center, at its mouth. From this point travel was comparatively easy in all directions. The full description of this route is copied from the report of a reconnaissance of the region made in 1898 by F. C. Schrader:¹

Starting from Valdes the trail leads 4 miles northeast, with a very gentle rise over the delta gravels, to the foot of Valdes Glacier, thence about north for 18 miles up the glacier to the summit, which is 4,800 feet high. The glacier is broken or transversely marked by four or five successive long benches or terraces, from one to the other of which the rise of 100 feet or more is usually sharp and sometimes difficult, the topography of the ice being very rugged, with crevasses, ridges, and turrets. With the exception of these benches, the ascent from the foot of the glacier to near the summit is gradual, but just before reaching the top there is a steep rise of 1,000 feet at an angle of 15° to 20°. The pass is guarded by two prominent peaks, one on each side, standing about a mile apart. From the summit the trail descends rapidly, but nowhere abruptly, for a distance of 6 miles, through a canyon-like valley, to the foot of Klutena Glacier, which is the source of the Klutena River.

From the foot of Valdes Glacier to the foot of Klutena Glacier, a distance of 25 miles, there is neither vegetation, timber, nor brush, but only a waste of barren rock

¹A reconnaissance of a part of Prince William Sound and the Copper River district, Alaska, in 1898, by F. C. Schrader: Twentieth Ann. Rept. U. S. Geol. Survey, Part VII, 1900, p. 365.

walls, peaks, and snow and ice, so that fuel for camping while on the glacier must be brought from either end. From the foot of Klutena Glacier the trail continues down the north side of the river and lake to Copper Center, where the elevation is about 1,050 feet.

During the season of 1899 practically everyone who went from Valdes to the interior traveled by the glacier route. Those who went in over the snow early in 1900 also followed the same trail, but during the summers of 1898 and 1899 the explorations carried on under the auspices of the United States Army resulted in the discovery of a more practicable route for summer travel, and many returning to the coast in the autumn of 1899 employed the new trail, leading from the head of Tonsina River, by way of Kanata and Tiekkel rivers and Ptarmigan Creek, to Thomson Pass, which lies between the Copper River drainage and Lowe River, flowing into Valdes Inlet. In the summer of 1900 this route became open with the disappearance of the snow upon Thomson Pass, late in the month of June. After that date several expeditions, including that of the Geological Survey, went into the interior by this route. It was also employed by the army pack train engaged in transporting supplies to the men who were extending the trail toward Copper River and Mentasta Pass.

Tasnuna route.—Somewhat to the east of Thomson Pass there is a low divide which has been named Marshall Pass. This lies between the north fork of Lowe River and the head of Tasnuna River, which joins the Lower Copper about midway in its course to Taral on the coast. The Tasnuna was explored by the Schrader party in 1898 and reported to be a feasible line of travel as far as Copper River, but from its mouth to Taral there is no real trail, and the river is passable only in winter or at low water, when boats may be cordelled by walking along the banks and river bars. The difficulties of building a trail along the sides of the canyon would be very great, and it is not probable that this route will be generally followed. However, for reaching the Bremner River region it is probably the easiest route at all times except during low water in October, when it is possible to travel with comparative ease between this region and the trading post at Alaganik, near the mouth of Copper River.

The Military trail.—During the seasons of 1898 and 1899 several expeditions, under the direction of Captain Abercrombie, were engaged in exploring for a feasible route between Valdes and the interior, with the intention of locating a trail to be built to Copper River and thence to the Tanana, by way of Mentasta Pass, with the idea of eventually extending it as far as Eagle City, on the Yukon, and thus affording an all-American route from the coast to the Yukon, and telegraphic communication both with the river settlements and with the military post at St. Michael. The result of these explorations was the discovery of Thomson Pass and the comparatively easy line of travel by way of

Lowe River, Tsina and Kanata rivers, and Mosquito Creek. It was first planned to carry the trail from the Kanata across the range northward to the valley of the Tonsina, but the present route is down Mosquito Creek in dry weather, or along a drier route passing somewhat farther east, by way of Kimball Pass, when the ground becomes soft. In either case Tonsina River is crossed several miles below the junction of Mosquito Creek, and thence the trail runs northward, crossing the plateau to Copper Center, at the mouth of the Klutina. In 1898 the trail was open as far as Dutch Flats, in the upper part of Lowe River, and during 1899 it was extended to Copper Center. From Valdes to the head of Kanata River the timber was chopped out to a width of 30 feet, and bridges were constructed over the principal streams. During the summer of 1900 work was continued and the trail was completed as far as Taslina River. Klutina River has been bridged, and ferries will be established across all of the principal tributaries between this and the Chestochina. Besides the actual construction of the trail a telegraphic line is proposed and has been completed between Valdes and a point on the Tsina River.

The establishment of the Military trail has been an important factor in making the Copper Basin available to prospectors and others desirous of investigating the resources of the region, and while at present portions of it would be considered as very bad by those who are not accustomed to traveling in such unfrequented regions as abound in the Territory of Alaska, without this trail transportation of supplies for prospectors and exploring parties would be well-nigh impossible. The greatest difficulties to be overcome are the swift and treacherous glacial streams and the soft, swampy ground which exists over much of the route; but with the destruction by forest fires of the timber along the line of the trail, and the construction of drains and such additional bridges as would naturally follow the continued use of the trail, constant improvement may be expected.

Late in the winter of 1900 many of those having interests in the interior transported their supplies by means of trail sleds drawn by horses over the Military route rather than by the shorter, though more difficult, glacier route, and it seems probable that the latter will eventually be abandoned in favor of the former.

Tonsina trail.—A good trail is reported from the vicinity of Tonsina Lake, along the northern bank of the river as far as the military bridge, and from here native trails are reported on both sides of the river, extending as far as Copper River. So far as known, the trail on the south side has not been followed by white men, but that along the north side of the river was opened in 1899, and forms a very easy line of travel from Tonsina bridge to Copper River, on the banks of which it comes out at a point about a mile below the mouth of Chetaslina River. From this place a native trail leads along the bluffs of

the Copper to the delta of Tonsina River, but this has been abandoned by those who have had occasion to traverse the region, and a new trail has been cut through the woods somewhat back from the river. Either of these trails, however, is entirely practicable.

Tonsina River to Taral.—Crossing Tonsina River near its mouth, an old native trail is found on the south side, which may be followed without difficulty and which was chopped out for the greater part of its length by the Schrader party in 1898. About 8 miles below Tonsina River it enters a valley parallel with Copper River and lying back from it a short distance, and follows along its course as far as Oostina Creek, just above Taral. From this point a trail is reported leading from Copper River and crossing the range to the head of the Kanata, but no definite information concerning it is at hand.

From a point opposite Tonsina River there is a well-marked native trail which has been chopped out by prospectors in that part of its course where it lies in the timber. This trail extends to the mouth of the Chitina and is entirely practicable, although it becomes somewhat dangerous at high water, since in several places it follows the clay banks which rise steeply from the river. On one occasion a horse is reported to have slipped into the river and to have been lost. Crossing Chitina River, which is probably fordable at low water, a trail is found running to the village of Taral and thence for several miles down the river, following the bank of the canyon.

Tonsina River to Copper Center.—From Tonsina River at a point about 6 or 8 miles above its mouth the trail of the Schrader party may be followed to Copper Center, although the route is reported as a very difficult one. From the Indian settlement at the mouth of the Tonsina there is also an Indian trail leading northward. It may be followed without difficulty as far as the Indian huts opposite Chetaslina River, but above this it is reported as impassable for horses.

Hanagita trail.—From the Indian village of Taral, below the mouth of the Chitina, there is a well-traveled Indian trail leading back into the depression which has been named Hanagita Valley, and which runs parallel with the course of Chitina River and at a distance of 10 to 15 miles from it. This trail was traversed by surveying parties during the autumn of 1900. From Taral the trail has a general easterly course, passing over the mountains lying between the angle of Chitina and Copper rivers and reaching a pass at an elevation of about 3,000 feet, thence circling about the high mountain east of the lower end of Wood Canyon and coming out into a flat divide between the waters which drain into the Chitina and those having their rise in the Hanagita Valley and flowing to the Copper. After a sharp descent of about 1,500 feet from this divide to the creek bed, the steepest and most difficult portion of the whole trail has been passed, within a distance of 6 or 8 miles from Taral. From this point the trail has a practically

straight course, and may be followed with ease across Tebay, Klu, and Chitina rivers, and thence to Tana River, which it reaches about 5 miles above its junction with the Chitina. The route is a comparatively open one, and the country traversed affords abundant forage for horses. Through the timbered portion of this region the natives have cut out the trees and bushes, so that the trail is well marked. Any difficulty found in following the usual lines of travel will be in swampy ground, where the natives are accustomed to pick their way and return to the course when the ground becomes harder.

In attempting to find this trail, which had been reported by prospectors, we were aided by directions given by Hanagita, the present chief of the Taral Indians, but the main traveled route was not discovered until Chakina River was reached. The intermediate ground between the Tana and the last-named river was traversed over an independent route. For any who should subsequently travel this trail it would probably be better to keep as nearly as possible to the line traveled by the natives.

At a point about 25 miles east of Taral a trail leads off toward the north, and is reported to connect with the trail crossing Chitina River about 7 miles above the mouth of the Nizina, and striking across to that river to join the trail which is known to follow the eastern bank of the Nizina as far as Nikolai House. This is the route known as the Nikolai trail, and is the one followed by Edward Gates in company with a native who guided him to the Nikolai mine in the summer of 1899.

By means of these two Indian trails the upper part of the Chitina drainage is easily reached from Taral, and should the route which is reported to exist from the head of Kanata River to Taral be discovered it would be very easy to reach the southern side of the Chitina Basin with pack trains. Also, should it be desired to prospect or explore in the region south of the Hanagita Valley, a region drained by streams of considerable length, well timbered, and of comparatively easy access, this country could also be reached by means of the Hanagita trail. It is supposed that these streams running into Chitina River head against Bremner River.

Kotsina trail.—About 3 miles below the mouth of the Kotsina, on the east side of Copper River, there are some Indian huts, and here the Indian known as Bellum has his residence. From this place there is a trail running in a southeasterly direction to the Kotsina at a point where it comes out of the mountains, a distance of 9 miles from Copper River. From this point it extends up the Kotsina to the glaciers at its head, and branch trails run up the various tributaries of the river. One of these branches follows Rock Creek toward the south, and by a pass about 4,800 feet in height makes its way into the southern fork of Strelna Creek, from which place it may be followed to the main

Chitina trail, which crosses Strelna Creek a short distance below the point where it emerges from the high mountains.

Trails to the Nikolai mine.—The first route followed by pack trains between Tonsina River and the Nikolai mine was by way of the trail already described, down the east side of the Copper to the mouth of the Chitina and thence to McCarthy's cabin, about 8 miles above its mouth. At this point the trail left the river and, striking across country, reached Strelna Creek, which it followed nearly to where it emerges from the mountains. Here it joined the Strelna trail, which has been described in the preceding paragraph, and the main Chitina trail as now used.

During the summer of 1900 the prospecting party operating under the direction of Mr. R. F. McClellan turned their attention to shortening the trail between the Tonsina and the Nikolai mine. They chopped a way through the timber from a point opposite Tonsina River to a point on the Kotsina trail about $2\frac{1}{2}$ miles from Copper River, and thence followed a direct route to the point on Strelna Creek where the old trail turns southeastward, crossing the Kotsina about 9 miles above its mouth. From Strelna Creek the route lies along the timbered plateau and in places follows an old Indian trail. Kuskulana River was originally crossed upon the lower end of the glacier, but during the summer of 1901 this route became impracticable owing to changes in the drainage of the glacier, and it became necessary to ford the river. The usual fording place is about $2\frac{1}{2}$ miles below the end of the glacial stream, but the ford is constantly changing through shifting of the sand and gravel. The route from Copper River to the Kuskulana is a comparatively easy one; the difficulties which are encountered are those attendant upon soft ground, but by burning the timber along the route this feature will be very largely overcome.

After crossing the Kuskulana Glacier the trail ascends a somewhat difficult gulch to a pass at about 3,500 feet, and thence continues by a comparatively easy grade across Chokosna Creek to Lakina River. From this place there are two routes. The old one, leading across the range, reaches the valley of Kennicott River several miles above the foot of the glacier. It is a steep and difficult trail and is now abandoned in favor of a route which follows down the west side of the Lakina, which it crosses just before it leaves the mountains, and, ascending on the eastern side, follows the plateau around the base of the mountains, reaches Kennicott River just below the glacier, and crosses upon the foot of the moraine. From Kuskulana River to the Kennicott is perhaps the most difficult portion of the whole trail, since the ground is swampy throughout almost the whole distance, and after the thawing of the ground it becomes very difficult for horses to carry considerable loads over it.

From Kennicott River the trail leads up McCarthy Creek, which

stream it crosses several times below the mouth of Nikolai Creek, coming in from the east. Following up this stream, it ascends to the Nikolai mine, which is located at an elevation of approximately 4,600 feet. It is possible to travel with horses eastward from the Nikolai mine across the divide into the drainage of Nizina River and to follow this river as far as the glacier. Also, doubtless, Chitistone River could be ascended for a considerable distance, probably to within a few miles of Skolai Pass, which is reported to be more easily reached from the Chitistone than from Skolai Creek, which joins the Nizina several miles higher up and above the foot of the glacier.

Routes east of Nizina River.—In order to reach Chitina and Tana rivers during the explorations of 1900, it was necessary to cut a trail from a point about 6 miles above the mouth of McCarthy Creek and across the intervening low mountains to Nizina River. While this was being done by the camp men, the geologists in charge, and the topographers made their way into the country lying between Nizina and Chitina rivers. No difficulty was found in traversing this region. There are native trails following the principal streams. From the Nizina the trail was carried to the Chitina at a point just above the junction with Tana River. Above this point the Chitina Valley was traversed for a distance of 15 miles, and with horses it would be possible to go a considerably greater distance. A trail was also opened along the eastern side of the Tana as far as the glacier at its head; and from the Tana, which was crossed about one-half mile above its mouth, a trail was cut to Chakina River and up the western fork of that stream until the native trail, which has been named for Chief Hanagita, was found.

Millard trail.—The Millard trail follows an old native route from a point on the Copper opposite the mouth of the Klutina up Klawasina River and thence along the base of Mount Drum, and, crossing Sanford River, reaches Slana River by a route lying at some distance from the Copper. Throughout this distance the trail is said to be well marked and comparatively easy for horses. The Millard trail is the shortest route from Copper Center to Slana River at Mentasta Pass.

Chestochina trail.—A route of travel which has been followed for several years runs along the western bank of Copper River from Copper Center to Slana River and thence to Mentasta Pass, affording an alternate route with the Millard route to the Tanana and Yukon regions. This trail has been considered more difficult than the Millard trail because of the size of the rivers which it has to cross; however, it has been deemed the most feasible route for the Military trail, and it is the purpose of those having the matter in charge to extend the trail as far as the middle fork of Chestochina River and ascend this stream for a considerable distance before turning to the right and reaching Mentasta Pass. The general line of travel for those who

have explored the Upper Chestochina has been to the mouth of the river and thence along its left bank to the headwaters.

From the upper part of Chestochina River it is comparatively easy to reach the route which has been followed from Cook Inlet across the great Matanuska Plateau to the head of Delta River and thence to the Tanana.

Before the end of another season the construction of the Military trail will doubtless have been completed as far as Mentasta Pass, and much of the danger attendant upon crossing the swift glacial streams north of Klutina River will be avoided.

Copper River to the Nabesna.—The following description is taken from a report by Oscar Rohn:¹

From Batzulnetas a good trail leads in a general southerly direction for a distance of about 10 miles, where it forks, leading by three different passes to the Nabesna River. These are all feasible for horse trails, and each is advantageous according to the point on the Nabesna that is to be reached. The western one, by way of Lake Tanada, was used by prospecting parties traveling with pack train during the season of 1899, and the central one was used as a sled route. The eastern one, however, is the most practicable and the easiest, particularly for reaching the trail from the Nabesna to the Tanana and White rivers. The western one, which was traveled by pack trains, is well marked up, but the others are difficult to follow and require guides.

The trail from the Nabesna to the Tanana leads to one of two passes. The northern one, the most direct and the one used by the natives, is not feasible for pack horses, while the one a little farther south is. This is the only part of the route that offers any difficulty whatever for railroading, but the difficulties are not such that they can not be readily overcome.

Copper River to the Tanana.—From Copper River there are several trails leading to the Tanana, and thence to the White River and Yukon regions. From the vicinity of the mouth of the Slana there are four routes across the mountain range; two of them lead to Mentasta Pass, as does also the proposed Army trail, while the others traverse the range in passes farther to the southeast, the first of which is known as Suslota Pass, while the second is as yet unnamed. All of these routes have been traversed by prospectors and are reported to offer no extraordinary obstacles to travel with pack trains.

GEOGRAPHY.

The Prince William Sound and Copper River district, taken as a whole, lies at the head of the Gulf of Alaska, where, roughly considered, it forms an inverted keystone of the great arch or crescent of the coast line. It is limited, in a general way, by parallels 60° and 63° north and meridians 142° and 149° west. Its outline is quadrilateral, or roughly that of a truncated isosceles triangle, the base coinciding with the sixtieth parallel. Its area is about 55,000 square miles.

¹A reconnaissance of the Chitina River and the Skolai Mountains, Alaska: Twenty-first Ann. Rept. U. S. Geol. Survey, Part II, 1901, p. 417.

It is bounded on the north and on northeast by the basin of the Yukon, here represented by the Upper Tanana district; on the east by the Upper White River district, and on the northeast by the St. Elias Mountains; on the south by that part of the North Pacific Ocean known as the Gulf of Alaska, and on the west, beginning at the north, by the Sushitna River district and Kenai Peninsula.

From near Mount St. Elias a broad belt of snow-capped mountains, 5,000 feet high, concentrically follows the crescent of the coast line westward and southwestward to Kenai Peninsula, where the mountains descend to the sea. In the northeastern part of the district the local but somewhat noted group of mountains of which Mount Wrangell is the highest peak rises to a height of more than 17,000 feet.

The drainage of the district, which is separated from that of the Yukon on the north by the Alaskan Mountains, is all southward, directly to the coast. The master stream is Copper River, which flows southward through the district. It breaks through the Chugach Range in a long, mountainous canyon, and soon after debouches over its large mud-flat delta into the sea.

TOPOGRAPHY.

Prince William Sound.—To the body of water, with its islands, which is now known as Prince William Sound, the name "Chugach Gulf" was formerly applied. The term *sound* is not correctly applied to a body of water of this description, but rather to a strait of large size, and while *gulf* is preferable, since it indicates a large body of water lying within a curving coast line, the geographic term which best fits the conditions is *archipelago*. However, common usage can hardly be changed at this time, and the inner, island-studded portion of the Gulf of Alaska will continue to be known as Prince William Sound.

The number of islands comprised in the area is approximately fifty, and for the most part they rise abruptly from the water to a height which is usually between 1,000 and 2,000 feet, but in some cases their summits reach above 3,000 feet. The interior of Prince William Sound forms a basin that is almost entirely landlocked, being sheltered from the ocean on the south by Hawkins, Hinchinbrook, and Montague islands. The islands of the archipelago show a general linear arrangement, which is roughly parallel with the course of the peninsulas between the fiords which cut back from the more open water into the Chugach Mountains.

Montague, Hinchinbrook, and Hawkins islands cut off the waters of the sound from the open gulf, and, with Knight and Flemming islands, form the five principal land areas of the archipelago. Montague Island is approximately 45 miles long and has an average width of from 6 to