

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

BULLETIN 605

THE ELLAMAR DISTRICT, ALASKA

BY

S. R. CAPPS

AND

B. L. JOHNSON

PROPERTY OF
The Alaska Agricultural College
and School of Mines



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between Boulder and Galena bays, and the other, which enters from the north and is called Indian Creek, drains a basin lying south of the divide between Jack and Galena bays.

Two creeks of moderate size enter the head of Landlocked Bay. Lagoon Creek, the larger of these, heads to the northeast, toward the east side of Mount Denson, and in at least two places near its lower end has cut short, sharp canyons into the slates and graywackes over which it flows. In the upper canyon there is a waterfall in a narrow cleft in the rock. The stream heads outside the mapped area, and the exact location of its headwaters is not known. Reynolds Creek, the second largest tributary of Landlocked Bay, enters the bay from the northwest and drains a small area northeast of Copper Mountain. It has a canyon near its mouth. A water right has been staked on it for the purpose of developing power for the mine at Landlock.

In addition to the streams already mentioned a large number of smaller streams reach the coast, some of them permanent, though many flow intermittently. Some of these streams occupy well-defined though short valleys; others flow in shallow notches down the steep mountain sides or emerge at the sea from indefinite channels on the borders of the swampy lowlands. During a heavy rainstorm in Landlocked Bay 32 streams could be seen on the south side of Copper Mountain, where ordinarily only two or three are visible.

TRANSPORTATION.

The Ellamar district is favored with unusually good transportation facilities as compared with most parts of Alaska. As it lies on deep water it can be reached directly by ocean vessels, and it is on the regular route of the two steamship lines that ply between Seattle and ports on the Gulf of Alaska. During the summer about one boat a week, on the average, brings passengers, mail, and freight from Seattle to Ellamar, which is a regular port of call. Occasionally the boats stop both on their way west and on their return trip, but more often only once on each round trip. The channel leading to the Ellamar pier is narrow and somewhat difficult to navigate, so that passengers, mail, and light freight are usually discharged by small boat, the steamship remaining in deep water out in Tatitlek Narrows. In winter the steamships run somewhat less frequently, but even then a satisfactory service is maintained. In addition to the passenger boats several boats that carry freight exclusively are kept in service, their schedules depending to some extent on the quantity of ore available for shipment. These boats load ore at the piers at Ellamar and Landlock. The regular fare for passengers from Seattle to Prince William Sound ports is \$45. Freight rates depend

on the class and the amount of freight of ore from the mines to the smelter at rates as low as \$3 a ton.

Since conditions for travel by boat whereas travel on land is difficult because of heavy vegetation, very little effort has been made to build roads between the mining camps and shore and roads to them are unnecessary. Some sort of a trail leading to the mine road about 4 miles long has been built. Some prospects on the north side of the road runs from the head of Landlocked Bay to the northwest. With these exceptions travel by land. Practically all communication between the camps is by water.

CLIMATE.

The climate of this district is not typical of Alaska nor is it subject to the great extremes of Alaska. Owing to the modifying influence of the water, the winter temperature seldom falls below zero. In the Prince William Sound region, where the miles apart may differ greatly, depending on the mountains and valleys, the winds from different directions. For these reasons a study of the weather records may fail to give an adequate idea of the climate near by. In the district under discussion, the nearest points for which weather records are obtained being at Orca, Cordova, and Sitka, do lie about 40 miles southeast of Ellamar. The climate at those three places is not typical of the temperature and precipitation at Orca, Cordova, and Sitka, below, represent rather closely the climate of the district. They are only 3 miles apart, and the temperature records between June, 1899, and March, 1900, for Cordova, extending through D

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on the class and the amount of freight. Contracts by large shippers
 of ore from the mines to the smelter at Tacoma have been made
 at rates as low as \$3 a ton.

Since conditions for travel by boat are so favorable in this district,
 whereas travel on land is difficult on account of the steep slopes and
 heavy vegetation, very little effort has been made to improve trails
 or roads between the mining camps. All the large mines are near the
 shore and roads to them are unnecessary. Nearly every prospect has
 some sort of a trail leading to the nearest point on the beach. A good
 road about 4 miles long has been built from the head of Galena Bay to
 some prospects on the north side of Copper Mountain, and another
 road runs from the head of Landlocked Bay for about a mile to the
 northwest. With these exceptions nothing has been done to facilitate
 travel by land. Practically all communication between the mining
 camps is by water.

CLIMATE.

The climate of this district is not so mild as that of southeastern
 Alaska nor is it subject to the great ranges of temperature of interior
 Alaska. Owing to the modifying effects of the Japan current, the
 winter temperature seldom falls below zero, and the summers are mild.
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 miles apart may differ greatly, depending on their situation with rela-
 tion to the mountains and valleys of the mainland, their exposure to
 the winds from different directions, and their nearness to the coast.
 For these reasons a study of the weather records taken at one place
 may fail to give an adequate idea of the conditions at another place
 near by. In the district under discussion no weather records are avail-
 able, the nearest points for which a series of observations could be
 obtained being at Orca, Cordova, and Fort Liscum. Orca and Cor-
 dova lie about 40 miles southeast of Ellamar, but it is believed that
 the climate at those three places is much the same and that the tem-
 perature and precipitation at Orca and Cordova, given in the table
 below, represent rather closely those at Ellamar. Orca and Cordova
 are only 3 miles apart, and the table for Orca, covering the period
 between June, 1899, and March, 1908, is supplemented by the table
 for Cordova, extending through December, 1912.

31-1-25

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

BULLETIN 607

THE
WILLOW CREEK DISTRICT

ALASKA
PROPERTY OF
The Alaska Agricultural College
and School of Mines

BY
STEPHEN R. CAPPS

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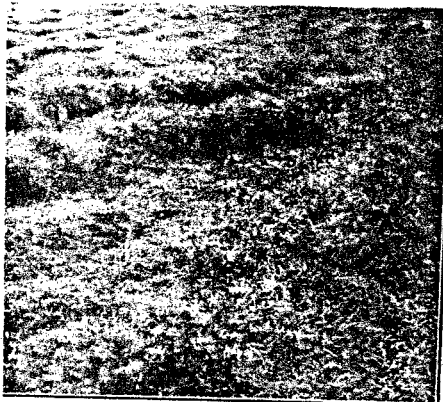
SUPPLIES AND TRANSPORTATION.

The Willow Creek district is always approached by way of the village of Knik, which is the center of supplies for this region. Although Knik is situated on Knik Arm, an embayment of Cook Inlet, it is on the shallow upper portion of the inlet and can be reached by boat only at high tide. When the tide is out no water is visible from the village, which then looks out upon miles of barren mud flats cut by an irregular network of tidal channels. At high tide boats drawing several feet of water may reach the town by following one of the deeper channels. During about half the year the upper part of Cook Inlet is closed to navigation on account of the ice which forms in it. The head of the inlet is made brackish by the large quantity of fresh water which it receives from Susitna, Matanuska, and other rivers, and on this brackish water ice forms more readily than on the normal salt water. The mean tidal range is about 30 feet, and in the rapid currents formed by the tides the ice is carried back and forth and renders navigation impossible during the winter. During this time the village maintains communication with the coast by way of a trail which crosses the divide at the head of Crow Creek, passes around the head of Turnagain Arm, and thence follows the general course of the railroad to Seward. The mail is brought over this route by dog trains, but the other traffic is so small as to be negligible.

During the open season practically all travelers to Knik go by ocean steamer to Knik Anchorage, near the mouth of Ship Creek, about 18 miles below the town. From the anchorage freight is lightered by scows to Knik and passengers are transferred by launch. In 1913, between May and November, one steamship, plying from Seattle through southeastern Alaska to ports on the Gulf of Alaska and Cook Inlet, made trips every three weeks to Knik Anchorage. The passenger rate in 1913 between Seattle and Knik Anchorage was \$55 each way. The freight rate varied with the class of material shipped but was \$30 each for horses and from \$15 to \$26 a ton for groceries and provisions. Wharfage at Seattle was not included in these charges, and the additional cost of transportation from Knik Anchorage to Knik was \$2 each for passengers, \$8 a head for horses, and 30 to 40 per cent of the freight rate from Seattle to Knik Anchorage for supplies.

Two routes were formerly in general use between Knik and the mines in the Willow Creek district, both of which followed the shore of Knik Arm in a northeasterly direction as far as the mouth of Cottonwood Creek, 6 miles from Knik. From Cottonwood the Bald Mountain trail extends northward across the lowlands, crosses Bald Mountain Ridge into the head of Wet Gulch, follows Wet Gulch to its mouth, and thence goes up Willow Creek. One branch extends up Craigie Creek valley, and another crosses the divide to the Little

BULLETIN 637 PLATE VII



ON TOP OF BALD MOUNTAIN RIDGE.



ON TOP OF BALD MOUNTAIN RIDGE.

Susitna basin, follows down Hatcher Creek, and ends at the mines on upper Fishhook Creek. The portion of this trail which lies in the mountains affords good footing, but the stretch between Cottonwood and Bald Mountain Ridge is said to be soft in summer. The lowland portion is now little used. The other route was the old Carle wagon road, which extended from Cottonwood northeastward to Little Susitna River, several miles below the canyon, and after crossing that stream kept on its west side to Fishhook Creek, which it followed up to the mines. The Carle road has now been displaced by a new wagon road completed by the Alaska Road Commission in 1913. This road follows the general course of the Carle road from Knik for 23 miles, but keeps to the right of Little Susitna River as far as the canyon, crosses it in the canyon, and extends up the west bank of the stream and up Fishhook Creek to the mines. This road is well graded, is furnished with good bridges, and is now used for practically all summer travel to the Willow Creek district as well as for winter travel to points in the Fishhook and Little Susitna valleys. The winter road for sledding to the Willow Creek basin leads northward from Knik, skirts the west end of Bald Mountain Ridge, and proceeds up Willow Creek.

The summer freight rate by wagon to upper Fishhook Creek from Knik is from 4 to 5 cents a ~~power~~. Supplies for the Willow Creek basin must be transported by pack train from Fishhook Creek, at a considerable additional expense. In winter freight may be sledged to the camps by either the new wagon road or the Willow Creek winter road, at about half the cost of summer transportation. The district will be made readily accessible by the Government railroad from Seward to Fairbanks, construction of which has been begun. This railroad will pass close to the southern margin of the district, and the distance to Seward, its coastal terminal, will be about 165 miles.¹ The plan includes a branch line into the Matanuska coal field, with another tidewater terminal at the mouth of Ship Creek near the entrance to Knik Arm, which will be available during the season of open navigation on Cook Inlet.

GEOLOGY.

PRINCIPAL FEATURES.

The areal distribution of the geologic formations of the Willow Creek district is shown on the accompanying map (Pl. III, in pocket) and the relations of the various rock formations to one another are represented in a generalized form in figure 2. The details of distribution of the different formations as shown on the geologic map differ somewhat from those shown on earlier published maps of this district, more accurate representation having been made possible by

¹ Railway routes in Alaska: Alaska Railroad Comm. Rept., House Doc. No. 1346, pts. 1 and 2. 62d Cong., 3d sess., 1913.

the longer time available for the surveys and by the completion of a part of a large area that was previously published. The Willow Creek district is only a short time ago, the main subdivisions made

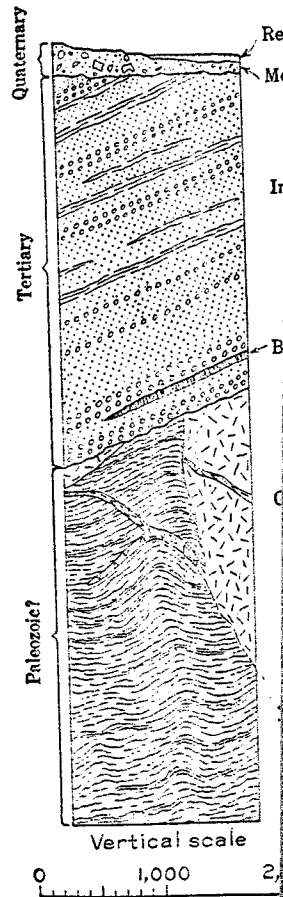


FIGURE 2—Generalized columnar

Katz² are adopted here. The Bald Mountain Ridge and Willow Creek district and Mountain region. They contain garnetiferous mica schists and

¹ Paige, Sidney, and Knopf, Adolph. Geol. Alaska: U. S. Geol. Survey Bull. 327, Pl. I.

² Katz, F. J., A reconnaissance of the Willow Creek district, Alaska, 1911.

4-1-25

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

BULLETIN 608

THE
BROAD PASS REGION, ALASKA

BY

FRED H. MOFFIT

WITH SECTIONS ON

QUATERNARY DEPOSITS, IGNEOUS ROCKS
AND GLACIATION

BY

JOSEPH E. POGUE

PROPERTY OF
The Alaska Agricultural College
and School of Mines



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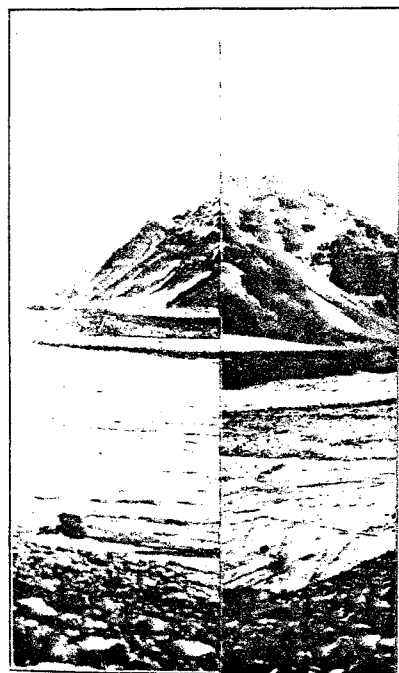
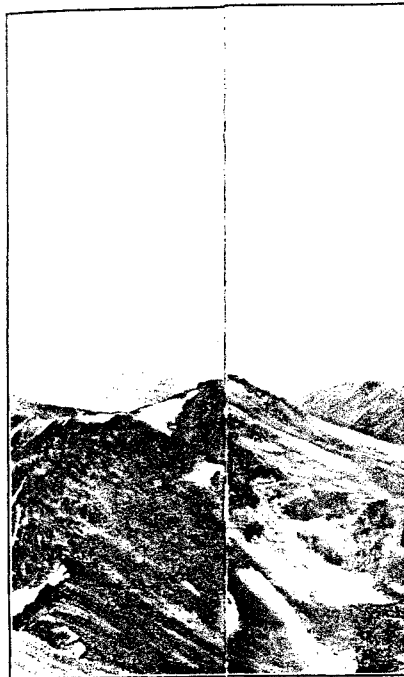
Its current, although swifter in this lower course than above, is not so rapid as that of Yanert Fork or of Delta River, which cuts through the range in a similar way farther east.

The principal tributaries of Nenana River, aside from the Yanert Fork, are Wells Creek on the north and Jack River and Brushkana Creek on the south. The eastern branch of Wells Creek, which joins Nenana River about 15 miles above the mouth of Jack River, and the Nenana itself for 5 or 6 miles above Jack River, lie in a minor intermontane valley that extends westward from the Nenana Glacier. Brushkana Creek, which is as large as the Nenana at the junction of the two streams, drains the central part of the area mapped and flows for the most part in a lowland country covered with marshes and small lakes. Jack River, on the contrary, is surrounded by high mountains (Pls. IV, *A* and *B*, p. 12). Its principal branches flow in deep, rocky canyons and its current is swift. The waters of Jack River, like those of the Brushkana, are clear.

Chulitna River drains the western side of the area. It is a large stream, but only the upper part of two of its branches lie within the area here mapped. It receives the water from many large glaciers in the vicinity of Mount McKinley, as well as from several eastern tributaries, and unites with Susitna River about 75 miles from the coast.

Butte, Watana, and Deadman creeks are the largest tributaries of Susitna River that rise within the area mapped. They can hardly be considered as belonging properly to the Broad Pass region, but they lie within the area of the summer's work. Butte Creek flows from Butte Lake, the largest lake shown on the map.

Routes and trails.—The Broad Pass region has been reached by three routes. The earliest explorers and prospectors approached it from the south through the Susitna and Chulitna valleys. Later hunters and prospectors came into it from the Tanana Valley through either the Nenana River or the Wood River valley. Others approached it by way of Valdez Creek and over the trails leading westward from the Military Road. All three routes have certain advantages and all offer difficulties. For summer use the route from the east is probably the best. At the outset it offers the advantage of a good wagon road from Valdez or Chitina, and farther on, between the road and Valdez Creek, of trails that are being traveled more and more each year. In contrast to this, the route from Cook Inlet is little used. No trails have been marked out in the valleys of Indian Creek or the Chulitna and no means of transportation have been established on Susitna River. The route from the Tanana Valley is traveled occasionally by hunters and less often by prospectors, but no trails have been made.

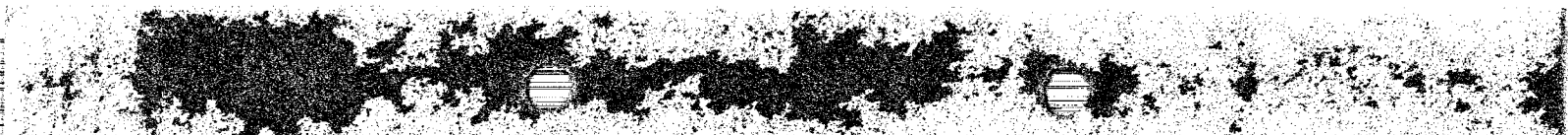


In winter the Susitna and Chulitna rivers, Nenana River, and the upper Susitna River afford practicable routes for freighting such supplies as would be required by prospectors in the Broad Pass region. Most of the supplies and mining equipment taken to Valdez Creek since 1907 have been sledged over the ice of Gulkana and Susitna rivers, yet in some of these years a part of the supplies has been brought from Fairbanks on the Nenana and Susitna rivers.

In the Broad Pass region travel has been so slight, and the visits of white men have been so infrequent and their wanderings so variable, that no usable trails have been established. In places the Indians, passing from one hunting ground to another, have followed trails that can be traced readily for short distances. In places also wandering caribou and moose have left trails that are still more conspicuous but that for the most part are of little benefit to travelers. It is evident, then, that all who now go into the region must choose their own ways. Travel, however, is not difficult for either horses or men where courses in the higher ground can be used. The best going is generally above timber line, at elevations between 2,800 and 3,500 feet above the sea. At such elevations trees and brush are absent, soft ground is less common, for the steeper slopes give better drainage, and grass for horses is most plentiful and of the best quality. The supply of firewood is less abundant than in the lower valleys, but willows for cooking and for tent poles can usually be found at elevations below 3,200 feet. In the lowlands the swamps and lakes make travel slow and tiresome.

Some of the larger streams offer difficulties to travel both because of their depth and swift currents and because of quicksand. Nenana River and Yanert Fork may be difficult or even impossible to ford at times of high water, but on cool days later in the summer may be forded safely if care is used in choosing the place. A few of the small streams are so full of granite bowlders that horses are likely to have trouble in fording them.

Railway routes.—Broad Pass offers one of the most favorable railway routes from the Pacific seaboard to the Tanana and Yukon basins and has been chosen for the route of the Government railroad from Seward to Fairbanks. The Chulitna, flowing into the Susitna on the south, and Jack River, flowing into the Nenana, a tributary of the Tanana, on the north, both head in Broad Pass. It therefore marks the watershed between Cook Inlet and Yukon drainage. The waters of the Nenana in the past ran through Broad Pass into the Chulitna, but were diverted by the glacier that formerly occupied the region. Since the disappearance of the ice the drainage has not reverted to its preglacial course.



part of the region. Tyone River issues from a large lake, and after receiving Tyone Creek, a large tributary, locally known as Little Tyone, that rises in the Talkeetna Mountains, enters Susitna River near the "big bend." East of Tyone River are Oshetna River, with its two tributaries, Little Oshetna and Black rivers, and Kosina River. The main tributaries entering the Susitna from the north, named in order from east to west, are Coal, Watana, Deadman, and Tsusena creeks.

POPULATION.

Copper Center, the principal settlement of this region, is situated at the confluence of Copper and Klutina rivers, 101 miles north of Valdez, on the Fairbanks-Valdez Government road, and may be reached from Cordova by rail to Chitina, a distance of 131 miles, and thence by wagon for 50 miles, or by wagon road direct from Valdez. Copper Center is a distributing point for the Nelchina, upper Susitna, Gulkana, and Chistochina regions. A post office, a Government telegraph station, and a Government school for the natives are located here.

Nelchina is a small settlement of 15 or 20 cabins, at the mouth of Crooked Creek. It is the seat of the Nelchina recording precinct and the general headquarters of the neighboring region. Aside from these two settlements the white population of the region is confined to the road houses along the Government road and the transient prospectors and miners.

The Indian population is small. Cabins and camps on Klutina and Tazlina lakes, on Susitna River, and in other places are temporarily used by natives on hunting and fishing expeditions, but aside from a few natives scattered over the region the permanent Indian population is confined to Copper Center.

ROUTES OF TRAVEL.

The Nelchina region may be reached either by way of Knik or by way of Copper Center from Cordova or Valdez. The route from Copper Center follows the wagon road for 10 miles to a point half a mile north of Simpson's road house, and thence goes by a trail along the north bank of Tazlina River and Tazlina Lake to the mouth of Mendeltna Creek. From this point the trail takes a northwesterly direction to Little Nelchina River, and then follows that stream to Nelchina, at the mouth of Crooked Creek. This is a winter trail, and winds around somewhat, to take advantage of several large lakes. For summer travel it is in places very swampy and is passable for horses with difficulty. The distance from Copper Center to Nelchina is about 90 miles.

The Knik route goes by trail up to Chikaloon, from which several possible routes lead to the Nelchina region. One follows the Matanuska River, goes up Squaw Creek, and then down Crooked Creek. Another route is by way of Billy Creek to the head of Little Nelchina Creek to the head of Albert Creek. A third route is by way of Chickaloon and Talkeetna rivers to the waters of Kosina Creek, a tributary of the Susitna.

Supplies for this region are taken from Knik and Copper Center; but, as Knik is inaccessible in winter, freight from the outside usually comes from either Chitina or Valdez. The distance from Valdez to Knik is about 106 miles.

This region will be more accessible when a railroad is constructed along Susitna River, the Tanana and the branch line up to Chikaloon. When the coal-field branch of the proposed railroad reaches Chikaloon, Albert Creek may be reached in about 100 miles.

CLIMATE.

The climate is characteristic of the interior of Alaska. The rainfall is a medium amount for the region of the coast and the semiaridity of the interior. The days are warm, but sudden changes of temperature are common and may be accompanied with a heavy snowfall any time during the summer. The winter is long and the fall is not heavy. The open season for travel is from June until October, varying somewhat from place to place on the elevation of the region. Ice usually forms in November and lasts until March.

VEGETATION.

Spruce covers the lowland area to the north of the coast, but by local conditions but ranging from 20 to 40 feet. It varies considerably, from the scrubby spruce of the drained swampy areas to trees 2½ feet in diameter usually found in favored localities. The size and quantity for building and firewood is small. Birch, of which there are several species, is common. Cottonwood, willow, and other shrubs are common higher than spruce, and in places are available for firewood. Alder is not abundant.

issues from a large lake, and after a tributary, locally known as Little Nelchina Mountains, enters Susitna River. The Yone River are Oshetna River, with the Oshetna and Black rivers, and Kosina River entering the Susitna from the north. The rivers, are Coal, Watana, Deadman, and

RELATION.

settlement of this region, is situated on the Klutina rivers, 101 miles north of the Valdez Government road, and may be reached to Chitina, a distance of 131 miles by trail, or by wagon road direct from Copper Center, distributing point for the Nelchina and Tazlina regions. A post office, a school, and a Government school for the

of 15 or 20 cabins, at the mouth of the Klutina recording precinct and the neighboring region. Aside from the population of the region is confined to the Government road and the transient population.

Cabins and camps on Klutina River, and in other places are tenanted by hunting and fishing expeditions, but over the region the permanent population is Copper Center.

OF TRAVEL.

reached either by way of Knik or by Cordova or Valdez. The route from Copper Center is a road for 10 miles to a point half a mile from the mouth of the Klutina, and thence goes by a trail along the Klutina and Tazlina Lake to the mouth of the Klutina. At this point the trail takes a northwesterly course, and then follows that stream to the mouth of the Klutina. This is a winter trail, and the advantage of several large lakes makes the trail very swampy and is passable for the distance from Copper Center to Nelchina.

The Knik route goes by trail up the Matanuska Valley to Chickaloon, from which several possible routes lead to the Nelchina-Susitna region. One follows the Matanuska around the east end of Sheep Mountain, goes up Squaw Creek, and crosses a low divide to the head of Crooked Creek. Another route is the Hicks Creek trail, by way of Little Nelchina River, or by way of Alfred Creek to the head of Albert Creek. Susitna River may be reached by way of Chickaloon and Talkeetna rivers to low passes at the headwaters of Kosina Creek, a tributary of the Susitna.

Supplies for this region are taken in during the winter from both Knik and Copper Center; but, as Knik is not an open port during the winter, freight from the outside usually goes by way of Copper Center from either Chitina or Valdez. The distance from Albert Creek to Knik is about 106 miles.

This region will be more accessible when the proposed Government railroad is constructed along Susitna River through Broad Pass to the Tanana and the branch line up the Matanuska to the coal field. When the coal-field branch of the proposed railroad is built to Chickaloon, Albert Creek may be reached by an overland journey of 50 miles.

CLIMATE.

The climate is characteristic of the district lying behind the coastal barriers. The rainfall is a medium between the excessive precipitation of the coast and the semiaridity of the interior. The summers are warm, but sudden changes of temperature are not uncommon and may be accompanied with a heavy frost or light fall of snow at any time during the summer. The winters are cold, but the snowfall is not heavy. The open season for placer mining lasts from May until October, varying somewhat from year to year and depending on the elevation of the region. Ice suitable for winter sledding usually forms in November and lasts until March or April.

VEGETATION.

Spruce covers the lowland area to an elevation governed somewhat by local conditions but ranging from 2,500 to 3,000 feet. The quality varies considerably, from the scrubby growth covering the poorly drained swampy areas to trees 2½ feet in diameter, which are occasionally found in favored localities. Most of the timber is ample in size and quantity for building and mining purposes.

Birch, of which there are several varieties, is less abundant than spruce. Cottonwood, willow, and quaking asp are found at elevations higher than spruce, and in many localities furnish the only available firewood. Alder is not abundant.

DEPOSITS OF THE PORT VALDEZ DISTRICT.

D. L. JOHNSON.

INTRODUCTION.

This report is to describe briefly the general characteristics of the mineral deposits (Pl. VIII, p. 186). A brief preface bearing on the economic development of the district precedes a discussion and description of the mineral deposits and of many of the ore bodies. The work begun in the Port Valdez district by G. L. Harrington. Mr. Harrington's report of this report, which is only a preliminary account of the geology and mineral resources, and the final mapping and studies have been completed.

GEOGRAPHY.

The district is in the northeastern part of the State and comprises the area immediately adjacent to the coast (Pl. VIII.) The relief. The mountains inclosing the district and in parts of the district attain elevations of 6,970 feet. The main range of the coast, with peaks from 2,000 to 6,970 feet, lies north of Port Valdez. The mountainous spur south of Port Valdez, the main range is broken only by the head of the Valdez Glacier. A few lower mountains, cross the spur range between Port Valdez and the coast. The district has been intensely glaciated in places. In places of alpine glaciation, two distinct types are present, one shaped by frost action about

the surface of the glaciers, with sharp peaks, cirques, and narrow, steep-walled, comblike ridges, and the other with the rounded features of an area overridden and smoothed beneath glacial ice. The characteristic sharp, angular forms developed by high-level erosion occur at elevations above 4,000 feet. Practically all of the district below this elevation is characterized by the rounded summits, slopes, and U-shaped valleys produced by glacial abrasion.

In pleasing contrast to the rugged relief of most of the district are the broad, gravel-covered, timbered lowlands that border the head of Port Valdez. These plains, which slope gently seaward, all lie below an elevation of 250 feet above sea level. The Valdez and Mineral Creek plains have a slope of only 50 feet to the mile, and the gradient of the Lowe River flats is even less.

The glaciers that cover much of the area north of Port Valdez are, with the exception of Anderson Glacier, of the alpine type. Columbia Glacier, the largest in the Prince William Sound region, borders the northwestern part of the district. The long ice tongue of Valdez Glacier debouches on the gravel plain at the head of Port Valdez. Shoup Glacier discharges into Shoup Bay. Mineral Creek heads in a valley glacier, and numerous hanging glaciers occur in this and other valleys. Anderson Glacier caps the mountainous area between Sawmill and Shoup bays and occupies a pass between Shoup Bay and Columbia Glacier. South of Port Valdez only a few small glaciers remain.

The shore line is remarkably even. The shores are mostly steep, in places precipitous, and rocky, with a few small rock peninsulas and islands. The head of Port Valdez is fringed by a wide mud flat, and smaller flats adjoin the mouths of many of the streams. The otherwise even shore is dented by three small bays—Jack, Sawmill, and Shoup bays.

Most of the drainage of the district enters Port Valdez. The streams drain small areas, and are mostly short, and as they derive a considerable part of their water supply from melting snow and ice, the stream flow is subject to wide variations during the year.¹ Two power plants are in operation on Solomon Gulch, and some smaller plants are utilized during the summer. There are also some undeveloped water powers in the district.

COMMERCIAL CONDITIONS.

Port Valdez, the supply point of the district, with a population of about 1,500, lies at the head of Port Valdez, which is open to navigation throughout the year. It is the coastal terminus of the Valdez

¹ Ellsworth, C. E., and Davenport, R. W., Preliminary report on a water-power reconnaissance in south-central Alaska: U. S. Geol. Survey Bull. 592, pp. 178-179, 1914.

Fairbanks military road. It is connected by cable with Seward, Cordova, Juneau, and other points on the Alaska coast and with Seattle, and by telegraph with Fairbanks. Valdez can be reached in six days by steamer from Seattle. Two companies operate steamers to Valdez, giving a service in summer of eight times a month and in winter of four to six times a month. Freight charges from Seattle to Valdez (1915) vary from \$3 to \$40 a ton according to classification. Transportation for passengers (1915) costs \$45 for first class and \$25 for second class.

Valdez is provided with wharves, banks, hotels, stores, public schools, telephones, and electric lights. A good stock of supplies is kept on hand, and prices are not high except for fuel. Gasoline in 1914 cost 45 cents a gallon in 10-gallon cases, and British Columbia coal retailed at \$12.50 a ton delivered. The town has in the past been subjected to occasional disastrous floods of the streams from Valdez Glacier, but it is now protected by a dike built in 1913-14.

On the south side of Port Valdez wharves have been built at Solomon Gulch, forming the coastal terminal for the aerial tram of the Midas mine, and at Fort Liscum, an army post. Wharves have also been built at the mouth of Mineral Creek and at the Cliff mine. A wagon road has been built from the Mineral Creek wharf to a point 5 miles up Mineral Creek, and one up Solomon Gulch to the Midas mine. The other properties have been connected with tide water by trails, some of which traverse the glaciers.

Transportation along the coast is effected largely by the use of gasoline launches, some of which give a regular service to the Port Wells district. Launches can be chartered at a cost of \$10 to \$30 a day. Wages in the district are about \$3 to \$4 a day and board. At the height of the mining season in summer it is not always possible to obtain the services of experienced lode miners, though there are a number of them in the district.

The climate of the Port Valdez district is somewhat colder and drier than that of neighboring districts on Prince William Sound, which are more directly exposed to the influence of the Pacific Ocean. Records at Valdez show a total annual precipitation of about 56 inches; at Fort Liscum, on the south side of the bay, it is 74 inches. The average annual snowfall is about 30 feet. The average temperature for the three summer months is about 52° F. and for the three winter months about 21° F. At higher elevations the climate is more severe. The steep slopes and heavy snowfall lead to numerous snow slides, and this is one of the elements the miner has to contend with in winter work in the district.

Timber is scarce in the Valdez district, but there is some in the Lowe River valley and at Sawmill Bay. Trees 5 feet in diameter

may be found, but the average size is very small. Spruce and hemlock predominate, although on the higher mountains cottonwoods are more abundant. The timber extends from sea level to 1,500 feet. The timber available from Port Fidalgo, 20 miles to the west, is suitable for mine workings and rough lumber are brought from Seattle.

The district is included in the Chugach National Forest.

In the lowlands, which are not extensively cultivated, most of the horse feed is brought from the coast. Beans supply the hardier vegetables and potatoes, which are the only local sources of food.

To summarize the commercial conditions, the coal can be landed at tidewater on the coast. Transportation to inland properties, however, is expensive. Fuel is costly, but other supplies are not high. Timber, though abundant, has to be brought from points near by. Uninterrupted throughout the year, and no power is available throughout the year. The use of the Bering River and Matanuska River as a source of cheap fuel. The strong reluctance of lodes, where good evidence is shown, doing away with the necessity of a large investment at tidewater, like that of the Cliff mine, and the expense of pumping of water.

GEOLOGY

OUTLINE

The Port Valdez district lies in the Chugach Mountains, which so far as known consist of sedimentary rocks, chiefly slates, argillite, and shales with minor amounts of greenstone. In many places to schistose rocks by dynamite. The age of these rocks is unknown, but they are of Mesozoic or early Mesozoic. The intrusives are believed to be of Mesozoic age. Earlier workers in this part of the district and the Chugach Mountains have sub-

¹ Ellsworth, C. E., and Davenport, R.

of this area falls within the Nutzotin Mountains, which have an alpine character and consists of a series of ridges, separated by steep-walled mountain valleys. The highest peak is Mount Allen, which has an elevation of 10,000 feet. High points reach heights of 7,000 to 8,000 feet. The mountains in the more favorably situated valleys rise above the level of perpetual snow. The mountains are relatively small and, unlike those of the Wrangell and St. Elias ranges, are not conspicuous features of the landscape.

The drainage from this district is toward the Chisana Glacier of the same name and drains a large mountain mass, part of the Nutzotin Mountains, between these ranges. White River is fed by a number of glacial streams from the Wrangell and St. Elias ranges. The White, drains the south flank of the Chisana basin. It receives only water from melting glaciers and is a clear stream. The Chisana and White rivers, however, are of glacial origin and are characteristic of the heavily charged with sand, gravel, and silt the summer season, and flow over the surplus load supplied by the rapid fluctuations in volume, the seasonal range of temperature in the tributaries and by local conditions.

GLACIATION.

Ice of large size are numerous in the Wrangell Mountains, many smaller ice tongues are to be seen in the Nutzotin Mountains, these are of much greater ice fields which formed at the time of their greatest development. They covered all of the region except the Wrangell Mountains, broken only by the Nutzotin Mountains, slowly moving glaciers had greatly altered the shape of the land which they rounded the hills and widening the valleys. They also disturbed the preglacial stream courses so that old stream courses were completely obliterated. The results of the glacial effect upon the drainage of this district in which placer gold occurs

and the present distribution of the gold can be properly accounted for only after the influence of the glacial ice is taken into account. A further discussion of the influence of the ice upon the distribution of placer gold will be given in the more complete report on this district.

ROUTES OF TRAVEL.

The Chisana district is remote from all the well-established systems of transportation in Alaska (see fig. 5), and the available routes to it are subject to certain difficulties, so that communication with it is slow and the transportation of supplies is tedious and expensive. During the winter of 1913-14 the cost of transporting supplies by sled varied greatly with different freighters, being controlled by the efficiency with which the work was done, by the route traveled, and by the quantity of material moved. Reported costs of sledding, not including railroad or steamer freights to the point from which sledding began, varied from 12 to 50 cents or more a pound, but most of the contracts for freighting were let at prices between 20 and 30 cents a pound.

Seven different routes of travel to this district are available, and each has been traveled by many people. The route chosen by any person is naturally determined by the direction from which he wishes to approach the district, but for one coming to Alaska from Seattle a number of routes are available. Various articles have been published which make much of the difficulties of approaching this district, and especially of the dangers encountered in traveling the trails that lead from McCarthy by way of Nizina and Chisana glaciers and over Russell Glacier. It is true that during the stampede several persons were drowned in rashly attempting to ford the glacial Chitistone and Nizina rivers or their tributaries during periods of high water, but so far as could be learned only one man of several thousand who crossed the glaciers was lost. None of the routes is easy, and none should be attempted without proper equipment, but one familiar with the conditions of travel by trail in Alaska may use any of the routes here described. (See fig. 5, p: 189.)

NIZINA-CHISANA ROUTE.

The shortest route from the coast and the one most used during the winter of 1913-14 was by way of the Copper River & Northwestern Railway from Cordova to McCarthy, a distance by rail of 191 miles. From McCarthy all travel goes up the Nizina Valley to the mouth of Chitistone River, where the trail forks. For winter travel a trail was established up the Nizina to Nizina Glacier and thence up that glacier to its head, across a high ice divide with an elevation of about 8,000 feet, down Chisana Glacier to its terminus, and down Chisana Valley to the town of Chisana, a total distance of about 75

miles from McCarthy, of which about 40 miles is on glacial ice. This route was much used both by foot travelers and for freighting during the winter of 1913-14 and has the advantage of being at a shorter distance from a railroad than any other route. It is, nevertheless, a difficult and dangerous trail and was made passable only by the building of many temporary bridges across crevasses in the glacier and by a careful staking of the trail so that crevasses could be avoided when the snows had covered and concealed them. The movement of the glaciers also frequently caused the crevasses to engulf the bridges and opened new cracks which in turn required bridges. Furthermore, almost all work on the glacier portion of this trail must be renewed each fall, and new trails must be staked at places where changes in the ice conditions have rendered the old trail impassable. It seems probable, therefore, in view of the impossibility of establishing a permanent trail over the glaciers and the cost of restaking a trail and building new bridges each winter, that the route over Nizina and Chisana glaciers will not be long used.

NIZINA-WHITE RIVER ROUTE.

For summer travel a different route, by way of White River, was generally followed. From the mouth of Chitistone River two branches are available. One takes the same course as the glacier route up to and for a few miles on Nizina Glacier but branches eastward, crossing that glacier to the mouth of Skolai Creek. The Skolai Valley is then followed for 15 miles to its head in Russell Glacier. The other branch ascends Chitistone River to its head and crosses a high pass to the head of Skolai Creek, where the two branches join. Each of these branches presents some advantages over the other, and the travelers are about equally divided in their preferences. The Nizina-Skolai branch is several miles longer and necessitates the fording of Nizina River and the crossing of Nizina Glacier, but the trail is fairly good, the grade is moderate, and there is a better distribution of grass for horse feed. The Chitistone branch crosses Chitistone River several times, and that stream is subject to sudden floods. It also crosses a high divide over a narrow and somewhat dangerous trail known as the "Goat Trail." Furthermore, it is impassable on account of snow until early in July, and snows in the fall may block it by the 1st of September. To the cautious traveler the somewhat longer but safer Nizina-Skolai branch recommends itself.

At the head of Skolai Valley the two branches join, and a single trail extends for about 14 miles across Russell Glacier. For most of that distance the trail follows the moraine-covered portion of the glacier, winding back and forth over its irregular surface. Although the melting of the glacier affects the trail somewhat, rendering

certain portions impassable from time to time, if necessary, the glacier crossing is not more than six hours for pack horses. From the placer mines various routes may be found in the country with low passes, no difficulties but some soft ground. One of these routes is from the mouth of Lime Creek and goes in a high flat to the head of Gehocenda or stream to Chisana River, at the town of Beaver Lake to the town of Bonanza.

COPPER RIVER-NABESNA ROUTE.

The Copper River-Nabesna route starts at the Copper River & Northwestern Railway. It follows the Government military route from the Copper River to Gulkana. From Gulkana a trail follows the Copper River to the Indian village of Nabsna, then an eastward direction to the head of Placer Creek, then to Nabesna River. Crossing the Placer Notch creeks to Chisana River, 8 miles. By this trail the distance from Chitina to Nabesna and the route is little used for summer travel, the greater distance is largely offset by the avoidance of glaciers, and the abundance of grass on the whole route. The only high pass to Nabesna is a free divide at an elevation of about 5,000 feet on moderate grades. Considerable freight was carried on the winter of 1913-14 in competition with the Chisana route, although the sledding was as great, and many freighters are said to prefer the Nizina-Chisana to the Copper-Nabesna route.

DAWSON-WHITE RIVER ROUTE.

Many of the gold seekers in this district follow the Dawson-White River route. Freight may be taken on White River, a distance of about 70 miles to the mouth of Donjek River, or even to the mouth of the Dawson River, and poling boats can be used on White River a few miles below the mouth. White River freight is taken in winter, and a winter trail has now been cut from the mouth of the Dawson River to the point where that stream first crosses the Dawson River, said to offer no great difficulties, although

about 40 miles is on glacial ice. The 7 foot travelers and for freighting during has the advantage of being at a shorter any other route. It is, nevertheless, and was made passable only by the bridges across crevasses in the glacier trail so that crevasses could be avoided and concealed them. The movement caused the crevasses to engulf the bridges in turn required bridges. Furthermore, er portion of this trail must be renewed st be staked at places where changes in ered the old trail impassable. It seems of the impossibility of establishing a iers and the cost of restaking a trail and winter, that the route over Nizina and ong used.

WHITE RIVER ROUTE.

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certain portions impassable from time to time, so that short detours are necessary, the glacier crossing is not difficult and requires only two to six hours for pack horses. From the head of White River to the placer mines various routes may be followed through a rolling country with low passes, no difficulties being encountered other than some soft ground. One of these routes leaves White River near the mouth of Lime Creek and goes in a northwest direction across a high flat to the head of Gehoenda or Trail Creek and down that stream to Chisana River, at the town of Chisana. A branch of this trail leaves it near the head of Solo Creek and runs northward past Beaver Lake to the town of Bonanza.

COPPER RIVER-NABESNA ROUTE.

The Copper River-Nabesna route starts at the town of Chitina, on the Copper River & Northwestern Railway, 131 miles from Cordova. It follows the Government military road from Chitina up Copper River to Gulkana. From Gulkana a trail follows the north bank of Copper River to the Indian village of Batzulnetas, whence it takes an eastward direction to the head of Platinum Creek and follows that stream to Nabesna River. Crossing that river it follows Cooper and Notch creeks to Chisana River, 8 miles below the town of Chisana. By this trail the distance from Chitina to Chisana is about 235 miles, and the route is little used for summer travel. In winter, however, the greater distance is largely offset by the gentle gradient, the avoidance of glaciers, and the abundance of timber for fuel along the whole route. The only high pass to be crossed is Cooper Pass, an ice-free divide at an elevation of about 6,000 feet, approached by moderate grades. Considerable freight was taken over this route in the winter of 1913-14 in competition with the much shorter Nizina-Chisana route, although the sledding distance is nearly three times as great, and many freighters are said to contemplate a change from the Nizina-Chisana to the Copper-Nabesna route for future freighting.

DAWSON-WHITE RIVER ROUTE.

Many of the gold seekers in this district come from Dawson by way of White River. Freight may be taken by steamer up the Yukon to White River, a distance of about 70 miles, and by poling boats or shallow-draft power boats up White River as far as the mouth of Donjek River, or even to the mouth of Beaver Creek in favorable stages of water, and poling boats can be used to Canyon City, a village on White River a few miles below the international boundary. From White River freight is taken in winter by sled to the placer mines. A winter trail has now been cut from the mouth of Beaver Creek to the point where that stream first crosses the boundary, and this route is said to offer no great difficulties, although the distance by boat from

Dawson is about 175 miles to the mouth of Beaver Creek, and about 85 miles overland from the mouth of the Beaver to the placer mines.

TANANA-CHISANA ROUTE.

Upon the circulation of the report that rich placer discoveries had been made in the Chisana basin, a considerable number of men made their way up Tanana and Chisana rivers by launch and small boats. Under favorable conditions launches may be taken up these rivers as far as the north front of the Nutzotin Mountains, and boats were lined or poled all the way up to the mouth of Chathenda Creek. The route from Fairbanks, the base of supplies, is, however, long and difficult and, though possible, will never be an economical route for bringing in supplies. In the fall of 1914 many persons availed themselves of this water route and built boats in which they rowed downstream to Fairbanks.

WHITEHORSE-KLUANE ROUTE.

The route from Whitehorse to Canyon City by way of Kluane Lake is available for travel both in summer and in winter, though the winter trail makes some short cuts and is shorter than that used when the lakes are unfrozen. A wagon road has been built from Whitehorse to Lake Kluane, a distance of 143 miles, and a trail extends about 170 miles from the upper end of the lake to Canyon City, on White River, and thence 55 miles farther up Beaver Creek to the placer mines. The total overland distance by this route is therefore about 368 miles in summer and perhaps 20 miles less in winter.

COFFEE CREEK ROUTE.

Coffee Creek joins the Yukon 110 miles above Dawson. From the mouth of this creek a good trail has been built to the junction of Beaver Creek with White River, a distance of about 80 miles, and another branch leads to Canyon City, 120 miles by trail from the Yukon. From the mouth of Beaver Creek the trail to the Chisana placer mines reaches the Beaver at the international boundary and thence proceeds up the Beaver to its head. The total distance by this trail from the Yukon to the town of Bonanza is about 160 miles.

ACCOMMODATIONS ON THE TRAILS.

Along all the most used routes to the gold fields there were in 1913 and 1914 road houses at intervals of 15 to 30 miles at which meals and lodging could be procured. Thus along the Nizina-Chisana and Nizina-White River routes one could travel from road house to road house each day for the entire distance. On the Copper River-Nabesna route there are road houses along the Government military road as far as Gulkana. On the Whitehorse-Kluane route

road houses are maintained between Vancouver and none west of that portion of the trail. These road houses vary on the different lines of transportation from established lines of transportation from \$1 a meal and \$1 for lodging to \$1 for more remote portions of the region.

VEGETATION.

Only a small portion of this area is timbered along the lower valley slopes of Chisana and the glaciers in which these streams head, and the tributaries also have some timber in the valley, near the town of Chisana, trees were seen, but over most of the timbered areas do not commonly exceed 1 foot in diameter. In places where trees were seen above an elevation of 5,000 feet below that elevation are untimbered. The timber of the region, however, is above the timber line. Camp wood for fuel and lumber for other purposes must be brought several miles to be used. Willow and alder brush are abundant and devoid of trees and furnish sufficient fuel, but in the area between upper Beaver Creek and all the higher mountain masses even the brush is entirely lacking, and for even the smallest amount of camp wood must be brought from a distance. Grass for horses may be found in places in the region, although it is only locally abundant. It is specially plentiful in the valley of Coffee Creek near the mouth of Horsfield Creek. It is winter successfully at both places. It appears about the first of June, and continues until the heavy frosts begin early in the fall.

GAME.

Game was formerly abundant throughout the district but has been greatly thinned out in the interior. Elsewhere sheep are plentiful in the mountains and furnish a valuable food of furs. Provisions are so difficult to obtain that game is easier to hunt and are fairly plentiful between Beaver Creek and White River. In the White River valley near the boundary and in other parts of the district. Black and blue are seen. Both rabbits and ptarmigan

TRANSPORTATION.

One of the important items entering into all mining calculations is that of transportation. Not only does it materially affect the cost of supplies, but it may even determine the feasibility of an enterprise. To appreciate the importance of transportation it should be realized that practically the only ice-free winter route from the States to this part of Alaska leads to one of the small bays on the west side of Cook Inlet. From that place the route to the interior lies across the general trend of the country, so that several ranges must be traversed. A route of this sort presents many difficulties which add to the cost and time of transportation.

The more natural highways by way of Kuskokwim and Yukon rivers are blocked by ice from October to June. Furthermore, both of these streams lie north of the winter limit of sea ice, so that they can not be reached by boats from the States for seven months of the year. Therefore, although the rivers offer a water grade for hauling supplies and are much used for this purpose, they are of much less value than they would be if at least parts of them could be reached during the whole year by boats from the outside world.

During the winter, transportation is effected mainly by dog teams or, on well-beaten trails, by horse-drawn sleds. Road houses are maintained at intervals along the main lines of travel and afford food and shelter for both persons and animals. The main winter trail from Iditarod to the sea used for the transportation of mail runs in general eastward to Takotna, thence to McGrath, thence up the Kuskokwim across the divide at Rainy Pass, thence southeastward in the basins of Skwentna and Yentna rivers to the crossing of the Susitna at Susitna, and thence to Knik, a distance of about 500 miles. From Knik the usual trail is followed to Seward, where all the year around connection by steamboat with the States is maintained. Other much-traveled trails lead from Iditarod to the Yukon and the Tanana. Many of these trails are staked and flagged by the Alaska Road Commission, so that they are recognizable even in severe storms, which are by no means infrequent.

In summer the main lines of transportation to the region from the States are by a sea trip to St. Michael and thence up Yukon River, or by the so-called "inside passage" to Skagway, thence by rail to Whitehorse, and thence down the Yukon. The coastwise steamships that call at the ports on the southern coast of Alaska afford a third means of approaching the area. However, this route presents the difficulty, already pointed out, that from the western shores of Cook Inlet no easy route of transportation into the interior has been developed. Small ocean-going vessels can ascend the Kuskokwim in summer as far as Bethel, but no regular trips are made by this route.

The two main summer lines of travel are by Yukon and Kuskokwim rivers. Steamers, operated by the White Pass & Yukon Route, have a definite schedule on Yukon River. The same company run up Innoko and above that point still smaller boats, and individuals, complete the water trail. Individuals and independent companies also run schedules to the Yukon and Innoko rivers. On the Kuskokwim shallow-draft boats run the river from Bethel as far as Fairbanks. The amount of freight they carry is small.

The recent decision of the Government to develop parts of Alaska called attention to the southern coast into the interior. The Tanana Bay to Iditarod and Yukon Alaska Railroad Commission,¹ but which was recognized it was dismissed by the court. This route had been privately surveyed and had been filed in Washington in the past. It presents no very difficult engineering grades into the interior, but much of it is so far as known, little promise of the future.

During the summer transportation is effected mainly by boats on the rivers and by wagon country trips. A few wagon roads are so wet and muddy that only pack animals can be used on them. In striking contrast to this is the Flat City up Flat Creek. This country is in the States, and although it was not good roads can be made even under the present conditions met in this part of Alaska.

A tram road for horse-drawn cars connects Iditarod and Flat. This tram road runs in the summer and carries freight for 2 to 3 cents a pound. It runs all winter, but at that time of year it is much less difficult than in summer and is engaged, so that they can profitably

¹ Railway routes in Alaska: 62d Cong.

TRANSPORTATION.

is entering into all mining calculations not only does it materially affect the cost but also determine the feasibility of an enterprise. In view of the importance of transportation it should be noted that the only ice-free winter route from the coast leads to one of the small bays on the coast from that place the route to the interior of the country, so that several ranges of this sort presents many difficulties in the way of transportation.

is by way of Kuskokwim and Yukon from October to June. Furthermore, both the winter limit of sea ice, so that they come from the States for seven months of the year. The rivers offer a water grade for hauling for this purpose, they are of much less value. At least parts of them could be reached from the outside world.

Transportation is effected mainly by dog teams and horse-drawn sleds. Road houses are the main lines of travel and afford shelter for persons and animals. The main winter route is used for the transportation of mail from Bethel, thence to McGrath, thence up the coast to Rainy Pass, thence southeast to the mouth of the Yentna and Yentna rivers to the crossing of the Yukon, thence to Knik, a distance of about 500 miles. The rail is followed to Seward, where all communication with the States is maintained. The main lines of rail lead from Iditarod to the Yukon and the trails are staked and flagged by the Government so that they are recognizable even in severe winter.

Transportation to the region from the coast is effected by Michael and thence up Yukon River, thence by "stage" to Skagway, thence by rail to the Yukon. The coastwise steamships on the northern coast of Alaska afford a third route.

However, this route presents the same difficulties from the western shores of Cook Inlet. Transportation into the interior has been demonstrated and vessels can ascend the Kuskokwim in winter. Regular trips are made by this route.

The two main summer lines of transportation within the region are by Yukon and Kuskokwim rivers. A fleet of shallow-draft river steamers, operated by the White Pass & Yukon Route, follows a more or less definite schedule on Yukon River. Smaller boats belonging to the same company run up Innoko and Iditarod rivers to Dikeman. Above that point still smaller boats, operated by other companies or individuals, complete the water trip to Iditarod. Several individuals and independent companies also run river boats on irregular schedules to the Yukon and Innoko river ports.

On the Kuskokwim shallow-draft river steamers or launches run up the river from Bethel as far as Takotna. These boats seldom make more than three or four round trips a season, and the amount of freight they carry is small.

The recent decision of the Government to build a railroad to develop parts of Alaska called attention to the possible routes from the southern coast into the interior. Among others the route from Iliamna Bay to Iditarod and Yukon River was considered by the Alaska Railroad Commission,¹ but while its value for local uses was recognized it was dismissed by the commission, as it "is too far to the southwest to permit its use as a trunk line into the interior." This route had been privately surveyed in part and the papers on it had been filed in Washington in the General Land Office. The route presents no very difficult engineering problems and would afford easy grades into the interior, but much of it would lie in a country holding, so far as known, little promise of much economic value in the near future.

During the summer transportation within the region is carried on mainly by boats on the rivers and by horses or back-packing on cross-country trips. A few wagon roads have been built, but most of them are so wet and muddy that only very light loads can be drawn on them. In striking contrast to the other roads is the one from Flat City up Flat Creek. This compares favorably with many roads in the States, and although it was expensive to build it shows that good roads can be made even under the adverse conditions which are met in this part of Alaska.

A tram road for horse-drawn cars running on wooden rails connects Iditarod and Flat. This tram road is in operation only during the summer and carries freight the 8 miles between the two towns for 2 to 3 cents a pound. It undoubtedly could be kept open in winter, but at that time of year transportation across country is much less difficult than in summer and the people are not otherwise engaged, so that they can profitably do their own freighting.

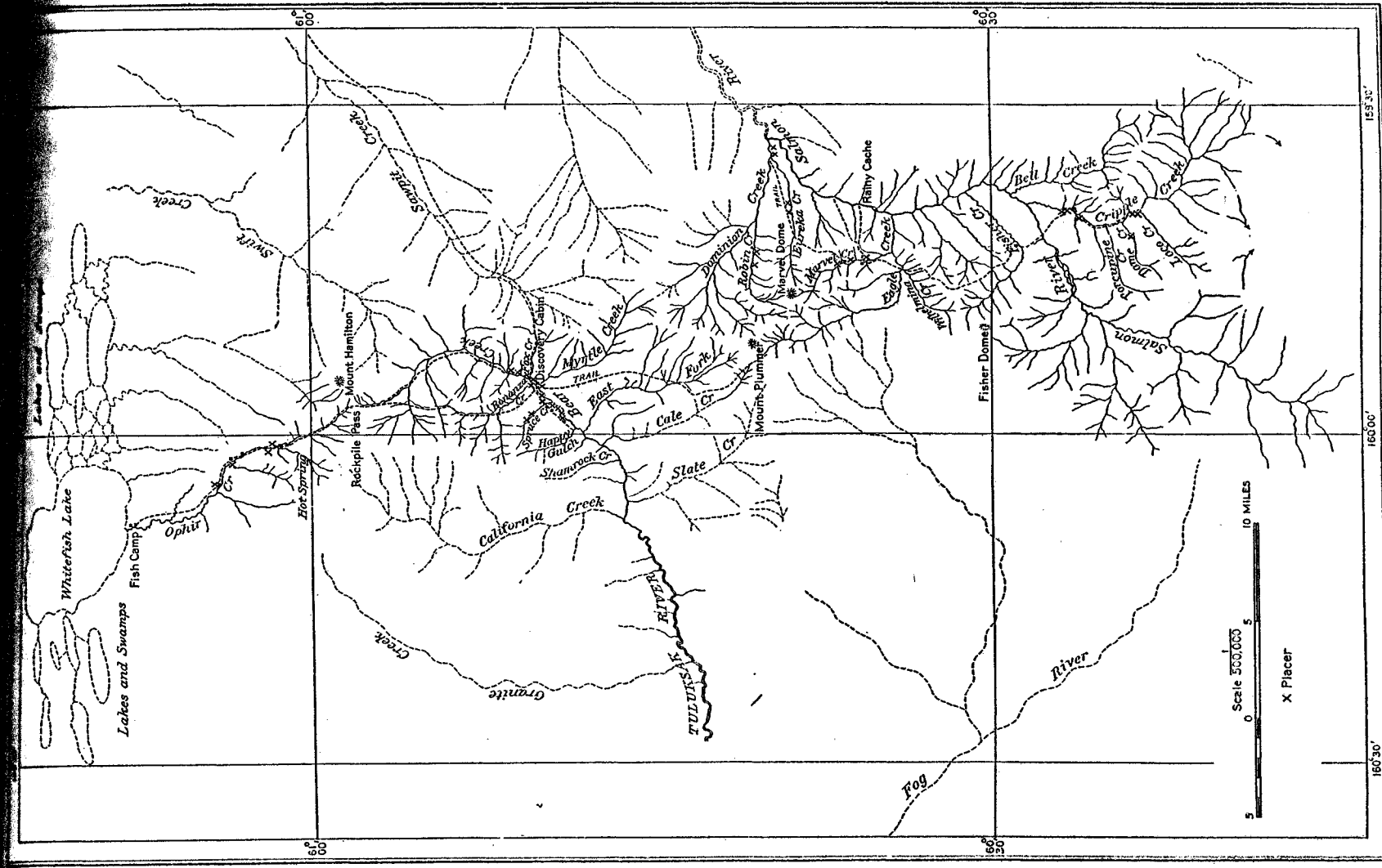
¹ Railway routes in Alaska: 62d Cong., 3d sess., H. Doc. 1346, p. 8, 1913.

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ALASKA DISTRICT

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Bulletin 630 ✓

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Chisana, and White rivers, and less than half of that number occupied the region here discussed. The only settlement then, as now, was on Cross Creek, opposite the mouth of Notch Creek, in Chisana Valley, where a few families had their winter houses. In the summers they moved to White River or to other localities where game was plentiful. The Chisana natives were then little in contact with the white man, and although they had to some extent adopted clothing of his type, they subsisted largely on the fish, game, and berries of the country. It is to be feared that with the coming of large numbers of miners the natives will lose their independent manner of living and will become dependent on the white man for food and clothing.

The white population in the years preceding 1913 was variable but generally small. In 1902 a reported gold placer discovery brought on a small stampede, but no workable ground was found, and most of the prospectors immediately left the district. A few stayed to prospect, and from 1903 to 1913 there were always a dozen or two prospectors in the district. A small village, known as Canyon City, was established on White River a few miles east of the international boundary and was used as winter quarters by some of those who stayed through the winter. In 1913, after the news of the gold discoveries was circulated, several thousand persons, including a number of women, came to the district. Most of them made only a brief stay, so that there were probably at no one time more than 500 or 600 people in the camp. Perhaps 200 of these spent the winter, most of them at Chisana. During the summer of 1914 the average number of people, distributed among the towns of Chisana and Bonanza, the placer mines, and the creeks which were being prospected, was about 350. The town of Chisana contained in 1914 about 150 log cabins scattered along Chathenda Creek and through the timber, two sawmills, a post office, restaurants, stores, and a few other buildings. Most of the cabins were vacant in the summer, as the owners were mining or prospecting on the creeks. The town of Bonanza consisted during that summer of over 100 tents and a few log cabins and contained the assortment of stores, etc., characteristic of a temporary mining settlement. (See Pl. VI, B.) It was reported that between 150 and 200 persons planned to spend the winter of 1914-15 in the district.

TRAILS AND ROUTES.

DIFFICULTY OF ACCESS.

The Chisana district is remote from all the well-established systems of transportation in Alaska and Canada, and all the routes to it present certain difficulties, so that communication with the district is

slow and the transportation of supplies is difficult. The length of time required to transport supplies is so great that it seems proper to describe the routes of approach.

Seven different routes to the district have been traveled by many people. The route is naturally determined to some extent by the way he wishes to approach the district. From Seattle many may choose from a number of routes. The Alaska coast points several steamer routes. The vessels are large and are used in the coastwise trade generally. The steamship schedules call for sailing only a few days.

Some published articles have been written in traveling to this district. The trails which lead from McCarthy to Chisana glaciers and over Chitistone are true that during the stampede in 1902 many men in rashly attempting to ford the creeks or their tributaries during periods of high water were learned only one man of the party crossing glaciers was lost. None of the routes attempted without proper equipment. It is on any of the routes here described that no one is familiar with the conditions.

PRINCIPAL

NIZINA-C

The shortest route from the district to the winter of 1913-14 was the route from the Copper River & Northway to McCarthy, a distance of 191 miles over Sourdough Hill to Nizina. The mouth of Chitistone River, where the town was established up the Nizina River to its head, across a high ice divide, down Chisana Glacier to its foot, is the town of Chisana, a distance of which about 40 miles is covered. This route is used both by foot travelers and by pack animals of 1913-14 and has the advantage of being a route from a railroad to the

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Seven different routes to the Chisana mines are available, and each has been traveled by many people. The route chosen by any person is naturally determined to some extent by the direction from which he wishes to approach the district, but one coming to Alaska from Seattle may choose from a number of routes. Between Seattle and Alaska coast points several steamship lines maintain a regular service. The vessels are large and comfortable and are similar to those used in the coastwise trade generally in the United States. The steamship schedules call for sailings in each direction at intervals of only a few days.

Some published articles have made much of the difficulties encountered in traveling to this district, and especially of the dangers on the trails which lead from McCarthy both by way of Nizina and Chisana glaciers and over Chitistone Pass and Russell Glacier. It is true that during the stampede in 1913 several persons were drowned in rashly attempting to ford the glacial Chitistone and Nizina rivers or their tributaries during periods of high water, but so far as could be learned only one man of the several thousand who crossed the glaciers was lost. None of the routes are easy, and none should be attempted without proper equipment, but the difficulties to be met on any of the routes here described are not sufficient to deter one who is familiar with the conditions of travel by trail in Alaska.

PRINCIPAL ROUTES.

NIZINA-CHISANA ROUTES.

The shortest route from the coast and the one most used during the winter of 1913-14 was the Nizina-Chisana route, which utilizes the Copper River & Northwestern Railway between Cordova and McCarthy, a distance of 191 miles. From McCarthy the trail leads over Sourdough Hill to Nizina River and up Nizina Valley to the mouth of Chitistone River, where it forks. For winter travel a trail was established up the Nizina to Nizina Glacier, up that glacier to its head, across a high ice divide at an elevation of about 8,000 feet, down Chisana Glacier to its terminus and down Chisana Valley to the town of Chisana, a distance of about 75 miles from McCarthy, of which about 40 miles is on glacial ice. This route was much used both by foot travelers and for hauling freight during the winter of 1913-14 and has the advantage of being the shortest of all the routes from a railroad to the mines. It is nevertheless a difficult

and dangerous trail and was made passable only by the building of many temporary bridges across crevasses in the glaciers, and by a careful staking of the trail so that crevasses could be avoided when the snows had covered and concealed them. The movements of the glaciers also frequently cause the crevasses to engulf the bridges, and opened new cracks which in turn necessitated bridges. Constant repair work on the trail was therefore necessary throughout the winter. Furthermore, almost all the work done on the trail over the glaciers is destroyed each spring on the renewal of activity of the glaciers and must be done again in the following fall. Portions of the old trail must be entirely abandoned as the result of changed ice conditions, and a new trail must be staked. No attempt is made to use this route in the summer, so that it is traveled for less than half the year. It seems probable, therefore, in view of the impossibility of establishing a permanent trail over the glaciers and the cost of restaking the trail and building new bridges over the crevasses each winter, that this route will not long be used but will be abandoned in favor of a route which can be used the year round and on which improvements will be permanent.

NIZINA-WHITE RIVER ROUTE.

For summer travel the same route is generally followed from McCarthy to the mouth of the Chitistone River, from which two alternate routes are available. One continues along the Nizina-Chisana trail up to and for a few miles up Nizina Glacier, but branches toward the east, crossing that glacier to the mouth of Skolai Creek. The Skolai Valley is then followed for 15 miles to its head. The other branch ascends Chitistone River to its head and crosses a high pass to the head of Skolai Creek, where the two branches join. Each of these branches presents some advantages and some disadvantages over the other, and travelers are about equally divided in their preferences. The Nizina-Skolai Creek branch is some miles the longer of the two and necessitates the fording of Nizina River and the crossing of Nizina Glacier, but the trail is fairly good, the grade is moderate, and there is a better distribution of grass for horse feed. The Chitistone branch, while shorter, crosses Chitistone River several times, and that stream is subject to sudden floods. It also crosses a high divide over a narrow and somewhat dangerous trail known as the "goat trail." Furthermore, it is impassable on account of snow until early in July, and snow in the fall may block it by the first of September. To the cautious traveler the somewhat longer but safer Nizina-Skolai Creek branch recommends itself.

From the head of the Skolai Valley the trail continues for about 14 miles across Russell Glacier. It follows for most of that distance



the moraine-covered portion of the glacier, winding back and forth over its irregular surface. (See Pl. VII.) Although the melting of the glacier affects the trail somewhat, rendering certain spots impassable from time to time so that short detours are necessary, the crossing of the glacier is not difficult and requires only 5 to 6 hours for pack horses. From the head of White River to the placer mines various routes may be followed through a rolling country with many low passes, no difficulties being encountered other than some soft ground. One of these routes leaves White River near the mouth of Lime Creek and proceeds in a northwesterly direction across a high flat to the head of Gehoenda or Trail Creek and down that stream to Chisana River at the town of Chisana. A branch of this trail leaves it near the head of Solo Creek and runs northward past Beaver Lake to the town of Bonanza.

There seems to be no good reason why a better route than any now used for both summer and winter travel could not be established by way of Nizina River, Skolai Creek, and White River. It is known that at times Nizina Glacier is impassable for horses, but the glacier can be entirely avoided by a detour around its eastern edge, and horses have been taken that way on a number of occasions. With a moderate amount of work a good trail around the glacier could be constructed. Russell Glacier can now be crossed, both in summer and winter, but the present trail over it is tortuous, being about 14 miles long to cover an air-line distance of 7 miles. It is reported that a route along the west side of the glacier, which almost entirely avoids the ice and which is many miles shorter than the present route, can now be used by one familiar with it, and by means of a little trail building this route could be made much easier than the route now traveled.

COPPER-NABESNA RIVER ROUTE.

The Copper-Nabesna River route starts at the town of Chitina, on the Copper River & Northwestern Railway, 131 miles from Cordova. It follows the Government military road from Chitina up Copper River to Gulkana. From Gulkana a trail parallels the north bank of Copper River to the Indian village of Batzulnetas, whence it takes an eastward direction to the head of Platinum Creek and follows Cooper and Notch creeks to Chisana River, 8 miles below the town of Chisana. By this trail the distance from Chitina to Chisana is about 235 miles, and the route is little used for summer travel. In winter, however, the greater distance is largely offset by the gentle gradient, the avoidance of glaciers, and the abundance of timber for fuel along the entire route. The only high pass to be crossed is Cooper Pass, an ice-free divide at an elevation of about 6,000 feet, approached by moderate grades. Considerable freight was taken

over this route in the winter of 1913-14 in competition with the much shorter Nizina-Chisana route, although the sledding distance is nearly three times as great, and many freighters are said to contemplate a change from that route to this one for future freighting.

DAWSON-WHITE RIVER ROUTE.

Many of the gold seekers in this district came from Dawson by way of White River. Freight may be taken by steamer up the Yukon to White River, a distance of about 70 miles, and by poling boats or shallow-draft power boats up White River as far as the mouth of Donjek River, or even in favorable stages of water to the mouth of Beaver Creek, and poling boats can be used to Canyon City, a village on White River a few miles east of the international boundary. From White River freight is taken in winter by sled to the placer mines. A winter trail has now been cut from the mouth of Beaver Creek to the point where that stream finally crosses the boundary into Alaska, and this route is said to offer no great difficulties, although the distance from Dawson is about 175 miles by boat to the mouth of Beaver Creek and about 85 miles overland from that point to the placer mines.

COFFEE CREEK ROUTE.

From the mouth of Coffee Creek, which joins the Yukon from the south 110 miles above Dawson, a good trail has been built to the junction of Beaver Creek with White River, a distance of about 80 miles, and another branch leads to Canyon City, 120 miles by trail from the Yukon. From the mouth of Beaver Creek the trail to the Chisana placer mines again reaches Beaver Creek at the international boundary, and thence proceeds up the creek to its head. The total distance by this trail from the Yukon to the town of Bonanza is about 160 miles.

WHITEHORSE-KLUANE LAKE ROUTE.

The route from Whitehorse, at the terminus of the White Pass & Yukon Route, to Canyon City, by way of Lake Kluane, is available for travel both in summer and winter, though the winter trail is shorter, as it crosses some bodies of water which the summer trail skirts. A wagon road has been built from Whitehorse to Lake Kluane, a distance of 143 miles, and a trail extends about 170 miles from the upper end of the lake to Canyon City, on White River, and thence 55 miles farther up Beaver Creek to the placer mines. The total overland distance by this route is about 368 miles in summer and perhaps 20 miles less in winter.

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ACCOMMODATIONS

Along all the most used trails in 1913 and 1914, road houses at intervals meals and lodging could be procured the Nizina-Chisana and Nizina-White to travel from one road house to distance. On the Copper-Nabesna along the Government military route Whitehorse-Kluane Lake route road Whitehorse and Kluane Lake, but trail. The rates charged at these routes and with the distance from but range from a minimum of \$1 and \$2 a meal in the more remote places.

COST OF TRAVEL

The cost of travel by trail from the placer mines varies so greatly method of travel used that no comparison involved can be made here. For his own bed and simple and comfortable and sleeps out, the cost is little more on the way. For the man who rests at the road houses, the expense of time spent in reaching his destination pack train, carrying their own cost is much the same as for the other Alaska trail. The regular passengers on the steamship lines from \$30 and to Cordova \$45. By rail

TANANA-CHISANA ROUTE.

On the circulation of the report that rich placer discoveries had been made in the Chisana basin, a considerable number of men made their way up Tanana and Chisana rivers by launches and small boats. Under favorable conditions launches may be taken up these rivers as far as the north front of the Nutzotin Mountains, and boats were lined or poled all the way up to the mouth of Chathenda Creek. The route from Fairbanks, the base of supplies, is, however, long and difficult and, although possible, will never be an economical route for bringing in supplies. In the fall of 1914 many persons availed themselves of this water route, and built boats in which they rowed downstream to Fairbanks.

ACCOMMODATIONS ON THE TRAILS.

Along all the most used trails to the gold fields there were, in 1913 and 1914, road houses at intervals of 15 to 30 miles, at which meals and lodging could be procured by the traveler. Thus along the Nizina-Chisana and Nizina-White River routes it was possible to travel from one road house to the next each day for the entire distance. On the Copper-Nabesna River route there are road houses along the Government military road as far as Gulkana. On the Whitehorse-Kluane Lake route road houses are maintained between Whitehorse and Kluane Lake, but none west of that portion of the trail. The rates charged at these road houses vary on the different routes, and with the distance from established lines of transportation, but range from a minimum of \$1 a meal and \$1 for lodging to \$1.50 and \$2 a meal in the more remote parts of the region.

COST OF TRANSPORTATION.

The cost of travel by trail from steamship or railroad points to the placer mines varies so greatly with the route traveled and the method of travel used that no comprehensive statement of the expense involved can be made here. For the man who travels afoot, carries his own bed and simple and compact food, prepares his own meals, and sleeps out, the cost is little more than the value of his time while on the way. For the man who rents or purchases a horse and stops at the road houses, the expense depends to a great degree on the time spent in reaching his destination. For parties that travel by pack train, carrying their own camping outfit and provisions, the cost is much the same as for the same length of time spent on any other Alaska trail. The regular scheduled rates for first-class passengers on the steamship lines from Seattle to Skagway in 1914 was \$30 and to Cordova \$45. By rail from Skagway to Whitehorse the

WHITE RIVER DISTRICT, ALASKA.

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fare is \$20, and by steamboat between Whitehorse and Dawson the downstream trip costs \$30 and the upstream trip \$50. From Cordova to Chitina by rail the fare is \$15.60 and from Cordova to McCarthy \$22.80.

The cost of freighting supplies to the mines varies greatly with different shipments, being controlled by the efficiency with which the work is done, by the route traveled, and by the quantity of material moved. During the winter of 1913-14 little information was available as to the cost by the different routes, and each person chose the route which seemed best to him at that time. Most of the freight was taken over the Nizina-Chisana route, though the other routes had some traffic. Reported costs of sledding from railroad or steamboat lines to Chisana or Bonanza ranged from 12 to 50 cents or more a pound, but most of the contracts let for freighting were at prices between 20 and 30 cents a pound. A considerable amount of supplementary equipment and provisions was brought in by pack train from McCarthy by way of White River during the summer of 1914, the rate charged ranging from 25 to 35 cents a pound.

GEOLOGY.

PRINCIPAL FEATURES.

The areas covered by the several rock formations which have been differentiated in this district are shown on the accompanying geologic map (Pl. II, in pocket). Only reconnaissance geologic work has been done in this area, and the formation boundaries shown are subject to change as more detailed information becomes available. The determination of the age of certain rocks is based largely on the evidence furnished by fossils, which could not be examined and identified in the field, this work being done in the office, several months after the field work upon which this report is based had been completed. As shown by the fossils, the district contains rocks belonging to two great divisions of the Paleozoic, although on account of the similarity of structure and lithology of these divisions no field distinction was made between them. Similarly, the Mesozoic rocks seen are all much alike lithologically and were not separated during the field work, although the fossils obtained from them show that they belong to two and possibly three great systems. On the geologic map it has therefore been necessary to group certain systems together. It is highly desirable that these systems should be separated, but sufficient information is not now available upon which to make this separation, and more field work will be necessary before it can be accomplished. Furthermore, because of the large area to be covered during a brief season of reconnaissance mapping,

it was impossible to examine carefully is likely that the larger units mapped not properly belong with the divisions placed. Nevertheless, it is believed as given delineate with a fair degree subdivisions here described. The lithologic units into which the rocks of Knopf¹ are shown also on Plate I that the two maps are directly comparable map which shows the geology of the Mountains between Chisana and Hoenda Creek, and much of the area south of White River is the result of the mapping. The area north of White River and the valley of Skolai Creek were mapped procured by the writer in 1914.

The rocks of the Chisana-White River area are Devonian to Recent and comprise including all the common sedimentary rocks both intrusive and extrusive. In general the formations of the St. Elias and Wrangell are composed dominantly of igneous rocks, but contain considerable quantities of sedimentary rocks composed primarily of sedimentary rocks by large masses of crystalline igneous rocks and surface lava flows. The lava flows of the St. Elias and Nutzotin mountains are the stratigraphic sequence for the geologic studies that have so far been made.

Quaternary:

Glacial deposits, gravels, volcanic materials.

Glacial morainal deposits, with associated materials.

Tertiary:

Conglomerates and unconsolidated sandstones, shales, conglomerates, and shales.

Cretaceous:

Shales, slates, and graywackes.

Jurassic:

Shales, slates, graywackes, and conglomerates.

Triassic:

Thin-bedded limestone of Cooper and shales and graywackes of the Nutzotin Mountains.

¹ Moffit, F. H., and Knopf, Adolph, Mineral Resources of Alaska: U. S. Geol. Survey Bull. 417, pl. 2.

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DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Bulletin 630

THE
CHISANA-WHITE RIVER DISTRICT
ALASKA

BY

STEPHEN R. CAPPS



WASHINGTON
GOVERNMENT PRINTING OFFICE

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WHITE RIVER TRAIL

U. S. GEOLOGICAL SURVEY