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UNITED STATES DEPARTMENT OF THE INTERIOR  
Harold L. Ickes, Secretary  
GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

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Bulletin 862

# THE SOUTHERN ALASKA RANGE

BY  
STEPHEN R. CAPPS

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fairly well stocked with large and smaller variety than in tributary to Lake Clark they are fairly easy to approach. In, from 50 to 100 having been. They are especially abundant in the Skwentna Basins. As these are, they show little fear, and are likely to raid any provisions common, and precaution must be taken. Moose are present in the

East of the range they are abundant, but in the upper Chakana Basins they are fairly abundant along all the larger valleys, as they are relatively free of hunters. Caribou range in the Kuskokwim area in some Skwentna Basin. They are also abundant in the upper Stony Basins and as far south as Lake Clark. In the basin of the South Fork of the river bands of few individuals in the Skwentna Basins, at the head of the

Animals found in this area include moose, mink, fox, lynx, marten, and beaver. Except for beaver, upon the mountains from time to time, the range is said to offer no exceptional

Animals are generally present in the mountains have decreased greatly and many have disappeared. Ptarmigan, like the hare, varies from year to year and were once abundant of rabbits and ptarmigan, but animals rely for food, has a small annual catch of furs.

The streams drain the mountains head during the summer season of fishing. Here and there are many trout of several varieties, and the salmon run up all the

streams that empty into Cook Inlet, as well as up the Stony, and Lakes Clark and Iliamna have a heavy run of salmon. These lakes and their tributary streams also offer exceptionally fine fishing for the angler.

## ROUTES OF TRAVEL

Although the eastern edge of this region can be easily approached by way of Cook Inlet and boats drawing several feet of water can ascend the Kvichak River from Bristol Bay to all points on Iliamna Lake, nevertheless this region as a whole is difficultly accessible, and considerable areas within it had not been visited by white men until the expeditions of the Geological Survey upon which this report is based. The Survey expeditions of 1926 to 1929 all entered the region from the east, by way of Cook Inlet, and as all of them transported camp equipment and supplies by means of pack horses, it was necessary to establish trails passable for horses from some point on the coast to the areas to be surveyed. It is true that all parts of the region are within a few hours' travel by airplane from Anchorage, and planes can land on open stream bars or on lakes, or in winter almost anywhere on skis, but inasmuch as planes cannot be used in summer in the day by day moving of camp to all parts of the region, irrespective of landing places, the pack horse still remains the most reliable means of transportation for this type of work.

To survey the upper Skwentna Basin pack horses were carried by scow to the mouth of the Beluga River and thence were taken with light loads overland around the head of the Talushulitna River to the Skwentna some 4 miles above the mouth of Canyon Creek. Parts of this route are brushy and required considerable trail chopping, and other stretches are difficult as the result of swamps and lakes caused by beaver dams. From 7 to 10 days should be allowed for traversing the 70 miles from Beluga to the Skwentna.

After arrival at the Skwentna it is necessary to cross that river, which is there too deep to ford. In summer stages of water there are likely to be two or more channels, each at least 100 yards wide, and it would be hazardous to have the horses swim with their loads. It is therefore necessary to have a boat at the crossing to transfer the equipment and members of the party. From the north side of the river the winter trail can be followed westward by pack horses, though in places the ground is boggy.

It is also possible to ascend the Skwentna River in summer by shallow-draft boats as far as the mouth of the Happy River, though many stretches are so swift that lining must be resorted to. In 1926 the Survey party took most of its provisions by way of the Skwentna to the Happy River, from which horses were used exclusively.

Some 4 miles west of the Happy River travelers into the upper Skwentna Basin leave all marked trails behind, but except for some brushy areas, where cutting must be done, pack horses can be taken almost anywhere without unusual difficulty. Numerous well-traveled game trails are of great assistance and with a moderate amount of cutting can be developed into good trails for horses.

For winter travel the old winter dog trail from the Alaska Railroad at Nancy to the Kuskokwim by way of Rainy Pass is still open and may be used to points on the Skwentna as far west as the Happy River. This trail, however, is now rarely used and offers no accommodations to travelers. Anyone now using it would be forced to break his own trail the entire way.

Some account of the route from Cook Inlet, at Trading Bay, into the basin of the Chakachatna River has been given on pages 10-12. Until that trail was opened by the United States Geological Survey party in 1927, no summer route across that part of the piedmont belt was known to be practicable for horses, and no horses had until that time been taken into the Chakachatna and upper Stony Basins. The route actually followed was chosen because, as seen from Cook Inlet, there appeared to be a ridge of high ground extending from the beach to the mountains. The trail as established leaves the shore of Cook Inlet at Trading Bay, at a point just north of the mouth of Nikolai Creek. For several miles it follows the benches just above the great flat there, skirting several open marshes, and gradually ascends the piedmont ridge to and above timber line. Through the timber the trail is blazed, and where brush was encountered much cutting was done. In both 1927 and 1928 Geological Survey pack trains used this trail, and it should be passable for some time, though a new growth of brush and vegetation will obliterate much of it as time goes on. With the exception of the Survey parties no more than half a dozen persons have used it, and no other horses have been taken over it.

After following the south edge of the piedmont ridge for some 22 miles in an air line from the coast and reaching an altitude of 2,600 feet, the trail leaves the high ridge and descends abruptly to the valley of Straight Creek over steep slopes densely overgrown with large alders. It ascends that valley for about 4 miles and then crosses to the Chakachatna River through an extremely brushy country. Through this stretch the traveler will be wise to follow the trail meticulously, for the brush is almost impenetrable unless much trail cutting is done. Above the point at which the Chakachatna River is reached the route followed by the Survey parties (see pl. 1) can be followed without more difficulty than is to be expected in an uninhabited country. To reach Merrill Pass and the Stony Basin

it is impossible to follow the shore Lakes on foot or with horses, and that up the Nagishlamina River to the Chilligan and Igitna River, and up that valley to Merrill Pass can proceed on foot without difficulty. The ridge to the Stony, which can be borne in mind, however, that to Cook Inlet is a difficult trip. No difficulty sufficiently to require considerable cutting through. There are many down logs on the beach, and many stretches of trail. Furthermore, much rebuilding of trail across the lower ends of Barrier Pass through Merrill Pass.

The western slope of the range, by the River, can be most easily approached from Bristol Bay by way of the Iliamna Bay across a low divide to Iliamna about 4 miles above the mouth of the trail, long in use over that portage now being replaced by a wagon road. A small pack train has been maintained of supplies across this trail, but farther west than the east end of Iliamna of 1929, like that of Martin and K. Smith, in 1914, landed with horses transported the outfit by pack horses. The horses were sent with light loads to the lake to the foot of the Newhalen portage and part of the personnel traveled. No good summer trail along the lake ground and brushy country must be in this country goes by boat in summer. There are a number of medium-sized boats available for hire. From Severs Lake end of the Newhalen portage, to the Newhalen River at a point above the fall all supplies for the country contiguous packed across this portage, a distance of the portage, and in fact generally to the north, there are only faint native trails of these may be followed from Nonon to the Chulitna River, and another to

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it is impossible to follow the shores of Chakachamna and Kenibuna Lakes on foot or with horses, and the only feasible route known is that up the Nagishlamina River to its head, thence across the passes to the Chilligan and Igitna Rivers, down the Igitna to Another River, and up that valley to Merrill Pass. From Merrill Pass one can proceed on foot without difficulty to Two Lakes and thence over the ridge to the Stony, which can be traveled to its head. It should be borne in mind, however, that to take horses over this route from Cook Inlet is a difficult trip. No doubt the brush has already grown sufficiently to require considerable cutting before horses can be taken through. There are many down logs within the first 20 miles from the beach, and many stretches of trail so soft as to be barely passable. Furthermore, much rebuilding of the trail is likely to be necessary across the lower ends of Barrier, Pothole, and Harpoon Glaciers and through Merrill Pass.

The western slope of the range, between Lake Clark and the Stony River, can be most easily approached either by boat to Iliamna Lake from Bristol Bay by way of the Kvichak River, or from Iliamna Bay across a low divide to Iliamna village, on the Iliamna River about 4 miles above the mouth of that stream at Iliamna Lake. A trail, long in use over that portage, a distance of about 12 miles, is now being replaced by a wagon road, not quite completed in 1932. A small pack train has been maintained for the summer transportation of supplies across this trail, but few horses have ever been taken farther west than the east end of Iliamna Lake. The Survey party of 1929, like that of Martin and Katz, in 1909, and of Sargent and Smith, in 1914, landed with horses and supplies at Iliamna Bay, transported the outfit by pack horse to Iliamna village, from which the horses were sent with light loads around the north shore of the lake to the foot of the Newhalen portage, while most of the supplies and part of the personnel traveled to that point by boat. There is no good summer trail along the lake shore, and considerable soft ground and brushy country must be traversed. Practically all travel in this country goes by boat in summer and by dog sled in winter. There are a number of medium-sized gas boats on Iliamna Lake that are available for hire. From Seversen's trading post, at the Iliamna Lake end of the Newhalen portage, there is a trail across to the Newhalen River at a point above the falls. For summer transportation all supplies for the country contiguous to Lake Clark are back-packed across this portage, a distance of about 6 miles. From the head of the portage, and in fact generally throughout the country to the north, there are only faint native trails for land travel. One of these may be followed from Nondalton village northwestward to the Chulitna River, and another follows the north shore of Lake



Clark, for the most part keeping to the beach and so being submerged during periods of high water. Another faint trail, formerly much used by the natives, leaves the shore of Lake Clark at the mouth of the Kijik River and continues northward through the foothills to Telaquana Lake. These are the only trails of consequence on the west face of the mountains, but pack horses can be taken almost everywhere without serious difficulty.

#### POPULATION

Except for a few small settlements around its margins, this region is entirely uninhabited by either whites or natives. On its eastern edge, according to the census of 1930, there were 78 persons residing at Tyonek, on Cook Inlet, all but a few of whom were natives; 52 persons at Susitna station, on the Susitna River, of whom perhaps a dozen were white; and a few white trappers and fishermen scattered along the shores of Cook Inlet and the Susitna, Yentna, and Skwentna Rivers. At Iliamna village, on the Iliamna River, the records show 100 inhabitants, of whom perhaps a dozen were whites, and many of those actually reside at various places along the shores of Iliamna Lake. The village of Nondalton, on Sixmile Lake, below the mouth of Lake Clark, was credited with 24 inhabitants, all but one or two of whom are natives. A few white trappers and prospectors and a few families of natives live along the shores of Lake Clark. From all these points of settlement trappers maintain trap lines during the winter, and many families have summer fishing camps at some distance from their winter houses, but except for the shores of Cook Inlet and of the larger rivers and lakes there are no permanent habitations in this great region.

There was formerly a considerable native village at the foot of Telaquana Lake, but it is now abandoned. Before the advent of the white man the natives of Tyonek were accustomed to make summer hunting trips into the headwaters of the Chakachatna Basin, and similarly the Susitna natives formerly hunted in the upper Skwentna Basin, but for the last 30 years these expeditions have been given up, for the natives find it easier to gain a living by various employment with white men than to make the difficult journeys of former years.

Although a few prospectors occasionally visit the more accessible parts of the region, and a few mining claims are held near Iliamna Lake and Lake Clark and on Iliamna Bay, there is now no mining in progress, and in the past mining has been confined to the production of small amounts of placer gold from the north shore of Lake Clark. The natives subsist largely upon fish and rely upon their catch of fur and the sale of fish to supply them with

money for such purchases as the of the region are all fishermen, t do some prospecting also. As a v as it was 30 years ago, and there hood of any improvement in this of importance are discovered. I spent by the writer in this region the party seeing any other human

#### GEO. GENERAL

The general distribution of t Range is shown on plates 1 and been differentiated. Prior to the based the region was unmapped northeastern border by Spurr, a between the Beluga and Skwentn Katz in the Iliamna-Clark region lower Lake Clark to the Kuskokw exploratory or reconnaissance nat, naissance mapping was attempted the fact that on each of these e faced in transporting personnel a field of work through an almost and great effort were expended i obstacles to travel with horses in a been used. Furthermore, the sum geologic field work with horses tending from early June to mid-S days. In penetrating to a remot is consumed in merely traveling work, so that a period of 50 to is all that can be expected, and t of weather so inclement that fiel handicap to the close mapping o the fact that on each of these exp was carried on concurrently with pleted topographic maps as a bas able until several months after t consequence of these difficulties th the accompanying maps are only the best information obtainable u

The geologic units shown on pla and 2 groups of relatively young

RES OF ALASKA, 1933

ct, by J. M. Hill. Bulletin 849-B,

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HIC MAPS

White Rivers; scale, 1:250,000; by D. R. Capps. In Bulletin 417, 1910.

250,000; 1911, by T. G. Gerdine, D. retail or 30 cents wholesale. Also

maissance map; scale, 1:500,000; Witherspoon, and A. G. Maddren. issued separately.

1:250,000; 1911, by T. G. Gerdine, J. W. Bagley. 50 cents retail or 37, 1908, 25 cents, and Bulletin 52

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UNITED STATES DEPARTMENT OF THE INTERIOR  
Harold L. Ickes, Secretary  
GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

Bulletin 864—B

THE WILLOW CREEK-KASHWITNA DISTRICT  
ALASKA

BY  
S. R. CAPPS AND RALPH TUCK

Mineral Resources of Alaska, 1933  
(Pages 95-113)



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gs. Practically all the tributary  
leys at elevations 500 to 1,200 feet  
it on reaching the Kashwitna Valley.  
3. Many of the tributary streams  
rise in small glaciers. For its  
r is a rapidly flowing silt-laden  
t is sluggish, with beautifully de  
wall to wall of the valley. Below  
rapidly again for a number of miles  
Susitna, where it has a moderate grade  
itna River.

3. tributaries of Willow Creek, and  
character in that for the upper 10  
ed valley which becomes narrower down  
s of these creeks the tributaries emerge  
se of the Kashwitna River. Peters  
glaciers as their sources. Their basin  
asymmetric development, for the north  
almost unbroken by tributary streams,  
icular being straight and unbroken for  
t 12 miles, whereas the south walls  
numerous tributaries, all of which head  
the ridge. This conspicuous lack of  
the structure of the underlying rocks  
ifting of the divides as the result of

CLIMATE  
of other mountainous localities in  
e Alaska Range. From the first of  
w may be expected, particularly in  
flurries may occur even during the  
re free of ice about the middle of  
er. The winter temperature is pre-  
uly, August, and a part of Septem-  
sheltered from the sun or at the  
of the annual precipitation falls  
n August and September.  
re not available, as there are no  
which records have been kept in  
of Knik Arm, a few miles south  
records at Matanuska from 1922  
n of 11.25 to 18.31 inches, which  
es. The mean annual tempera-  
n 33.4° to 37.6°. The Talkeetna

basins, because of their higher elevation, undoubtedly have a  
precipitation and a lower mean annual temperature than  
Matanuska.

VEGETATION

A large part of the area lies above timber line (see fig. 4), which  
most places has an elevation of 1,800 to 2,000 feet, although in  
larger valleys clumps of timber are often found 200 to 400  
feet higher. Below timber line spruce and birch are abundant in the  
well-drained areas, and cottonwoods are numerous in many places  
along the streams. The maximum diameter attained by the spruce  
and birch trees is from 2 to 3 feet, but cottonwoods 4 to 5 feet in  
diameter are common. The swamps and poorly drained areas below  
timber line do not support a growth of timber with the exception  
of stunted black spruce. The spruce, which is in most demand  
locally, both for fuel and for building material, has in the last few  
years been attacked by beetles that have already killed large num-  
bers of the trees. It is estimated that in this area at least 60 percent  
of the spruce is already dead or dying. In a few years green spruce  
will be hard to obtain, and travel will be made difficult by windfalls  
resulting from the rotting of the roots of the dead trees. The danger  
of forest fires will also be increased. The beetles are not confining  
themselves to one particular area but are threatening to devastate  
the entire Susitna Valley of spruce.

Above the zone of timber alders and willows grow up to an ele-  
vation of 3,000 feet and furnish fuel for camp purposes. Above 3,000  
feet only grasses, mosses, and heatherlike plants grow. The most  
common grass, a variety known as "redtop", grows luxuriantly  
at all but the higher elevations and furnishes stock feed from the first  
of June to the middle of September.

SETTLEMENTS AND ROUTES OF TRAVEL

No permanent settlements exist in the area examined, with the  
exception of the stations of Willow (mile 185.7 from Seward),  
Kashwitna (mile 193.9), and Caswell (mile 202.3), on the Alaska  
Railroad. At these points the railroad keeps small crews for track  
maintenance, and a few cabins are occupied occasionally by prospec-  
tors or trappers. A few trappers' cabins are also scattered through-  
out the area and are occupied in season. Several fur farms have  
been started in the vicinity of the railroad, and at Willow there is a  
roadhouse for the convenience of transients going to and from the  
Willow Creek mining district.

The region here described lies immediately north of the Willow  
Creek district, and the southern part of it, particularly the basins  
of Purches and Peters Creeks, can be most easily approached from

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that direction. The Willow Creek district is connected by a good road with the Alaska Railroad at Wasilla and by a newer but poorer road with Willow station on the railroad. The drainage basins of

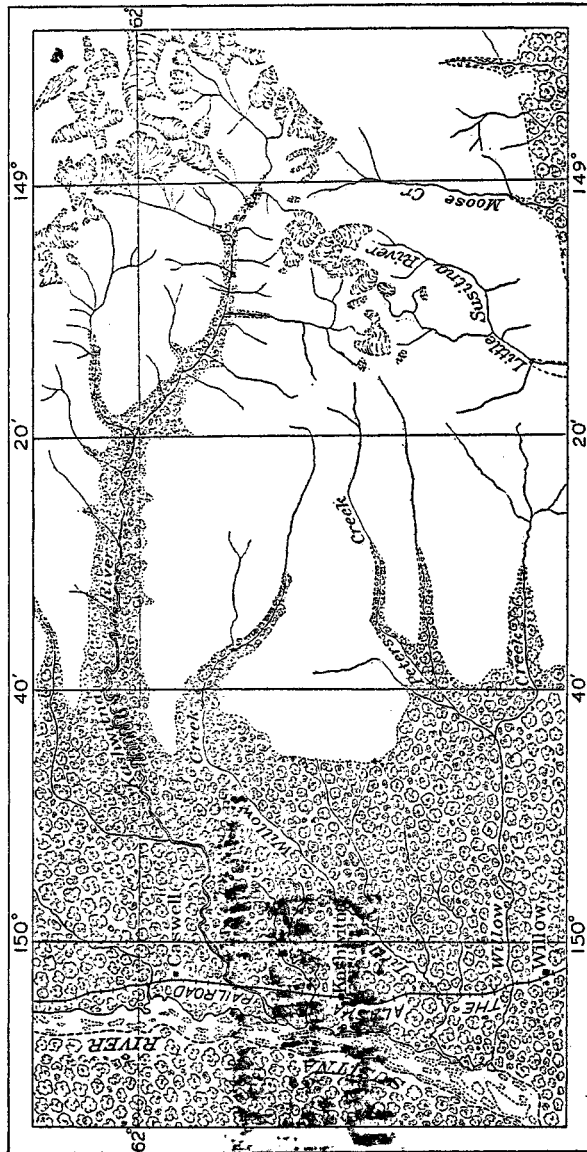
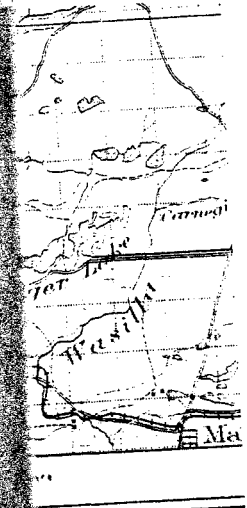


FIGURE 4.—Sketch map showing the distribution of timber in the Willow Creek-Kashwitna district.

the Kashwitna River and of Little Willow Creek can be reached from the railroad stations of Willow, Kashwitna, and Caswell. (See plate 1.) The Kashwitna Basin is most easily reached from Caswell. From this point there are 4 miles of wagon road leading northeastward to a



A MOUNT

15 Miles

DOCUMENTS

locally known as "Caswell Lake", where there is a fur farm. From this lake a passable pack trail runs eastward to the North Fork of the Kashwitna River. This trail leads up the North Fork, and faint trails also continue directly eastward along the north side of the Kashwitna almost to its headwaters. Pack horses can be taken along this route from Caswell up the Kashwitna River for a distance of about 40 miles, although some care must be exercised in crossing the camps, particularly those in the Susitna Valley. From the station on the Kashwitna there is a winter trail leading back to the mountains, and no summer trail is known to the writers. No doubt a passable route could be selected, but the marshy nature of the ground in the lowland of the Susitna Valley presents difficulties to summer travel. Short trails also exist on the south side of the Kashwitna River, and one leads up Bartholf Creek.

The knifelike character of the ridges and the abundance of coarse talus slopes makes north-south travel with pack horses impossible on the higher mountains. However, a roundabout route, such as that taken by the Geological Survey party of 1933 (see pl. 1), can be followed without great difficulty.

Each of the streams here discussed flows in a wide-floored glacial valley with a moderate gradient. No unusual difficulties would be encountered in building a road from the Alaska Railroad to any part of the district in which mining developments warranted the expenditure.

## GEOLOGY

### GENERAL FEATURES

It has long been known that most of the southwestern part of the Talkeetna Mountains is composed of and is a part of the Talkeetna Mountain granodiorite batholith. Early reconnaissances by Paige and Knopf<sup>4</sup> and by Capps<sup>5</sup> showed the presence of granodiorite and related rocks along the west face of the range, and from examination of float from the streams they inferred that the interior mass of the mountains was also predominantly granodiorite. The present detailed investigation confirmed these inferences. Conclusive evidence of more than one intrusive mass is lacking, and although several types of intrusive rocks are present, they all probably represent one general magmatic period.

No other consolidated deposits were found in the area, as the field work did not extend into the Susitna Valley beyond the west face of the range. However, as Tertiary (Eocene?) lignite is present at numerous localities throughout the Susitna Valley, and as several

<sup>4</sup> Paige, Sidney, and Knopf, Adolph, op. cit., pp. 19-20.

<sup>5</sup> Capps, S. R., op. cit., pp. 196-197.

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UNITED STATES DEPARTMENT OF THE INTERIOR  
Harold L. Ickes, Secretary  
GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

Bulletin 864-C

MINERAL DEPOSITS  
OF THE RUBY-KUSKOKWIM REGION  
ALASKA

BY  
J. B. MERTIE, Jr.

Mineral resources of Alaska, 1933  
(Pages 115-245)



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The stand of timber in this region is nowhere very heavy, and the trees are usually small, but along the valley floors trees as large as 24 inches in diameter are not uncommon. This timber in the past has sufficed locally for lumber and firewood, but among the larger mining camps the supply has now become scant, so that its use for fuel is rather costly. Great forest fires have repeatedly swept over the country, destroying a great deal of the timber. During the summer of 1933 the whole area between Poorman and the Cripple Creek Mountains was burned over, and extensive fires also occurred in and about the Nixon Fork district.

Forage for stock is fairly plentiful along the valley floors of some of the larger streams, such as the Sulatna, Nowitna, and Takotna Rivers; but on the upland slopes grass is scarce, particularly where the country rock is ultrabasic, and in general these upland areas are not good grazing ground for packhorses in summer.

Game is by no means plentiful. In the higher groups of mountains small scattered bands of caribou may be seen, though not comparable in numbers to the great herds of the Yukon-Tanana region. Bears are likewise not plentiful. Some moose live in the broad valley lowlands, such as that of the Nowitna. Small game, such as ptarmigan, grouse, and rabbits, are more plentiful now than when this country was visited by the writer in 1915, but the fires of 1933 undoubtedly destroyed or drove out much of the smaller game from the northern part of the region. Salmon run up the Yukon and Kuskokwim Rivers and are depended upon to a considerable extent for dog feed as well as for human consumption. Whitefish and pike are also found in the larger streams, and the smaller streams are well stocked with grayling.

#### SETTLEMENTS AND COMMUNICATION

Ruby is a small town on the south bank of the Yukon River, about 110 miles in an air line below the confluence of the Yukon and Tanana. It is the principal settlement and distribution point for the northern part of this region and according to the census of 1930 had a population of 132. In summer passengers, freight, and mail for Ruby are handled by steamboats operated by the Alaska Railroad, which ply on the Tanana and Yukon Rivers between Nenana and Marshall. Ruby also has an airplane landing field and can also be reached by hydroplane; many passengers now use these flying services rather than the river boats. In winter mail and passenger traffic is handled largely by airplanes equipped with skis. Until the fall of 1933 Ruby had a wireless telegraph station, operated by the United States Signal Corps, but this has now been discontinued and is replaced by a commercial telegraph and radiophone station.

The two other settlements in the northern part of the region are Long and Poorman, respectively 30 and 40 miles from Ruby, which they are connected by a road. This road is used for transport in summer and for sledding in winter for freighting supplies, particularly into the Cripple Creek area. Launch up the Sulatna River to Tamarac is north or south by the road, but this is a commercial radiophone at Poorman transmitting messages but by the use of a radiophone to receive messages transmitted by Ruby and Poorman.

The village of Cripple is the source of the Cripple district. This settlement is about 6 miles above the mouth of Colorado Creek, or 6 miles above the mouth of Graham and Cripple Creeks by both routes, the distance being about 9 or 10 miles. A trail continues from Cripple Creek eastward to the mouth of Cripple Creek, and another winter trail from Cripple Creek to the mouth of Cripple Creek in summer. A summer trail connects Cripple Creek to the mouth of Cripple Creek in the summer of 1933, when low water in the river made it possible to land freight at Cripple, some supplies by air from Anchorage. Cripple Creek by airplanes from Anchorage field was available, but the planes used for this purpose were not able to carry supplies along a line of ground trails.

Ophir, the distributing point for the Cripple district, is a small village on the upper Innoko River, about 10 miles west of Poorman. Ophir is credited with a population of 19 persons, but in summer the population on the creeks engaged in mining is probably greater. Ophir has no telegraph service, but is reached by routes by means of which passengers and freight are carried. First, a good automobile road connects Ophir in turn obtains its supplies from the mouth of the Innoko and Takotna Rivers; most of the freight is carried to Ophir from the States now by way of the Innoko River. The Innoko River may be navigated in its upper course by poling boats, but it is not possible on this route that supplies were formerly carried. At present the river is used mostly for freighting route. Third, a winter trail connects Ophir to Poorman by way of Cripple, a distance of about 40 miles. In the summer of 1933-34 the winter mail to Ophir was discontinued and the service is now discontinued.

region is nowhere very heavy, and the valley floors trees as large as spruce are common. This timber in the past has been used for firewood, but among the larger mining districts it is so scant, so that its use for fuel has been repeatedly swept over the face of the timber. During the summer of 1933 in Poorman and the Cripple Creek districts extensive fires also occurred in and

along the valley floors of some of the Sulatna, Nowitna, and Takotna districts. Grass is scarce, particularly where the timber is dense, and in general these upland areas are used only for packhorses in summer.

In the higher groups of mountains caribou may be seen, though not in large herds of the Yukon-Tanana region. Some moose live in the broad valleys of the Nowitna. Small game, such as grouse, are more plentiful now than when the writer in 1915, but the fires of 1933 have cut out much of the smaller game from the district. Salmon run up the Yukon and are depended upon to a considerable extent for human consumption. Whitefish and pike are abundant in the streams, and the smaller streams are well

COMMUNICATION

On the north bank of the Yukon River, about 10 miles from the confluence of the Yukon and Sulatna, is the distribution point for the district. According to the census of 1930 had a population of 19 persons, but in summer two-thirds of these are out on the creeks engaged in mining, and if all others on the nearby creeks are counted, the population of the Ophir district is considerably greater. Ophir has no telegraphic communication but has four routes by means of which passengers, freight, and mail can enter. First, a good automobile road connects Ophir with Takotna, which in turn obtains its supplies from Bethel by way of the Kuskokwim and Takotna Rivers; most of the supplies and equipment consigned to Ophir from the States now come by this route. Second, the Innoko River may be navigated in its lower course by launches and in its upper course by poling boats and horse-drawn scows; it was by this route that supplies were formerly brought into the country, but at present the river is used more as a summer mail route than as a freighting route. Third, a winter trail comes into Ophir from Poorman by way of Cripple, a distance of about 90 miles; up to the winter of 1933-34 the winter mail to Ophir was carried by this route, but the service is now discontinued, and Ophir will receive its winter

The two other settlements in the northern part of this region are Long and Poorman, respectively 30 and 58 miles south of Ruby, with which they are connected by a road. This road serves for automotive transport in summer and for sledding in winter. Another means of freighting supplies, particularly into the Poorman district, is by launch up the Sulatna River to Tamarack Landing and thence either north or south by the road, but this route is no longer used. There is a commercial radiophone at Poorman. Long has no means of transmitting messages but by the use of broadcast receivers is able to receive messages transmitted by the radiophones operating at Ruby and Poorman.

The village of Cripple is the source of supplies and equipment for the Cripple district. This settlement is on the Innoko River about 5 or 6 miles above the mouth of Colorado Creek and is connected with Graham and Cripple Creeks by both winter and summer trails, the distance being about 9 or 10 miles. The winter and summer trails continue from Cripple Creek eastward to the head of Colorado Creek, and another winter trail follows down Colorado Creek. A summer trail connects Cripple Creek with Ophir. During the summer of 1933, when low water in the Innoko River made it impossible to land freight at Cripple, some supplies were delivered at Cripple Creek by airplanes from Anchorage. For this service no landing field was available, but the planes, flying low, successfully dropped supplies along a line of ground targets.

Ophir, the distributing point for the Ophir district, is a small village on the upper Innoko River about 72 miles in an air line S. 25° W. of Poorman. Ophir is credited in the census of 1930 with a population of 19 persons, but in summer two-thirds of these are out on the creeks engaged in mining, and if all others on the nearby creeks are counted, the population of the Ophir district is considerably greater. Ophir has no telegraphic communication but has four routes by means of which passengers, freight, and mail can enter. First, a good automobile road connects Ophir with Takotna, which in turn obtains its supplies from Bethel by way of the Kuskokwim and Takotna Rivers; most of the supplies and equipment consigned to Ophir from the States now come by this route. Second, the Innoko River may be navigated in its lower course by launches and in its upper course by poling boats and horse-drawn scows; it was by this route that supplies were formerly brought into the country, but at present the river is used more as a summer mail route than as a freighting route. Third, a winter trail comes into Ophir from Poorman by way of Cripple, a distance of about 90 miles; up to the winter of 1933-34 the winter mail to Ophir was carried by this route, but the service is now discontinued, and Ophir will receive its winter

mail in future by airplane. Fourth, most passengers for Ophir now enter by means of airplanes, but because the aviation field at Ophir is not in good condition, passengers usually fly to Takotna and then continue by automobile to Ophir; some mail was brought in by this route during the summer of 1933.

Takotna is a supply point for the Ophir district and nearby places. In 1930 it had a population of 65 persons. It is on the north side of the Takotna River at the head of launch navigation. About 5 or 6 miles west of Takotna a branch goes off from the Takotna-Ophir road to the headwaters of Yankee and Ganes Creeks, so that the mining activities at the heads of these creeks are in reality tributary to Takotna rather than to Ophir.

McGrath is the main distributing point for the central part of the Ruby-Kuskokwim region, and in 1930 its population was 112. It is on the northwest bank of the Kuskokwim River at the mouth of the Takotna River, about 325 miles by river from Bethel. McGrath is the point of disembarkation for passengers and freight coming up the Kuskokwim River by steamboat, though it is not the extreme head of steamboat navigation. Ocean-going vessels discharge their cargoes at Bethel, on the lower Kuskokwim, and the steamboat *Tana* makes two trips every summer from Bethel to McGrath. From McGrath supplies go by launch up the Takotna River to Takotna and up the Kuskokwim River to Medfra. The average freight rate from Seattle to McGrath is about \$75 a ton and from McGrath to Takotna about \$25 a ton. From Takotna supplies are moved by autotruck to Ophir and vicinity for \$25 a ton and from Takotna to the head of Ganes Creek for \$30 a ton.

In addition to its importance as a distributing point for freight, McGrath in recent years has also become an aviation center for the Ruby-Kuskokwim region. It has a landing field for airplanes, and when the Kuskokwim River is low it also has a good natural landing field on the river bar. McGrath is likewise well situated for hydroplane traffic, as the quiet water at the mouth of the Takotna River affords an ideal landing place. As a result of these conditions and of its central location, airplanes are coming and going nearly every day from McGrath to Fairbanks, Anchorage, Takotna, Flat, and points on the lower Kuskokwim and Yukon Rivers. Under emergency conditions—as for example, if freight is delayed by low water or if perishables are needed—there is also considerable airplane freighting in and out of McGrath. For this service the rate from Anchorage to McGrath is 22 cents a pound, from Anchorage to Takotna 25 cents a pound, and from McGrath to Takotna 4 cents a pound. During the summer of 1933, when the water in the Takotna River was abnormally low, considerable airplane freighting was

done between McGrath and Takotna. Low-water transportation between McGrath and Takotna is being replaced by the construction of an automobile road between McGrath and Takotna by the people of this district.

Medfra, known also as "Berry's", is a supply point for the Nixon Fork district. It is on the Kuskokwim River about 32 miles west of McGrath, though probably two or three miles from Medfra a wagon road has been built. It is 11½ miles to the Nixon Fork mining district, being improved for automotive traffic. A bar opposite Medfra at stages of low water is a serious obstacle.

The Iditarod mining district, though it is on the Iditarod River, had for its original distributing point the mouth of Otter Creek. Supplies are brought up the Iditarod River to Iditarod, where the river is abandoned and is mainly the site of supplies pending their further distribution. Another settlement, called "Flat", is situated at the junction of Otter Creek and Iditarod, but in recent years it has become a distributing point for this district, and in 1930 it had a population of 100. It is connected with Flat by an automobile road leads up Otter Creek as far as Flat Creek, branching at its head into Chicken Creeks.

The present town of Flat has been built on the west bank of the Iditarod River from Holy Cross. About half of the supplies for Holy Cross by way of the Iditarod and nearly half are brought up the Iditarod district like the Iditarod. The Iditarod district like the Iditarod is a distributing point for the delivery of supplies and equipment, particularly true during the absence of water. As a remedy this difficulty, the people of the Iditarod district are constructing a road from McGrath or near Georgetown across the Iditarod. It will be brought in by way of Iditarod. The distance from Georgetown and Flat is 37 miles, but possible the solid ground of Iditarod is considerably longer.

ICES OF ALASKA, 1933

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done between McGrath and Takotna. To obviate the difficulties of low-water transportation between McGrath and Takotna the construction of an automobile road between these points is being urged by the people of this district.

Medfra, known also as "Berry's Landing", is the supply point for the Nixon Fork district. It is on the north bank of the Kuskokwim River about 32 miles in an air line upstream from McGrath, though probably two or three times that distance by river. From Medfra a wagon road has been constructed northward for 11½ miles to the Nixon Fork mining district, and this road is now being improved for automotive traffic. Airplanes land on the river bar opposite Medfra at stages of low water.

The Iditarod mining district, though mainly on Flat and Otter Creeks, had for its original distributing point the incorporated town of Iditarod, on the Iditarod River about 7 miles in an air line north of the mouth of Otter Creek. Supplies for this district still come up the Iditarod River to Iditarod, but the town itself is now almost abandoned and is mainly the site of warehouses for the storage of supplies pending their further transportation to the mines. Another settlement, called "Flat", was early established at the junction of Flat and Otter Creeks, merely as a subsidiary distributing point, but in recent years it has come to be the principal town in this district, and in 1930 it had a population of 124 persons. Iditarod is connected with Flat by an automobile road. From Flat a similar road leads up Otter Creek as far as Slate Creek and another up Flat Creek, branching at its head to go to Willow, Happy, and Chicken Creeks.

The present town of Flat has two general stores, a hotel, and a bank. All the supplies landed at Flat are transported up the Iditarod River from Holy Cross. Part of these supplies arrive at Holy Cross by way of the Alaska Railroad and its river steamboats, and nearly half are brought up the Yukon River from St. Michael. The Iditarod district like the Ophir district, is handicapped at times by low water in the Iditarod River, which prevents the prompt delivery of supplies and equipment at Iditarod. This was particularly true during the abnormally dry summer of 1933. To remedy this difficulty, the people of this district are urging the construction of a road from some point on the Kuskokwim River at or near Georgetown across the hills to Flat, so that all supplies can be brought in by way of Bethel. The airline distance between Georgetown and Flat is 37 miles, but a road following as much as possible the solid ground of the sinuous ridge tops would be considerably longer.

In recent years airplanes have become an important element in the transportation system of the Iditarod district. Two landing fields have been built—one on the valley floor of Otter Creek close to Flat and the other on top of the ridge north of Flat. Hydroplanes also land on the river at Iditarod. This air service has entirely revolutionized the transportation of passengers to and from the Iditarod district. In the early years of this camp all passenger traffic was carried by small steamboats or launches from Iditarod to Holy Cross and thence by river steamboat up or down the Yukon River. Now most passengers enter and leave Flat by airplanes, which fly on a regular schedule to Anchorage and at less frequent intervals to other Alaskan points. The mail is delivered at Flat by air service, and a certain amount of air freighting is also done. Thus fresh vegetables are brought to Flat from Holy Cross at a rate of 10 cents a pound, and occasional trips are made to outlying points, such as Julian Creek, where supplies are dropped along a line of targets, as on Cripple Creek. Airplane transportation to similar remote parts of Alaska is destined to play an increasingly important part in the Territorial transportation system.

#### GENERAL GEOLOGY

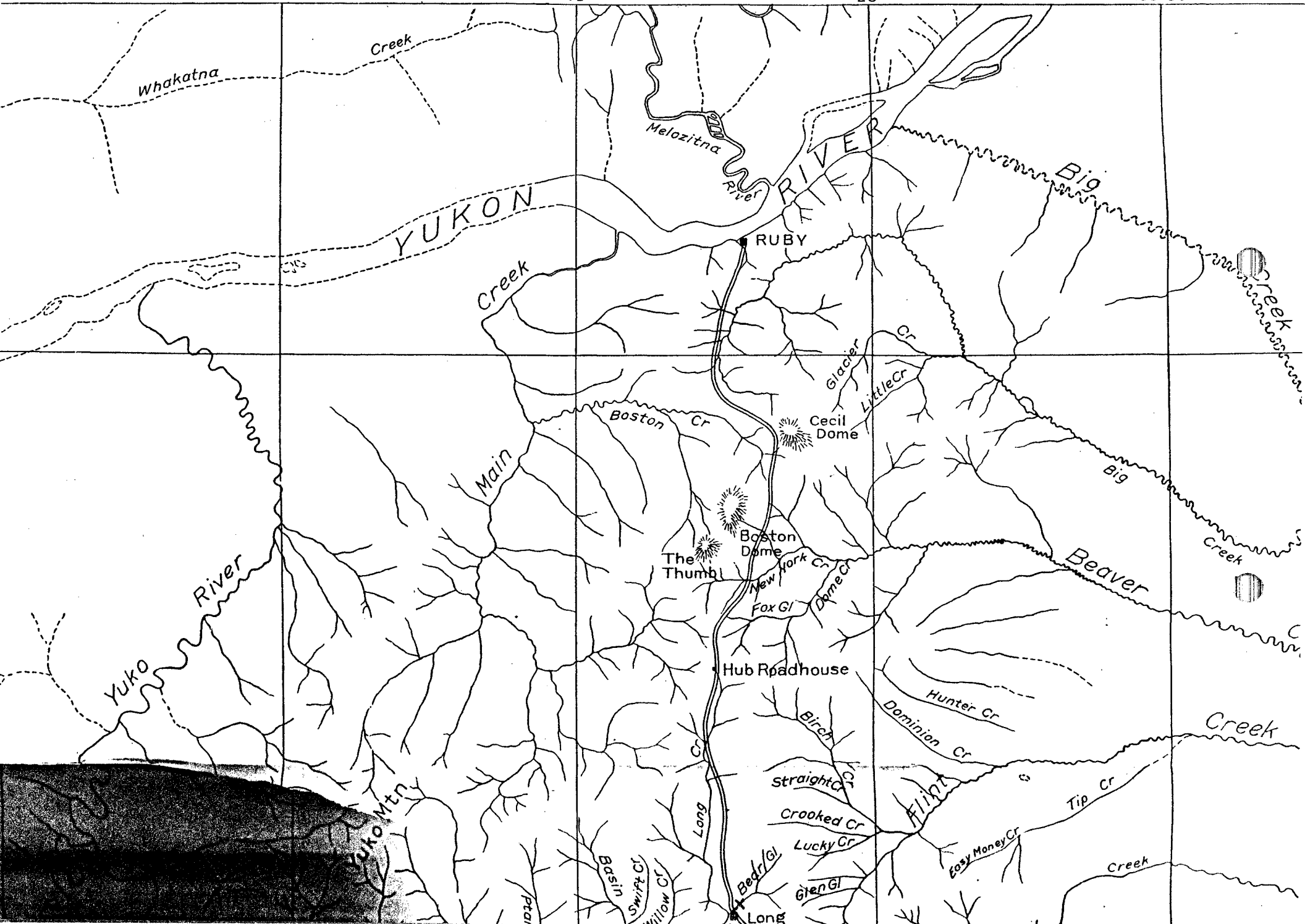
The geologic column of the Ruby-Kuskokwim region includes many types of rocks of diverse origin and age. Local descriptions of the geologic formations have been given in the various reports listed on pages 119–120, and a more general statement of the regional geology has also been presented.<sup>4</sup> In the hasty trip which the writer made through this region during the summer of 1933 no additional comprehensive geologic studies were attempted, and for the purpose of the present paper a synopsis of the prior geologic information seems adequate.

The sedimentary sequence consists of early Paleozoic or pre-Cambrian metamorphic rocks, later Paleozoic rocks of less altered character, early Mesozoic rocks, and a group of late Mesozoic and Eocene rocks that form the country rock over a large part of the region. The igneous sequence comprises early Paleozoic greenstone and related rocks, late Paleozoic or early Mesozoic lava flows, Mesozoic (?) granitic rocks, and a diversified assemblage of Cenozoic intrusive and extrusive rocks that show wide variations in chemical composition. Overlying all these hard rocks is a mantle of residual debris that covers the valley slopes and most of the lower ridges, and also thick alluvial deposits of Quaternary age that form the present valley floors.

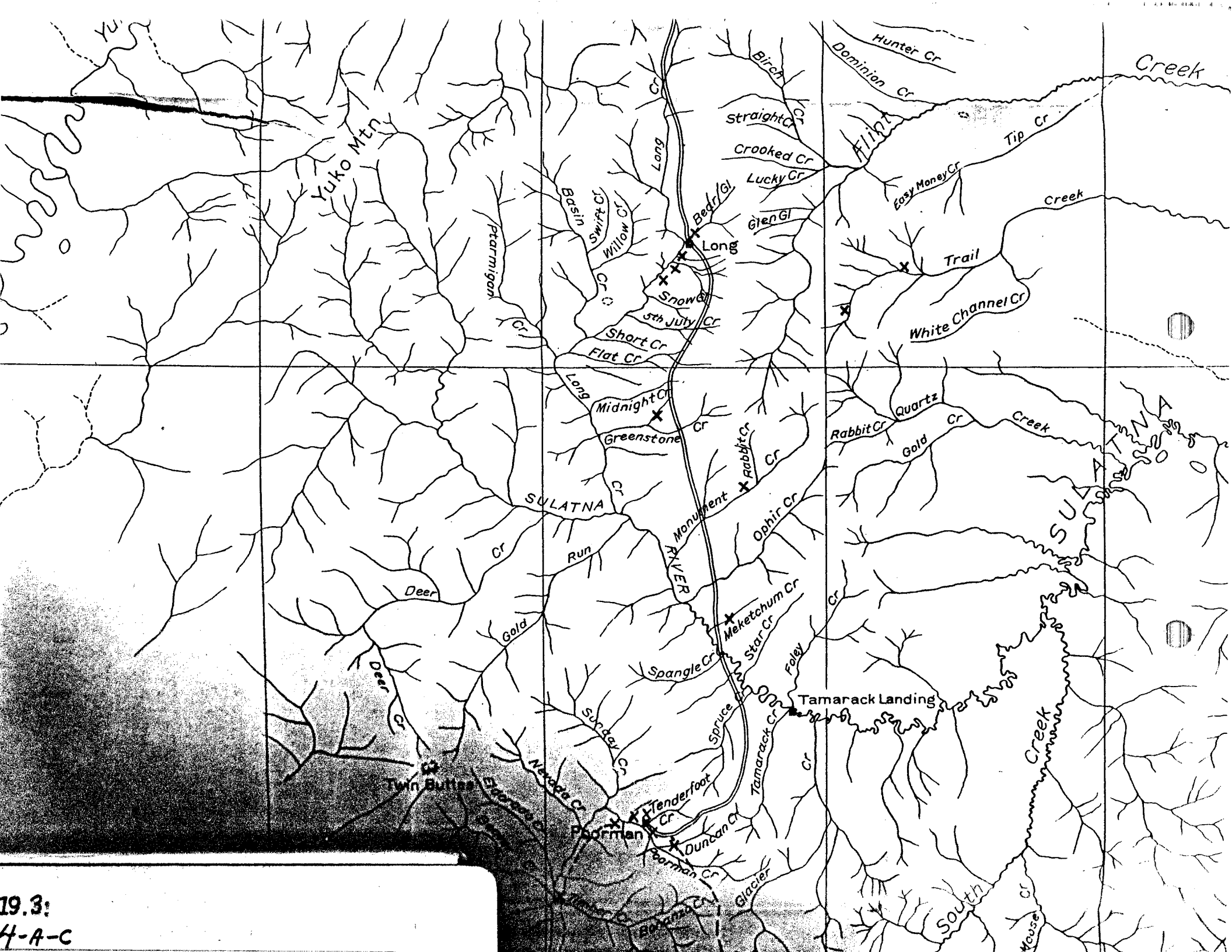
<sup>4</sup> Mertie, J. B., Jr., and Harrington, G. L., The Ruby-Kuskokwim region, Alaska: U. S. Geol. Survey Bull. 754, 1924.

In the geologic mapping so far of fossiliferous rocks, in different stratification, have been grouped together but this unit probably includes rocks of local origin for the undifferentiated material between Ruby and Poorman, which is country rock. These rocks also occur at the head of the Nixon Fork and are known in contiguous areas east of Nowitna Valley; north of the head of the Melozitna River; and along the south side of the Yukon River.

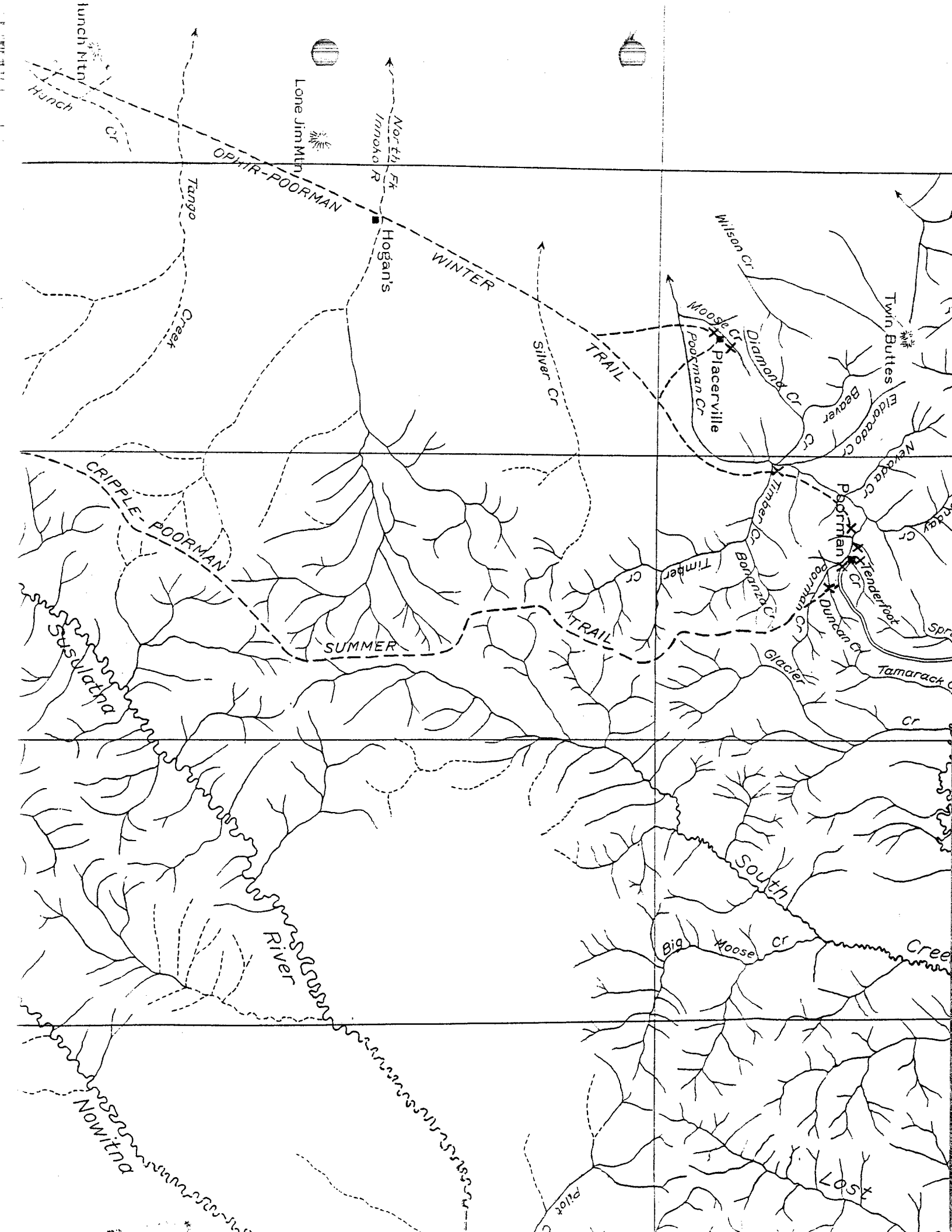
In the Ruby-Poorman area massive slate and phyllite, though locally containing tourmaline-bearing quartz, and totally recrystallized rocks are found. The phyllite and schist show cleavage, and the schist is shattering, with a subsequent filling of irregular lenses. There is no evidence that the quartz is gold-bearing. The geologic history of the altered rocks is complex, and on a large scale the structures in the Ruby-Poorman area are difficult to decipher. The dominant cleavage varies from 20° to 30° to the east, which indicates that the general structural trend is major axis pitching toward the east. The structural detail is much more complex. Associated with the altered section are igneous rocks, of which there is a sequence of lavas and tuffs of greenstone, and altered intrusive rocks. The igneous rocks are altered basalt and diabase but the intrusive greenstones consist of a variety of altered dioritic rocks. The amount of altered dioritic rocks is small, but these undifferentiated meta-igneous rocks of pre-Ordovician age, but the geologic history suggests that rocks ranging from Cambrian to Ordovician are also included. The geologic history is not definitely known, but from comparison with the interior of Alaska, it is believed that the Ruby-Poorman part of Ordovician age and is







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UNITED STATES DEPARTMENT OF THE INTERIOR  
Harold L. Ickes, Secretary  
GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

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Bulletin 866  
—

GEOLOGY OF THE  
TONSINA DISTRICT, ALASKA

BY  
FRED H. MOFFIT

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makes its way eastward in a deep canyon in unconsolidated deposits, similar to that of the Klutina River, to the Copper River. The larger tributaries of the Tonsina River from the west are Greyling and Squirrel Creeks; from the east, the Little Tonsina River, along which the Richardson Highway runs, and Quartz and Bernard Creeks.

The Tielkel River heads against the Little Tonsina near the old Ernestine road house and flows south to its junction with the Tsina River and Stuart Creek, where it turns east and flows to the Copper River through a canyon 14 miles long that lies parallel to the trend of the Chugach Mountains. The lower east-west valley of the Tielkel has never been traversed with horses in either summer or winter, and only a few men have been through it. The Tsina River, the largest tributary of the Tielkel, heads in glaciers north of Thompson Pass and flows in canyons for most of its length. Stuart Creek receives the water of several small glaciers. Its upper valley is above timber line and is open, but the lower 3 miles of the stream course is a series of waterfalls and rapids through rock-cut canyons. The Lowe River is a westward-flowing glacial stream that empties into the head of Port Valdez. It does not properly belong to the Tonsina district, but its valley is followed by the Richardson Highway. Thompson Pass (2,730 feet) between the Lowe and Tsina Rivers and the Keystone Canyon are points of special scenic interest on the Lowe River section of the highway.

The valleys of all these streams were once occupied by ice and show the characteristic features of glaciated valleys in typical form. They were straightened by the truncation of the spurs between tributary streams, their cross sections are U-shaped, and they head in cirques. Finally, the waste material transported by the ice that moved through them is widely distributed as morainal deposits.

#### ROUTES AND TRAILS

The prospectors who landed on the beach at Valdez in the fall of 1897 were bound for the interior of Alaska, and the military expedition which followed them the next year was specifically charged with the task of finding a feasible route to the interior. The first efforts of all in their attempt to cross the coastal mountain barrier were directed toward Valdez Glacier and the valley of the Klutina River. Hundreds of men and horses and many tons of freight passed over the long icy road from the foot of Valdez Glacier to the summit and down the steep slope of Klutina Glacier to the river. Some failed in the attempt, and their bodies are still entombed in the ice. The climb to the high point from the Valdez side is 5,000 feet in 15 miles, and the descent on the north side is about 3,000 feet. The air-line distance between the point of going on the ice and the point of leaving it is

19 miles, but a greater distance was for pack horses below the glacier to Klutina Lake and the Klutina River. A branch trail up the valley of St. Anthony's Prospectors in the Valdez Creek district other ascended Manker Creek and lower end of Tonsina Lake. These are now difficult to follow in places where the vegetation has grown up.

Not all the traffic, however, was also carried by boat, especially on the Lowe River. There the swift current and the narrow channel made navigation difficult and dangerous, so that many pieces of property were lost.

The Valdez Glacier route was followed by the Lowe and Tsina Rivers. The Lowe River was ascended to the point of 2,730 feet, and thence followed the Little Tonsina, and Tonsina River to the Copper River. The trail branched, one branch continuing to the Center, the other turning east and following the valley of the Tonsina and so reaching the Klutina River. This branch, together with the main trail, was used by the Circle, on the Yukon. Later, after the Klutina River was opened and the old trail beyond the Klutina River this route became part of the Richardson Highway of Gen. Wilds P. Richardson, who was the first construction as president of the Alaska Highway, a road 39 miles long, the "Edgerton Road" between the Copper River & Northwestern Railway at Willow Creek, a point near the Klutina River Center. The Richardson Highway was used by messenger cars and trucks between Valdez and either of these places and Chitina. The highway has not been kept open in recent years, and it is not a year that part of the highway is closed. The mail between the Tonsina district and Valdez is by airplane.

In addition to the highway there are many short local trails that lead to the Klutina River, trappers and other foot travelers. These include Boulder Creek, Hurtle Creek, the old military trail, and others used by the local residents.

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#### LAND TRAILS

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19 miles, but a greater distance was covered in the journey. The trail for pack horses below the glacier was on the west and north sides of Klutina Lake and the Klutina River as far as Copper Center. A branch trail up the valley of St. Anne Creek was later used by prospectors in the Valdez Creek district of the upper Susitna River. Another ascended Manker Creek and crossed to Quartz Creek at the lower end of Tonsina Lake. These trails are no longer in use and are now difficult to follow in places where the ground was marshy or where the vegetation has grown up in them.

Not all the traffic, however, went over the trails, for freight was also carried by boat, especially on Klutina Lake and the lower river. There the swift current and the many obstacles made boat transportation difficult and dangerous, so that some lives and a great deal of property were lost.

The Valdez Glacier route was abandoned after Thompson Pass, between the Lowe and Tsina Rivers, was discovered. The new route ascended the Lowe River to the pass, which it crossed at an altitude of 2,730 feet, and thence followed the valleys of the Tsina, Tiekel, Little Tonsina, and Tonsina Rivers to the Tonsina crossing. At Tonsina, where the margin of the Copper River lowland begins, the trail branched, one branch continuing north and west to Copper Center, the other turning east and crossing the lowland to the mouth of the Tonsina and so reaching the Chitina Valley. The northward branch, together with the main trail, became the Military Trail to Circle, on the Yukon. Later, after the new trail to Fairbanks was opened and the old trail beyond Tanana Crossing was abandoned, this route became part of the Richardson Highway, named in honor of Gen. Wilds P. Richardson, who was long connected with its construction as president of the Alaska Road Commission. A branch road 39 miles long, the "Edgerton cut-off", connects Chitina, on the Copper River & Northwestern Railway, with the Richardson Highway at Willow Creek, a point midway between Tonsina and Copper Center. The Richardson Highway provides a road suitable for passenger cars and trucks between Valdez and Fairbanks, or between either of these places and Chitina. Thompson Pass, however, has not been kept open in recent winters, and for more than half of the year that part of the highway is closed to traffic. For several winters mail between the Tonsina district and the coast has been carried by airplane.

In addition to the highway there are within the district a few short local trails that lead to mining properties or are used by trappers and other foot travelers. They include trails on Stuart Creek, Boulder Creek, Hurtle Creek, the Kimball Pass section of the old military trail, and others that are seldom used by any except the local residents.

UNITED STATES DEPARTMENT OF THE INTERIOR  
Harold L. Ickes, Secretary  
GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

Bulletin 868

# MINERAL RESOURCES OF ALASKA

REPORT ON PROGRESS OF  
INVESTIGATIONS IN

1934

BY  
PHILIP S. SMITH AND OTHERS



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are more nearly comparable with those within the Kaiyuh Hills are not definitely inferred from the temperature valley, except to state that the annual rainfall is appreciably greater nor appreciably

similar to that which prevails elsewhere in the subarctic, with long, cold winters. It is characteristic of interior Alaska that climatic conditions year by year are not uniform, so that there are few extremes. The conditions that appear to be abnormal in some respects in the adjoining Ruby district are none in the Kaiyuh Hills. Thus the summer of 1933 was one of little rainfall. The summer of 1934, on the other hand, was cool, and freezing temperatures with frequent frosts in the middle of July. The precipitation was about the same as in the summer of 1934, and even on some days was overcast by heavy clouds during

#### FOREST, WILDLIFE, AND GAME

The type of timber in and around the Kaiyuh Hills is also found in the lower reaches of the larger valleys. Birch and spruce are common in this country, but few of these trees were seen on the banks of streams, in upland areas near timber line willows and alders are common. Above timber line some dwarf birch and spruce are common. Most of the area just above timber line is covered with sedgehead grass. Timber line ranges from about 1,000 to sea level.

The Kaiyuh Hills is nowhere heavy, and the vegetation is scrubby, though in places rather dense. In the spruce-covered hills, however, the timber is being cut, but in the timbered saddles, the timber is mingled with the spruce, considerably less dense. In the larger valleys, as on the lower reaches of the Yuko River, timber to a diameter of 2 feet, and both on the Yuko River ample timber was available to

has been destroyed so much timber in the past. It is not in general spread into the Kaiyuh Hills, but stopped at the Yuko River, although

one burned area of considerable size was seen along the main ridge at the heads of the easternmost tributaries of Bishop Creek, mainly along the south or Yuko slopes. Close to the Yukon some good-sized burned areas were also observed, particularly along the western slopes of the wide depression that cuts across the southwest end of the Kaiyuh Hills. The fact that these hills are uninhabited and their isolation from the neighboring inhabited areas undoubtedly account for the preservation of the timber. Owing in part to the impervious character of the bedrock in these hills, but also in some measure to the freedom from burning, water occurs high in the headwater gulches and even on the spurs at timber line during summers of average rainfall, thus facilitating summer travel and camping on the ridges. Forage for stock is fairly plentiful along the valley floors of the larger streams, such as the Yuko, but good horse feed is also found among the alders near timber line.

The Kaiyuh Hills are peculiarly destitute of animal life, particularly in view of their isolated and uninhabited character. No caribou or recent signs of caribou were seen, nor do moose appear to be plentiful in the lower valleys. Relatively few signs of black bear were noted. A few ptarmigan were observed, but few rabbits, ground squirrels, or other small game animals appear to live in these hills. Grayling were seen in the headwaters of Bishop Creek, however, and the streams are believed generally to be well stocked with these and other fish.

#### SETTLEMENTS AND COMMUNICATION

Ruby, Nulato, and Kaltag, the three principal settlements nearest to the Kaiyuh Hills, have populations, according to the census of 1930, of 132, 204, and 137, respectively, of whom, however, a considerable part are natives. Nulato has a wireless radio station, maintained by the United States Signal Corps, and Ruby has a privately operated wireless and radiophone station. The telegraph line that was formerly used for communication along this part of the Yukon River is now abandoned, but the wire between Nulato and Kaltag is still in fairly good condition and is used for telephone communication. These towns and others along this part of the Yukon are served by a fortnightly steamboat schedule, operated by the Alaska Railroad, between Nenana and Marshall.

The Kaiyuh Hills are entirely uninhabited at the present time except for occasional prospectors, of whom, however, few signs were observed. About 12 years ago a silver-lead lode near the head of Bishop Creek was worked for a short time, and in that vicinity cuttings and other signs of habitation were seen. Likewise at the southwest end of the Kaiyuh Hills signs of old habitation were noted, but in general these hills appear to have been little visited by white men.

The Yuko River affords the best approach to the northeastern part of the Kaiyuh Hills, as it is navigable for small boats at least as far upstream as the forks. The southwest side of the hills is not readily accessible by river, although the Khotol River flows along the base of the western group of outlying hills. In winter, however, the Kaiyuh Hills should be reasonably accessible from the Yukon River by the use of dog-team transportation. An old trail that was formerly used for carrying winter mail from Lewis, opposite the mouth of the Yuko, to Dishkakat, was crossed by the expedition of 1934 and was found to be still fairly well marked and possible to travel with a little cutting. Another old winter trail, from a point on the Yukon about 15 miles below Kaltag, leads southeastward to Dishkakat by way of the Kluklaklatna River.

## GEOLOGY

### OUTLINE

Bedrock is not well exposed in the Kaiyuh Hills. The individual domes that occur along the main ridge rise only a few hundred feet above timber line and for the most part are covered with moss and vegetation of the tundra type. Where this vegetal cover is lacking the bedrock shows mainly as rubble, so that only at a few localities is it possible to make any structural observations. Between the domes the main ridge for miles is mantled by vegetation of various kinds, ranging from timber in the saddles to brush and tundra on the slopes, so that most of the bedrock is effectually concealed. The geologic map that accompanies this report (pl. 9) is therefore a generalized delineation of the distribution of various types of bedrock, based upon scattered exposures on the higher parts of the main ridge. Laterally the map has been extrapolated to the limits of the hills by means of long-distance field observations and according to the best judgment of the writer.

All the geologic formations that crop out in the Kaiyuh Hills are likewise found in the Ruby district, east of these hills, and in order to show the geographic and geologic relations between the two areas the accompanying map has been made to include an area extending eastward to and slightly beyond Ruby, Long, and Poorman. This extension adds several small areas of geologic formations other than those that occur in the Kaiyuh Hills, but these formations will not be described in detail, as they are only outlying parts of geologic units that are extensively and more typically developed farther south and have already been adequately described in an earlier publication.<sup>3</sup>

The oldest rocks of the Kaiyuh Hills are a group of undifferentiated metamorphic rocks, of pre-Paleozoic or early Paleozoic age,

<sup>3</sup> Mertie, J. B., Jr., and Harrington, G. L., The Ruby-Kuskokwim region, Alaska; U. S. Geol. Survey Bull. 754, 1924.

which include various types of sedimentary rocks, including phyllite, and slate, together with a minor amount of limestone. So far as practicable the various units are separately mapped. These metamorphic rocks form the eastern half of the exposed bedrock, both in the Ruby and the Kaiyuh Hills.

The next younger geologic unit is a group of basic igneous rocks of greenstone habit, which are in part intrusive. With these igneous rocks are included some sedimentary rocks that are of Carboniferous age, form the bedrock in the Ruby Hills and in about a third of the Kaiyuh Hills.

Both the undifferentiated metamorphic rocks and the igneous rocks have been intruded by granitic rocks of Mesozoic (?) age. Three small areas of Tertiary rocks are shown on the geologic map, together with a group of rocks that are younger. A small area of Tertiary rocks is shown in the vicinity of Poorman.

The youngest sedimentary rocks of this region are conglomerate, most of which are of Tertiary age. The low hills that form the extreme eastern limit of the Kaiyuh Hills are composed of such rocks. This is present southeast of Poorman. The limit of a much larger body of such rocks is shown in the area between Poorman and the Kuskokwim.

Alluvial deposits of various types, of Quaternary age, occupy large areas in this region, especially in the larger valleys and extending up the headwater tributaries. In addition to these are of fluvial or lacustrine origin, much of which is overlain by a mantle of residual and secondary deposits.

## UNDIFFERENTIATED METAMORPHIC ROCKS

### DISTRIBUTION

The undifferentiated metamorphic rocks occur in the southwest half of the Kaiyuh Hills, extending from the head of one of the forks of the Yuko eastward into the headwaters of the west fork of the Yuko and around the northwest slopes of the Kaiyuh Hills of Bishop and Kalakaket Creeks. At the head of the tributary of the Yuko several small bands of schist. These are too small to be shown on the map, but their position is indicated on the map as a



One of the points of interest at Fort Yukon is the Hudson Stuck Memorial Hospital, where the native people of the upper Yukon are cared for in sickness and are also taught the rudiments of sanitation and hygiene, as well as the fundamental principles of Christianity. This is the only well-equipped hospital in the upper Yukon Valley of Alaska and is therefore a great asset to both the white and the native people of the region. The population of Fort Yukon in 1930 is given in the Fifteenth Census as 304.

Eagle, Circle, Hot Springs, and Rampart are mining towns, with populations respectively in 1930 of 78, 50, 45, and 103. Eagle is a picturesque little settlement on the southwest bank of the Yukon River a few miles below the international boundary. It is built upon a terrace that stands well above the high-water level of the Yukon, even at times of severe flooding after the spring break-up, and has the best town site on the upper river. Eagle is the supply point for Fortymile, Seventymile, and American Creek mining districts and is also the port of entry in coming downstream from Yukon Territory.

Circle is on the southwest bank of the Yukon River at the east end of the Yukon Flats and is built upon the great flood plain of the river. It is the supply point for the Circle mining district and, being located at the north end of the Steese Highway, is a junction point for passengers coming up or down the Yukon River who wish to go by automobile to Fairbanks. About 35 miles in an air line southwest of Circle are the Circle Hot Springs, where a small watering place has been developed.

Hot Springs is built along a slough of the Tanana River, a few miles below the mouth of Baker Creek. It is the supply point for the Eureka and Tofty mining districts, which lie respectively to the northwest and northeast of the town. The Manley Hot Springs are located at this place but have not yet been successfully developed for visitors.

Rampart is on the southeast bank of the Yukon River a short distance below the mouth of Hess Creek. It is the supply point for the Rampart mining district, which lies to the south. Just across the river from Rampart the Department of Agriculture formerly maintained an experiment station, but this has been abandoned for 10 years.

#### TRANSPORTATION AND COMMUNICATION

Boats, steam trains, automobiles, airplanes, horses, and dogs are utilized for the transportation of people, freight, and mail in the Yukon-Tanana region. The Alaska Railroad, which connects Fairbanks with the south coast of Alaska, was completed in 1922 and since that time has been the quickest and most reliable route of entry into the southern part of this country. The trip from the coast

takes two days and may be made in winter. The Alaska Railroad also is equipped to handle all perishable goods. Another route from Valdez to Fairbanks over the River is open only during the summer. The route for passengers and freight destined for Fairbanks is by way of the White Pass and Yukon Route, a steam railroad from Skagway to Fairbanks, which is the head of a navigable steamboat service from Whitehorse to Fairbanks and Tanana Rivers. The steamboat service is maintained from the 1st of June until the 1st of September. Rapid transit, airplane service from Fairbanks to Whitehorse can also now be obtained, both in summer and in winter.

The navigable streams of this region are used for local travel in summer, and the steamboat service in winter. The Whitehorse and dog sleds in winter. The Tanana and the boundary are served by the American Yukon Navigation Company. This boat also plies up the Tanana River. The Yukon River below Tanana is used, both on the Yukon and Tanana Rivers, for power boats and poling boats. The Yukon River is an arterial highway and the Tanana is a treacherous stream. The Tanana is a treacherous stream, mainly to the north shore, between the two rivers inland to mine. The Tanana is also utilized in winter, mainly for mail. The longest of these is the 90-mile Richardson Highway, from Fairbanks to Tanana River at the mouth of the Tanana River. The Tanana River to Fairbanks serves as a local road in the lower valleys of the Chena and Seward Rivers on either side of those streams. From Fairbanks, the Tanana, and Fairbanks Creeks are supplemented by wagon and pack trails to the surrounding populated localities. An automobile road has also been built from Fairbanks to Whitehorse, both for local and through traffic.

at Fort Yukon is the Hudson Stuck native people of the upper Yukon are also taught the rudiments of sanitation and fundamental principles of Christianity. A hospital in the upper Yukon Valley is a great asset to both the white and the Indian. The population of Fort Yukon in 1930 was 304.

and Rampart are mining towns, with populations of 78, 50, 45, and 103. Eagle is a town on the southwest bank of the Yukon River, near the international boundary. It is built upon a high plateau above the high-water level of the Yukon, and is a fine town after the spring break-up, and has a fine view of the river. Eagle is the supply point for the American Creek mining districts and is a fine town. It is built upon the great flood plain of the Yukon River at the east end of the Circle mining district and is a junction point for the Steese Highway. It is a junction point for the Yukon River who wish to go up or down the Yukon River to Fairbanks. About 35 miles in an air line from Fairbanks to Circle Hot Springs, where a small water-

falling from a slough of the Tanana River, a few miles from Baker Creek. It is the supply point for the mining districts, which lie respectively to the north and south of the town. The Manley Hot Springs have not yet been successfully developed.

On the east bank of the Yukon River a short distance from Hess Creek. It is the supply point for the mining district, which lies to the south. Just across the Yukon River the Department of Agriculture formerly had a station, but this has been abandoned for

#### TRANSPORTATION AND COMMUNICATION

Automobiles, airplanes, horses, and dogs are used for the transportation of people, freight, and mail in the upper Yukon. The Alaska Railroad, which connects Fairbanks to Anchorage, Alaska, was completed in 1922 and is the quickest and most reliable route of entry into this country. The trip from the coast

takes two days and may be made by passengers both in summer and in winter. The Alaska Railroad also maintains a reliable freight service and is equipped to handle all kinds of commodities, including perishable goods. Another route of entry is by automobile from Valdez to Fairbanks over the Richardson Highway, but this road is open only during the summer. A third route, which is the best for passengers and freight destined to points along the upper Yukon River, is by way of the White Pass & Yukon Route. This consists of a steam railroad from Skagway across the Coast Range to Whitehorse, which is the head of navigation on the Yukon River; and a steamboat service from Whitehorse to Nenana by way of the Yukon and Tanana Rivers. The steamboat service on this route is maintained from the 1st of June until the 1st of October. For more rapid transit, airplane service from the coastal cities to Fairbanks can also now be obtained, both in summer and in winter.

The navigable streams of this region are the natural routes for local travel in summer, and the stream valleys are also much used by horse and dog sleds in winter. Points on the Yukon River between Tanana and the boundary are served by one steamboat, operated by the American Yukon Navigation Co. on a reliable fortnightly schedule. This boat also plies up the Tanana River to Nenana, but most of the local traffic on the Tanana is handled by a steamboat operated by the Alaska Railroad, which also serves the settlements along the Yukon River below Tanana. Motor launches are also extensively used, both on the Yukon and Tanana Rivers and on their navigable tributaries; and upstream from the upper limit of navigation for power boats poling boats are used to a considerable extent. In winter the Yukon River is an arterial highway for horse and dog teams, but the Tanana is a treacherous stream in winter, and sled travel sticks mainly to the north shore, between Nenana and Tanana. Many trails from the two rivers inland to mining camps and trappers' cabins are also utilized in winter, mainly for the transportation of freight and mail. The longest of these is the 90-mile trail from Eagle to Chicken.

The Richardson Highway, from Valdez to Fairbanks, crosses the Tanana River at the mouth of the Delta River and from that point to Fairbanks serves as a local road for those who wish to enter the lower valleys of the Chena and Salcha Rivers or the ridge country on either side of those streams. From Fairbanks good automobile roads radiate to the surrounding mining camps on Ester, Goldstream, Cleary, and Fairbanks Creeks and the Chatanika River; and these are supplemented by wagon and tractor roads that lead to less frequented localities. An automobile road known as the Steese Highway has also been built from Fairbanks to Circle, and this serves both for local and through traffic; and a 6-mile automobile road has

also been built to connect the Steese Highway with the Circle Hot Springs. Another road now connects Fairbanks with Livengood. The only other road of any consequence in this region is a 30-mile wagon road from Hot Springs to the Eureka mining district, which has recently been improved so that it is now suitable for travel by automobiles. Regular passenger schedules are maintained by automobiles in the summer on the Richardson and Steese Highways.

Many summer pack trails and winter sled roads have been built in this region, and some of these, for short distances from the river, have now been made into wagon roads. Thus, in good weather wagons may traverse the Eagle-Chicken road for 30 miles south from Eagle; a short road has been built from Nation, on the Yukon, to the Fourth of July Creek camp; the trail leading from Rampart up Minook Creek can be used by wagons for some distance; and a wagon road connects the lower end of the Hot Spring slough with Tofty. Considering the area of this region, however, established summer and winter routes of travel by land are as yet very meager.

The difficulties attendant on travel in this country have greatly favored the development of airplane routes, and at the present time many of the outlying towns and mining camps have aviation fields, so that rapid transit can be had when the occasion warrants it. Much of the mail is also now being carried by airplanes, though locally it must still be distributed by the older methods. Fairbanks, with its large aviation field, is the regional center of aviation, and several airplane companies offer service to all parts of Alaska. Outlying communities have been quick to avail themselves of these facilities, and there are now 16 regular landing fields in the Yukon-Tanana region.<sup>26</sup>

In the early days of the development of interior Alaska Fairbanks was connected with the south coast by a telegraph line, and the principal settlements on the Yukon and Tanana Rivers were likewise joined by telegraph lines. Most of these lines were later abandoned, but in their places radio stations were installed by the United States Signal Corps at Fairbanks, Tanana, Fort Yukon, Circle, Eagle, Hot Springs, and Livengood. Until recently these stations handled most of the long-distance and point-to-point communication, but in the fall of 1933 most of these stations, except Fairbanks, were abandoned, and commercial radiophones were introduced. Telegraph lines are still utilized, however, for communication between points along the line of the Alaska Railroad, as, for example, between Fairbanks and Nenana. For local communication telephones are much used, not only at Fairbanks but also at other places, as, for example, in the Livengood, Rampart, Hot Springs, and Circle mining districts.

<sup>26</sup>Taylor, I. P. (chief engineer, Alaska Road Commission), personal communication.

The Yukon-Tanana region is part of Alaska and therefore has a type of winters are long and cold, with summers are short but relatively nearly continuous daylight for 3 in a small area near Fort Yukon horizon at noon, even in the shortest days of summer it is visible for near this region at sunset has a horizon the apparent path of the sun, which long after sunset. This results in winter and summer.

Climatic records have been kept Bureau at several localities in this or more, but only at Eagle, Fort Yukon banks are the records fairly complete precipitation, and snowfall for these have been computed from the records are presented in the following table.

Mean temperature in Yukon

	Jan.	Feb.	Mar.	Apr.	May	Jun.
Eagle	-13.5	-3.7	7.5	26.7	44.7	50.3
Fort Yukon	-21.5	-13.6	-1.1	20.0	43.7	53.1
Rampart	-18.5	-7.7	4.1	22.9	44.9	57.8
Tanana	-12.5	-4.7	5.4	23.5	44.5	57.1
Fairbanks	-10.8	-1	10.2	28.5	47.3	58.1
Mean	-14.8	-6.0	5.2	24.3	45.0	57.6

Average precipitation in Yukon

	Jan.	Feb.	Mar.	Apr.	May	Jun.
Eagle	0.40	0.35	0.41	0.42	0.86	1.4
Fort Yukon	.42	.40	.34	.33	.52	1.8
Rampart	.63	.60	.47	.22	.45	1.6
Tanana	.72	.74	.60	.27	.82	1.3
Fairbanks	.81	.47	.70	.30	.57	1.4
Mean	.61	.53	.51	.31	.65	1.3

Average snowfall in Yukon

	Jan.	Feb.	Mar.	Apr.	May	Jun.
Eagle	8.5	5.2	3.6	3.6	0.5	
Fort Yukon	7.2	7.4	3.5	2.2	.1	
Rampart	8.5	8.0	6.0	4.0	.3	
Tanana	9.0	9.7	9.1	2.9	.0	
Fairbanks	9.4	6.2	8.3	2.8	.4	
Mean	8.5	7.3	6.9	3.1	.4	



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UNITED STATES DEPARTMENT OF THE INTERIOR

Harold L. Ickes, Secretary

GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

—  
Bulletin 894  
—

GEOLOGY OF THE  
CHITINA VALLEY AND ADJACENT AREA  
ALASKA

BY  
FRED H. MOFFIT

QE 75  
39  
no. 774



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much larger one called Barkley Lake is believed to discharge through the Tana River Valley. Barkley Lake is reported to be several miles long at the high stages of water and to empty at irregular intervals of several years, but the information regarding it is meager.

As a rule these glacial lakes break out each year sometime in late summer, after enough water has accumulated to form the head necessary to break through the barrier. The lake on the Kotsina River has been known to break in winter. Skolai Lake has held for 3 years before breaking and during part of the time had a natural overflow at the high-water level. A small lake has usually formed on the north side of Chitistone Glacier, but it disappeared in 1928, owing to the retreat of the ice from the rock wall that deflects the glacier to the southwest. After the barrier preventing the discharge of these glacial lakes gives way the emptying of the basin is rapid, requiring from a few hours to a day, and a great volume of water is released which spreads over the flood plain and piles up in the canyons. Great quantities of ice, some of it rounded like boulders, are left on the river bars. At times much timber is destroyed by the cutting away of wooded gravel benches. The bars of the upper Nizina River were piled up with tangled masses of trees brought down by the flood of 1927. A characteristic effect of such floods is that the river channels in the flood plain are filled with gravel and sand, so that for a short time after the waters have subsided, it is possible to ford even a stream like the Nizina River without getting into deep water.

#### ROADS AND TRAILS

Valdez, on Prince William Sound, was the port of entry for all the Copper River Basin from the time when the first prospectors landed there, in 1897, till the Copper River & Northwestern Railroad was completed in 1911. During those years supplies for the Chitina Valley were brought by sled over the military trail to Upper Tonsina, thence on the ice of the Tonsina and Copper Rivers to the Kotsina or the Chitina River and so to the Kuskulana, Lakina, Nizina, or other convenient stream for reaching the mining claims. The summer trail led from Tonsina to the Copper River at Billum's Crossing, near the mouth of the Tonsina River, and thence along the north side of the valley to the different camps.

Cordova is now also a port of entry, and the Copper River & Northwestern Railroad provides most of the passenger and freight service to the Chitina Valley, although the Richardson Highway out of Valdez is much used in summer. The railroad is 194 miles long and ends at Kennecott, where it receives much the larger part of its tonnage from the copper mines. A division point is located at Chitina, opposite the mouth of the Chitina River, where a branch of the Richardson Highway provides a connection by automobile with

either Valdez or Fairbanks. point for the Kotsina and K 191, which is the starting point was originally called "Shusha" for supplies on Dan and Chiti

The old pack trail from Bill the Nizina River is no longer follow because of burned timber within the area have been roads where traffic was sufficient to roads were built by mining Commission. A wagon road Strelna to the copper prospect Glacier. This road is now li Berg Creek, on the east side bridge that was built by the branch built by the Alaska R Valley. In the Nizina district of McCarthy with Kenneco follows McCarthy Creek to t was constructed privately by Commission. The longest ro to the gold placer mines on D was built by the Alaska Ro River by a long bridge 2 mil At the roadhouse on May Cr forks, one branch going to Da The trail to the White River and extends north to the C routes is offered. One leads Skolai Creek, part of the wa known as "the goat trail"; th mouth of Skolai Creek and t A choice of trails is offered along the west side of Nizina the ice to Skolai Lake, and glacier and climbs over a h the main trail on Skolai Cre and maintains relief cabins Nizina Glacier, at the mout Skolai Creek.

A trail from the Nizina was laid out by the Alaska development work done on of Young Creek to the ri

believed to discharge through reported to be several miles apart at irregular intervals of time and it is meager.

Each year sometime in late August or early September the ice is broken up and the water is forced to form the head of the lake on the Kotsina River has been held for 3 years and has had a natural overflow at the head usually formed on the north side of the lake. In 1928, owing to the fact that the glacier to the west of the lake deflects the discharge of these glacial waters into a rapid, requiring from a large amount of water is released which flows down the canyons. Great quantities of gravel and sand are left on the river bars. The cutting away of wooded hillsides on the Nizina River were piled up by the flood of 1927. A large amount of the river channels in the flood plain were cut for a short time after the flood and even a stream like the Nizina River.

#### RAILS

The port of entry for all the goods and supplies for the first prospectors landed on the Northwestern Railroad was at the mouth of the Chitina River. The trail to Upper Tonsina, Upper Kotsina, Upper Kuskulana, Lakina, Nizina, or other mining claims. The trail to the Copper River at Billum's Crossing, and thence along the river to the mouth of the Copper River.

The Copper River & Northwestern Railroad passenger and freight service is maintained by the Richardson Highway out of Fairbanks. The road is 194 miles long and carries the larger part of its freight. The main point is located at the mouth of the Copper River, where a branch of the road is maintained by automobile with

either Valdez or Fairbanks. Strelna, at mile 146, is the supply point for the Kotsina and Kuskulana Rivers. McCarthy, at mile 191, which is the starting point for travelers to the White River and was originally called "Shushanna Junction", is the distributing point for supplies on Dan and Chititu Creeks.

The old pack trail from Billum's Crossing on the Copper River to the Nizina River is no longer used, and much of it is now difficult to follow because of burned timber and washouts. Other old trails within the area have been replaced by wagon or automobile roads where traffic was sufficient to warrant the change. Some of these roads were built by mining companies, and some by the Alaska Road Commission. A wagon road 20 miles long was constructed from Strelna to the copper prospects on Nugget Creek near Kuskulana Glacier. This road is now little used. It has a branch leading to Berg Creek, on the east side of the Kuskulana River, by way of a bridge that was built by the Alaska Road Commission. Another branch built by the Alaska Road Commission leads into the Kotsina Valley. In the Nizina district a road 4 miles long connects the town of McCarthy with Kennecott, and another about 13 miles long follows McCarthy Creek to the old Mother Lode camp. This road was constructed privately but is now controlled by the Alaska Road Commission. The longest road in the district runs from McCarthy to the gold placer mines on Dan and Chititu Creeks. This road also was built by the Alaska Road Commission. It crosses the Nizina River by a long bridge 2 miles west of the mouth of Young Creek. At the roadhouse on May Creek 1 mile east of Young Creek the road forks, one branch going to Dan Creek and the other to Chititu Creek. The trail to the White River leaves the Dan Creek road at Dan Creek and extends north to the Chitistone River, where a choice of two routes is offered. One leads up the Chitistone River to the head of Skolai Creek, part of the way over a high mountain trail commonly known as "the goat trail"; the other leads up the Nizina River to the mouth of Skolai Creek and then up Skolai Pass and the White River. A choice of trails is offered on this route also, for one branch goes along the west side of Nizina Glacier for several miles before crossing the ice to Skolai Lake, and the other keeps to the east side of the glacier and climbs over a high rocky point before coming down to the main trail on Skolai Creek. The Alaska Road Commission built and maintains relief cabins for winter travelers at the lower end of Nizina Glacier, at the mouth of Frederika Creek, and at the head of Skolai Creek.

A trail from the Nizina River bridge to the upper Chitina River was laid out by the Alaska Road Commission and has had a little development work done on it. It runs through the lowlands west of Young Creek to the river bars, instead of crossing the divide

between the head of Young Creek and the Chitina River, like the trail formerly used. Little money has been available for improving this trail, but the results of the expenditure so far have been of much help to the prospectors using it.

Numerous shorter trails have been built throughout the district, but for the most part they were not intended for public travel and need not be described. The trails through the Hanagita and Bremner Valleys should be mentioned, although they have been traveled so little in recent years that it is doubtful whether parts of them could be followed now. Starting at the crossing of the Copper River at Taral, below Chitina, a trail ascends Taral Creek and crosses the divide to the Hanagita Valley. It then goes east to Monahan Creek and to Golconda Creek, from which it leads by way of the Bremner, Little Bremner, and Tebay Rivers back to the starting point. No summer trail for horses was ever built on the Bremner River between the Little Bremner and Copper Rivers.

#### CLIMATE

The Chitina Valley is part of the Copper River Plateau climatic province, one of the eight climatic provinces into which Abbe<sup>1</sup> divided Alaska. This province is in some respects intermediate between the Pacific coast, with its temperate, humid climate, and the interior plateau north of the Alaska Range, which is characterized by great extremes of temperature and very moderate rainfall. Minor local variations in precipitation and temperature exist within the province as a result of differences of altitude, the effect of mountain ridges, and similar variables, and only such climatic conditions as apply generally in the Chitina Valley will be described here.

Records of precipitation and temperature have been kept at several places in the Chitina Valley and nearby points and have appeared in the published reports of the United States Weather Bureau. These published records, covering a period from 1902 to 1930, are the source of the information to be given in the tables. The records are not complete and vary widely in the length of time covered, but those chosen include a sufficient number of years for the averages to give a fairly accurate picture of climatic conditions in the area. The places chosen for comparison are Chitina, Copper Center, and Kennecott. Weather observations were made at Strelina and Tielkel for several years, but only parts of the records are included here. The records from Copper Center go back to 1902 but stop with 1919. Those from Kennecott extend from 1916 to 1930, and the Chitina records from 1917 to 1923. Years or parts of years are missing from the records of each place.

<sup>1</sup> Abbe, Cleveland, Jr., in Brooks, A. H., The geography and geology of Alaska: U. S. Geol. Survey Prof. Paper 45, p. 140, 1906.

#### Climatic records for stations

Station	Mean monthly and annual				
	Jan.	Feb.	Mar.	Apr.	May
Chitina.....	1.16	0.88	0.34	0.34	0.34
Copper Center.....	.57	.51	.26	.21	.21
Kennecott.....	1.55	1.36	1.25	1.30	1.30
Mean monthly and annual					
Chitina.....	14.5	7.6	3.0	1.6	1.6
Copper Center.....	6.5	3.8	2.9	1.0	1.0
Tielkel.....	13.2	9.3	11.4	3.2	3.2
Mean monthly and annual					
Chitina.....	-3.2	6.4	14.2	32.3	44.4
Copper Center.....	-11.5	3.8	12.7	28.8	44.4
Kennecott.....	5.0	11.4	18.1	28.6	44.4
Highest monthly and annual					
Chitina.....	47	46	47	60	60
Copper Center.....	49	49	49	67	67
Kennecott.....	41	46	45	58	58
Strelina.....	46	49	46	56	56
Lowest monthly and annual					
Chitina.....	-49	-37	-30	-20	-20
Copper Center.....	-74	-55	-48	-26	-26
Kennecott.....	-35	-39	-29	-15	-15
Strelina.....	-52	-46	-38	-29	-29
Tielkel.....	-45	-36	-28	-21	-21
Average number of days with maximum temperature above					
Chitina.....	31	27	31	26	26
Copper Center.....	31	28	30	29	29
Average number of days with maximum temperature below zero and below (F)					
	Jan.	Feb.	Mar.	Apr.	May
Chitina.....	23	16	15	3	3
Copper Center.....	26	19	17	4	4

The tables show that Kennecott precipitation of Copper Center is considerably greater than it is at Chitina. The annual temperature at the highest temperature (96°) and at Copper Center.

In a more general way it may be said that the valleys of the Chitina Valley are short and usually moderate, though high at times.

DOCUMENTS

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UNITED STATES DEPARTMENT OF THE INTERIOR

Harold L. Ickes, Secretary

GEOLOGICAL SURVEY

W. C. Mendenhall, Director

—  
Bulletin 897-C  
—

GOLD PLACERS OF THE  
FORTYMILE, EAGLE, AND CIRCLE DISTRICTS

ALASKA

*Living Reed*

BY

J. B. MERTIE, JR.

—  
Mineral resources of Alaska, 1936  
(Pages 133-261)



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precipitation. In reality, the graph shows that the two curves diverge differentially, indicating that in February and March from 14 to 15 inches of snow equal 1 inch of water; whereas in November and January 18 inches of snow equal 1 inch of water; and in December 22 inches of snow is required to make 1 inch of water. It therefore appears that the snow of December is fluffier, or less dense, than the snow of other winter months.

The curve of mean temperature is a rather symmetrical one, except for an irregularity in March, during which the mean temperature appears to be about 3° lower than symmetry demands. No such irregularity in the curve is apparent for the corresponding period in the fall. That this irregularity is not accidental is indicated by the fact that temperature curves for other stations in interior Alaska show the same feature. It therefore appears that cold weather persists into March beyond the time when such conditions might be expected. The table also shows that the mean annual temperature is about 6° below freezing. It should be pointed out, however, that the temperature records at Eagle were not taken as a continuous record but are based upon a small number of observations during each day. It is therefore possible that an integrated mean temperature, derived from continuous curves, might show somewhat different monthly and annual means.

A partial record, compiled by the Weather Bureau up to and including the year 1921, also shows that 56 days may be expected at Eagle during which the temperature will rise to 70° or more; that 255 days may be expected when the temperature will fall to 32° or less; and that 120 days may be expected when the temperature will fall to zero or less. Up to 1921 the warmest summer temperature reported at Eagle was 96° and the coldest winter temperature -75°. Similar climatic conditions exist in the Fortymile and Circle districts.

On the basis of 22 observations at Eagle, it has been determined that the average date when the ice starts to move in the Yukon River is about May 10; and on the basis of 19 observations the mean date when the river freezes over in the fall is November 10. The date of the break-up is fairly regular, varying only about a week before or after the mean date; but the date of the freeze-up is more irregular, with possible variations of as much as 2 or 3 weeks. The Yukon River is therefore open for about 6 months in the year, but the presence of ice floes in the spring and fall and the uncertainty regarding the date of the freeze-up limit the period of steamboat navigation to about 4 months.

#### SETTLEMENTS, TRANSPORTATION, AND COMMUNICATION

Eagle and Circle are the principal towns within the Eagle and Circle districts, but smaller settlements have also been established, not

only in these two districts but also in an incorporated town on the Yukon River, 10 miles in an air line down the river. According to the census of 1930, with a population of 157, Circle is the native town of Eagle. The population is distributed on nearby creeks and rivers.

Circle is on the southwest side of the northeast of the east end of the Yukon Flats. A population of 157. Four other settlements in the district are mentioned. Central House and Circle are class post offices, are the local centers that center around Deadwood and Circle Hot Springs, with a rather popular watering place. Circle is a fourth-class post office, known in interior Alaska, particularly in the Fortymile district, on the southwest side of the Yukon River.

The Fortymile district includes several settlements, which have four class post offices. Supplies and mail are distributed to a considerable area. These post offices are on the Yukon River; Jack Wade, on Wade River; Franklin, on the South Fork of the Chicken Creek, a tributary of the Yukon. The population of the Fortymile district aggregated 142 persons.

According to local conditions, planes, horses, and dogs are used for freight, and mail in the district. Eagle and Circle are reached by mail service on the Yukon River Navigation Co. By this service a part of those for Circle are delivered to which they are delivered by completion of the Steese Highway. However, a considerable part of the mail is also used on the streams, particularly on the Fortymile River, at the mouth of the Fortymile upst-



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#### AND COMMUNICATION

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only in these two districts but also in the Fortymile district. Eagle is an incorporated town on the southwest bank of the Yukon River about 10 miles in an air line downstream from the international boundary. According to the census of 1930 the Eagle district is accredited with a population of 157, of whom 54 lived in the town of Eagle, 78 in the native town of Eagle Village, and the remainder were distributed on nearby creeks where mining is in progress.

Circle is on the southwest bank of the Yukon River about 15 miles northeast of the east end of the Crazy Mountains, at the southeast end of the Yukon Flats. According to the census of 1930 the town of Circle had a population of 50 persons, most of whom were natives. Four other settlements in the Circle district, however, should be mentioned. Central House and Miller House, both of which have fourth-class post offices, are the local supply points for the mining operations that center around Deadwood and Mammoth Creeks, respectively; and Circle Hot Springs, with a fourth-class post office, is the site of a rather popular watering place, which is patronized by many people in interior Alaska, particularly by residents of Fairbanks. Another fourth-class post office, known as Coal Creek, was established in 1933 on the southwest side of the Yukon River at the mouth of Coal Creek.

The Fortymile district includes no large towns but has four small settlements, which have fourth-class post offices and from which supplies and mail are distributed to a population scattered over a considerable area. These post offices are Steel Creek, on the Fortymile River; Jack Wade, on Wade Creek, a tributary of Walker Fork; Franklin, on the South Fork of the Fortymile; and Chicken, on Chicken Creek, a tributary of Mosquito Fork of the Fortymile. The population of the Fortymile district, according to the census of 1930, aggregated 142 persons.

According to local conditions, boats, automobiles, autotrucks, airplanes, horses, and dogs are used for the transportation of people, freight, and mail in the Fortymile, Eagle, and Circle districts. Eagle and Circle are reached in summer by a fortnightly steamboat service on the Yukon River, maintained by the American-Yukon Navigation Co. By this service all the supplies for Eagle and a part of those for Circle are brought downstream from Whitehorse, to which they are delivered by rail from Skagway. Since the completion of the Steese Highway between Fairbanks and Circle, however, a considerable part of the supplies for Circle come overland by autotrucks from Fairbanks. Gasoline launches and small boats are also used on the streams tributary to the Yukon River, particularly on the Fortymile River, where supplies are freighted from the mouth of the Fortymile upstream to Steel Creek.

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In winter the Yukon is closed to navigation and the Steese Highway is closed to automotive transportation. Hence most of the supplies required in these three districts are imported during the summer. In winter the mail is distributed by horse sleds from Fairbanks to Circle and from Whitehorse down the Yukon River to Eagle and is then further distributed to outlying areas, including the Fortymile district, either by horse or by dog sleds. It is probable, however, that the mail will soon be delivered to Circle and Eagle in winter by airplane.

A branch road from the Steese Highway leads from Central House to the Circle Hot Springs; and several other local roads have been built in the Circle district, connecting Central House and Miller House with the various mining camps. Coal and Woodchopper Creeks have also been considered to be a part of the Circle district. Under the stimulus of new mining developments now in progress on these two creeks, the construction of an automobile road was begun in 1936, from the Yukon River at the mouth of Coal Creek upstream to the site of the present dredging operations, thence westward over the ridge and down Mineral Creek, a tributary of Woodchopper Creek, and up Woodchopper Creek to the dredging ground in that valley. This road was completed in 1937.

No first-class roads have been built in the Eagle and Fortymile districts, but the summer trail from Eagle to Chicken, which has a length of 85 miles, is sufficiently passable in good weather during the summer for a light wagon to be driven from Eagle to Liberty Creek, a distance of 30 miles. An automobile, however, can be operated from Eagle only 7 miles over this road. No road connects Eagle with the Seventymile district, so that practically all supplies for the Seventymile Valley have to be transported in winter. A poor road, 10 miles long, now little better than a skid road, connects Nation, on the Yukon River, with the mining camp in the upper valley of Fourth of July Creek. No roads have yet been built in the Fortymile district, but the use of tractors is gradually making roads, without any deliberate road building.

Airplanes are rapidly becoming a factor in the transportation of people and freight in this region, particularly in the more remote parts, such as the Fortymile district. Landing fields have been built at Circle, Circle Hot Springs, Eagle, Jack Wade, Franklin, Walker Fork, and Chicken, and others are being projected. Emergency airplane service is also utilized for various purposes, as for example in 1936, when a drilling crew and their equipment were landed on a bar of the Seventymile River. The Yukon River and some of its tributaries also afford landing facilities for hydroplanes and make possible additional service, as for example from Fairbanks to the mouth of Coal Creek.

In the early years of the mining communication was effected by the United States Signal Corps, but also connected the coast of Alaska, whence messages. Later the Signal Corps abandoned substituted radio stations at Fairbanks from which messages could be sent to the States. In 1933 most of the Signal Corps along the Yukon River substituted radiophone stations, operated communication at Eagle and Chicken. Emergency and amateur radio stations at some of the more remote localities and at Chicken.

#### OTHER PLACERS

One of the most important industries is the transportation of supplies and equipment for these three districts. Skagway and the upper Yukon are reached from Seattle to Eagle or Circle by various types of commodities transported by rail, and from \$85 to \$116 a ton, rate, however, applies to commodities transported by way of Seward from Fairbanks to Circle by airplane and from Fairbanks to Miller House or Chicken.

The Fortymile district receives nearly all the heavy equipment and supplies enter the country by way of Fairbanks, but this freight is unloaded at Fairbanks and being to its ultimate destination. A road has been built westward from Fairbanks in the Sixtymile mining district. In point tractors are used for transportation in the Walker Fork area of the Fortymile district. Transported from Dawson to Fairbanks by the Walker Fork Gold Corporation for a freight rate cannot be said to exist, \$50 a ton.

The freight unloaded at Fairbanks from the Fortymile River, is transported in winter, to Steel Creek, Jackson

gation and the Steese Highway. Hence most of the supplies imported during the summer. Horse sleds from Fairbanks to the Yukon River to Eagle and other areas, including the Forty-mile sleds. It is probable, however, that Circle and Eagle in

the highway leads from Central House and several other local roads connecting Central House and other camps. Coal and Wooded to be a part of the Circle mining developments now in operation of an automobile road on the Yukon River at the mouth of Coal Creek dredging operations, thence to Mineral Creek, a tributary of the Upper Creek to the dredging completed in 1937.

In the Eagle and Forty-mile districts, the route from Eagle to Chicken, which has a skid road in good weather during the winter, is driven from Eagle to Liberty. Automobile, however, can be operated. No road connects Eagle and Chicken. Practically all supplies for the districts are imported in winter. A poor road, a skid road, connects Nation, and a logging camp in the upper valley have yet been built in the Forty-mile district. It is gradually making roads,

factor in the transportation of supplies, particularly in the more remote districts. Landing fields have been built at Jack Wade, Franklin, Walker Fork, and are being projected. Emergency air-landings for purposes, as for example in the case of equipment were landed on a skid road on the Yukon River and some of its uses for hydroplanes and make possible sample from Fairbanks to the

In the early years of the mining industry in interior Alaska, rapid communication was effected by a network of telegraph lines, operated by the United States Signal Corps. These lines not only served local needs, but also connected the towns of the Yukon Valley with the coast of Alaska, whence messages were relayed by cable to the States. Later the Signal Corps abandoned most of these telegraph wires and substituted radio stations at Eagle, Circle, and other outlying points, from which messages could be sent to Fairbanks and thence to the States. In 1933 most of the radio stations operated by the Signal Corps along the Yukon River were abandoned. In their place small radiophone stations, operated by private concerns, were installed, and communication at Eagle and Circle is now furnished by such facilities. Emergency and amateur radiophones are also being installed in some of the more remote localities, as at the dredge on Wade Creek and at Chicken.

#### OTHER ECONOMIC FACTORS

One of the most important economic considerations in a mining industry is the transportation of freight. A large part of the supplies and equipment for these three districts comes into Alaska by way of Skagway and the upper Yukon River. The summer freight rates from Seattle to Eagle or Circle by this route vary, according to the types of commodities transported, from \$78 to \$102 a ton for carload lots, and from \$85 to \$116 a ton for less-than-carload lots. A different rate, however, applies to commodities that are imported into the Circle district by way of Seward and Fairbanks. The local freight rate from Fairbanks to Circle by autotruck is \$40 a ton, but the rate from Fairbanks to Miller House or Central House is about \$30 a ton.

The Forty-mile district receives its supplies by several routes. Nearly all the heavy equipment and a large part of the other supplies enter the country by way of Skagway and the upper Yukon River, but this freight is unloaded at Dawson, Forty-mile, or Eagle, according to its ultimate destination. From Dawson an automobile road has been built westward for a distance of 60 miles to Glacier Creek, in the Sixtymile mining district of Yukon Territory; and from this point tractors are used for the transportation of freight into the Walker Fork area of the Forty-mile district. Most of the freight transported from Dawson to Walker Fork is hauled by the Walker Fork Gold Corporation for its own use, so that a local commercial rate cannot be said to exist, but the actual cost is probably about \$50 a ton.

The freight unloaded at Forty-mile, Yukon Territory, at the mouth of the Forty-mile River, is transported up that stream, mainly during the winter, to Steel Creek, Jack Wade, and Chicken, at rates varying

summer white population is perhaps 40 people, but the winter population is larger, owing to the fact that some of the miners from the near-by mining districts spend the winter in Eagle. On the Seventy-mile River and on American Creek, adjacent to Eagle, there are 15 to 30 people engaged in mining, and just upstream from Eagle is a small settlement of natives.

Circle is at the upper end of the Yukon Flats, upon a great river flood plain. It is the supply point for the Birch Creek mining district, to the south. It has at present a summer population of less than a score of white people, but, like Eagle, it has an augmented winter population, which is derived from the near-by Birch Creek mining district. There are also a considerable number of natives living permanently at and near Circle.

Between Eagle and Circle are two smaller settlements, Nation and Woodchopper, the former on the southwest bank of the Yukon about 2 miles below the mouth of the Nation River and the latter on the same side of the river just above the mouth of Woodchopper Creek. Only two men live permanently at Nation, but 8 or 10 others are engaged in mining on the near-by Fourth of July Creek. Similar to Nation at Woodchopper the population consists mainly of the 15 or 20 men engaged in mining and prospecting on Woodchopper, Coal, and Saugah Creek.

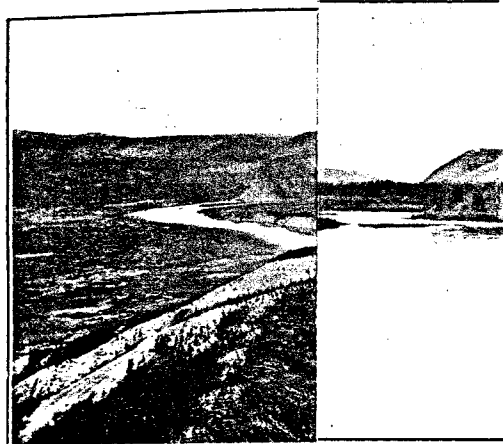
A few trappers and prospectors also live along the river between Eagle and Circle, but the total white population of this district immediately contiguous to the Yukon, not including the Fortymile and Birch Creek mining districts, is probably less than 100.

#### TRAILS AND TRANSPORTATION

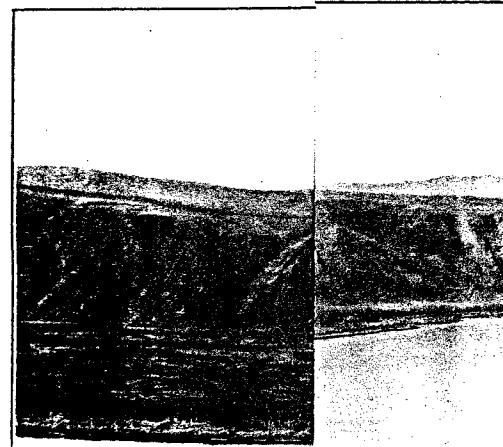
The Yukon River is the arterial highway of this region, being traversed by river craft in summer and by dog sleds in winter. Few summer roads have yet been made in this part of Alaska. A wagon road connects Eagle with American Creek and extends on southward as a pack trail to the Fortymile district, another extends out from Circle to the Birch Creek mining district, and during the summer of 1925 a short road was being constructed from Nation up Fourth of July Creek. Much of the freighting is done in winter by horse and dog sleds, but these winter trails are of little use for summer transportation.

Supplies for this region, including the Fortymile and Birch Creek districts, are received mainly by way of Skagway and Whitehorse and thence down the Yukon through Canadian territory by river boats. The Alaska Railroad does not serve the upper Yukon region and the costs of passenger and freight transportation are high. A new summer road has recently been built to connect Fairbanks with

U. S. GEOLOGICAL SURVEY



A. YUKON VALLEY, LOOKING SOUTH OF WASHINGTON  
Showing above present river level



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DEPARTMENT OF THE INTERIOR  
Roy O. West, Secretary

U. S. GEOLOGICAL SURVEY  
George Otis Smith, Director

4  
Bulletin 807

GEOLOGY OF HYDER AND VICINITY  
SOUTHEASTERN ALASKA

WITH A RECONNAISSANCE OF  
CHICKAMIN RIVER

BY

A. F. BUDDINGTON

QE 75  
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p. 807



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## BRITISH COLUMBIA

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## GEOGRAPHY

## TRANSPORTATION FACILITIES

The Stewart district of southeastern Alaska lies at the head of the Portland Canal, a well-known ford which cuts obliquely across the mountains from Dixon Entrance, at the southern end of the coast. The mountains are defined on the east and north by the Dixon Entrance and on the west by the drainage divide of the Skeena River, the streams tributary to Salmon River and the Skeena River. (See pl. 1.) The area lies between the Hyder mining district, and the mine

Portland Canal area that lies in British Columbia. Described by Schofield and Hanson.<sup>2</sup> The district is situated at the head of Portland Canal, at the mouth of the Skeena and on the international boundary, at

<sup>2</sup>George, Geology and ore deposits of Salmon River district. Canada Geol. Surv. Mem. 102, 1922.

approximately latitude 55° 55', longitude 130° 1'. (See pl. 4, A.) A spur of the Reverdy Mountains extends south to the coast, where the delta and tidal flats built out into the canal by Salmon River extend around the base of the steep mountain slope. Part of the town is built on piling over the tidal flats, but the newer part is on the gravel-floored valley of Salmon River, to the northwest. The original settlement was called Portland City, but it was renamed in honor of George Hyder, engineer for the Alaska-Gastineau Mining Co., which had an option on the Big Missouri property on the Canadian side in 1915. A wharf about two-thirds of a mile long has been built over the tidal flats to deep water, and Hyder is accessible to ocean vessels throughout the year. It may be reached by means of the regular steamship service to Stewart from Vancouver and Prince Rupert, B. C. (135 miles), by regular weekly mail boats from Ketchikan (155 miles), and by occasional steamships direct from Seattle.

The town of Stewart lies about 2 miles to the northeast, on the British Columbia side of the boundary, and although older than Hyder it is of about the same size. It is connected with Hyder by a road suitable for automobiles.

The district has been opened up by a road suitable for automobiles from Hyder to the Premier mine, on the Canadian side. This road runs along the east side of Salmon River most of the way, and about 11 miles of its course is in American territory. It affords the only practical mode of access to the mineral deposits in the upper part of the drainage basin of Salmon River, a factor that has contributed to the growth of Hyder.

A pack trail has been built by the United States Forest Service up the West Fork of Texas Creek, one of the major tributaries of Salmon River, from the bridge across Salmon River above Ninemile, at an altitude of 335 feet, to Chickamin Glacier, at the head of the West Fork Valley, at an altitude of 2,350 feet, a distance of about 11 miles. A branch trail goes over a low saddle, at an altitude of 870 feet, to the foot of Salmon Glacier, at an altitude of 535 feet. Another pack trail has been built by the Forest Service up Fish Creek from the Salmon River Road, and a branch from it to the Titan property.

## CLIMATE

The Salmon River district lies within the Pacific coast climatic province, where there is abundant rainfall and relatively moderate temperature. From November to March the precipitation at sea level is chiefly in the form of snow. The rainfall is least in late spring and early summer; it is greatest in July, August, September,

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Ray Lyman Wilbur, Secretary  
GEOLOGICAL SURVEY  
George Otis Smith, Director

Bulletin 813

# MINERAL RESOURCES OF ALASKA

REPORT ON PROGRESS OF  
INVESTIGATIONS IN

1928

BY

PHILIP S. SMITH AND OTHERS



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the courses of the major rivers was being done.

It began about 1894, when gold was discovered in the upper Cook Inlet area, and led into Turnagain Arm. These discoveries led to the introduction of prospectors into this part of Alaska, but the first systematic exploration in Alaska came in 1898, when prospectors discovered old placer deposits in the Klondike region. Adventurers throughout the civilized world realized the potential value of the region.

Expeditions launched in 1898 and 1899 by the United States Geological Survey and the U. S. Army, only those will be mentioned here. The location of the region north and west of the Alaska Range west of the coast.

To obtain an accurate survey of the route to the Geological Survey in charge of the expedition who in 1898 ascended the Susitna, in canoes, crossed the range through Portage Creek, and thence descended to the Pacific shore by the Alaska Peninsula to Katmai. On their journey they completely encircled the range and obtained important geologic information about a great area that was previously unexplored.

The distance was that of Brooks,<sup>3</sup> in 1902, when he, in the early spring, crossed the range on the north flank of the range to the Yukon. Thence northward to the Yukon. The first knowledge of the location of the Alaska Range. Before the discovery of geologic and geographic exploration by the Geological Survey around the west, south, and east, all of which added greatly to the knowledge of the range, there still remained a great area lying west of the range, Lakes Clark and Iliamna on the Kuskokwim lowland on the west and the Klondike region. The accurate geographic and geologic information was entirely lacking and into which few white men had penetrated.

The Geological Survey had for years had under consideration plans to carry surveys into this region, but demands for work elsewhere and lack of funds had delayed these projects.

In 1926, however, a series of expeditions, planned to explore this unknown area, was begun, and a combined geologic and topographic party in charge of S. R. Capps,<sup>4</sup> geologist, and K. W. Trimble, topographic engineer, ascended the Skwentna River to its head and mapped the headwaters of that basin, as well as some country tributary to the South Fork of the Kuskokwim River. In 1927 a second expedition, in charge of Mr. Capps,<sup>5</sup> with R. H. Sargent, topographic engineer, approached the region from the west shore of Cook Inlet, east of Mount Spurr, and explored and mapped most of the basin of the Chakachatna River, as well as a large area of the coastal region between Cook Inlet and the mountains.

#### PRESENT INVESTIGATIONS

The Chakachamna-Stony region adjoins to the southwest the area covered during the two preceding seasons. It includes part of the western headwaters of the Chakachatna River, most of the basin of the Necons River, and the upper, mountainous portion of the valley of the Stony River, all previously unsurveyed and largely unexplored. The lack of knowledge of this area was due mainly to its difficulty of access.

The eastern front of the mountains is separated from Cook Inlet by a belt of swampy lowland and of rolling brushy ridges, crossed by torrential glacial streams. In summer the lowland offered a serious obstacle to travel, and in winter the rugged mountains with their heavy snows and high winds presented little attraction to the prospector or trapper. Approach to this region from the southwest and west was also difficult, involving a long journey either from Bristol Bay or from the Kuskokwim River over a country devoid of trails, or up rivers that narrow canyons and rapids make difficult to navigate even by poling boat or canoe. Under the conditions that prevailed until within the last few years a prospecting or trapping expedition to the west front of the Alaska Range in this region was considered to be a 2-year undertaking, the first summer being used to transport the necessary supplies by poling boat to the head of navigable waters, from which supplies were taken by dog sled to the chosen field after the freeze-up in the fall. The winter was spent in trapping, building cabins, and opening trails, and the following summer could be devoted to prospecting. Few men have so far cared

<sup>3</sup> Brooks, U. S. Geol. Survey Prof. Paper 70, 1900.

<sup>4</sup> Capps, S. R., The Skwentna region: U. S. Geol. Survey Bull. 797, pp. 66-98, 1929.

<sup>5</sup> Capps, S. R., The Mount Spurr region: U. S. Geol. Survey Bull. 810, pp. 141-172, 1929.

to undertake such an expedition into this region. Mr. R. M. White had spent some time trapping on the headwaters of the Stony River, and he furnished a rough sketch map of the drainage with which he was familiar. During the last two or three years, however, the Geological Survey has surveyed considerable portions of this hitherto unexplored area, and in the winter of 1927-28 several men took advantage of the establishment of a commercial airplane service from Anchorage to fly into the headwaters of the Chakachatna and Stony Rivers to trap and prospect, and without doubt others will follow.

In the expedition of which this report is an account it was planned to utilize airplane transportation, in addition to pack train, in order to expedite the freighting of supplies and personnel to the field of operations and so lengthen the season of productive work. Arrangements were made in advance for the transportation of the three technical members of the party and about a ton of supplies and provisions by airplane from Anchorage to the head of Kenibuna Lake, in the Chakachatna Basin. This was accomplished on May 10 and 11, 1928. Meanwhile, the pack train and remaining supplies, with the two packers and the cook, were transported by launch and an open barge to Trading Bay, just east of Mount Spurr, and there put ashore to join the airplane party by way of the trail established the preceding summer. As a result of the bad condition of the trail, much snow on the ridges above timber line, rainy weather, and absence of adequate grass for horse feed due to the late spring, the pack-train party was three weeks on the way from Anchorage to the base camp, to which the other members had gone by air in a little more than an hour. Upon the arrival of the pack train at the head of Kenibuna Lake, on June 30, the expedition proceeded westward toward the crest of the range. The personnel included, in addition to the writer, who was geologist of the expedition, Gerald FitzGerald, topographic engineer; William A. Spurr, recorder; C. C. Tousley, packer; R. A. Francis, assistant packer; and Jim Brown, cook. To all these men the writer wishes to express his earnest appreciation of their faithful service during a season of trying weather conditions and difficult trail.

After leaving Kenibuna Lake the expedition proceeded westward to the head of Another River, toward Merrill Pass, a pass across the crest of the range which was discovered from the air by Russell H. Merrill, pilot of the Anchorage Air Transport Co., and which it was hoped would be feasible for pack horses. This pass is low, having an altitude of 3,180 feet, and is approached from both east and west by easy grades. The pass itself, however, is obstructed by coarse granite talus slides that extend down from the cliffs on both sides and that in three places meet along the valley axis. In their natural

state these accumulations of coarse talus make the passage of a man on foot but not of pack horses. Several days' work by all hands was required to fill in the interstices with talus to make a trail on steep slopes before the head of the pass. Part of the trail so constructed was on certain unstable slopes slides are sure to occur. It will be necessary before horses can be used to cross the pass.

Once across the crest of the range the expedition descended down a tributary valley to the head of Another River. Two Lakes. From the head of Two Lakes the trail was followed westward across a high ridge to Another River, and that stream was ascended to the head of the stream was found leading northward into the head of the stream, possibly the Hartman River. The heavy snow of the season prevented the exploration of the northward-flowing drainage system. Finally the party turned back and returned to the head of the trail followed in the spring.

Because of an unusually rainy season, an area of the range was mapped topographically and geologically. It was gained as to the interrelations of the geologic waters from this mountain mass to the head of the Chakachatna, and Kuskokwim Rivers. In accompanying geologic map the geologic structure is shown in a generalized way only. The difficulties of the weather during the field season, and the limited area as possible in the short time available, prevented many of the geologic boundaries from being subdivided. Certain groups of deposits in the region fossils are extremely scarce, and the fossils having been found during the entire season. The determinations of most of the formations and have been made largely by comparison with those in adjoining areas.

The thin sections of rocks collected during the expedition have been studied by J. B. Mertie, jr.

#### GEOGRAPHY

*Drainage.*—The drainage system of the range reported include part of the extreme west of the Chakachatna Basin and part of the head of the Chakachatna. The greater part of the Chakachatna







of the season was made on upper  
The writer feels that much of the  
Mr. Taylor's intimate knowledge  
n everything connected with trav-  
In addition to other activities Mr.  
f the fossil collections.

in detail, yet more time was given  
the usual reconnaissances that the  
ska. Unfortunately a part of the  
topographically, and a still larger  
which was made in the early days  
gh it has served its purpose well,  
represent many geologic features.  
a small plane table and open-sight  
e system and locating rock outcrops  
er McCarthy Creek, the Chitistone  
Nizina River.

a full account of the geology of the  
in new features that were observed  
of the general geology, which is  
described in other publications, to  
prehensive account of the geology  
parts of the Copper River Basin is in  
l later.

#### US WORK

egan with the exploratory expedi-  
in 1891 and of Rohn<sup>2</sup> in 1899.  
skolai Pass, which they were the first  
e River and reached the Nizina by  
ut had no time for making geologic  
line of travel. Rohn crossed the  
iers from the Nizina River to the  
ition for much of the geologic work  
. Schrader and Spencer<sup>3</sup> made a  
that covers part of the area here  
ogic survey of part of the Nizina  
apps<sup>4</sup> in 1909 and furnishes some of

the Yukon district: Nat. Geog. Mag., vol. 4,

Chitina River and Skolai Mountains, Alaska:  
pt. 2, pp. 393-445, 1900.

geology and mineral resources of a portion of  
ol. Survey Special Pub., 1901.

and mineral resources of the Nizina district,

the data contained on Plate 3. In 1914 Capps<sup>5</sup> spent several days  
in the Skolai Creek Valley and included his observations on a  
geologic map of the Chisana-White River district. The writer  
visited the upper part of McCarthy Creek and the Chitistone River  
in 1922 and made some studies whose results were not published but  
are included in this report. All these expeditions added something  
to the knowledge of parts of the district but left much to be learned,  
a statement which is also true of the work done in 1927, for the  
problems to be solved are too complicated to be worked out without  
detailed maps and considerable time.

#### PHYSICAL FEATURES

The area under consideration is on the southeast border of the  
Wrangell Mountains and includes over 350 square miles of extremely  
rugged country with a relief of more than 6,600 feet between the  
mouth of the West Fork and the high mountains south of Sko-  
lai Creek and of more than 8,800 feet between the West Fork  
and Frederika Mountain (10,820 feet), north of Skolai Creek.  
Regal Mountain (13,400 feet), at the head of McCarthy Creek  
and the West Fork, is not included in the area mapped. The  
five streams mentioned—the Nizina River, the West Fork, Skolai  
Creek, the Chitistone River, and McCarthy Creek—receive the greater  
part of their waters from melting glacier ice and are subject to  
great variations in volume depending on the temperature. In early  
spring and late fall they offer little trouble to travelers, but in mid-  
summer they are sometimes crossed with great difficulty, if at all.  
As a rule, however, the men who know the streams ford them with  
their horses at the established crossings with little interruption,  
sometimes waiting from evening till morning to take advantage of  
the lower water.

The Nizina River and Nizina Glacier extend southward through  
the middle of the area. McCarthy Creek, which flows into the Ken-  
nicott River and thus into the Nizina, and the West Fork lie on  
the west side of the Nizina. The Chitistone River, which joins the  
Nizina 5 miles below the West Fork, flows southwestward from the  
vicinity of Russell Glacier and Skolai Pass. Skolai Creek flows  
westward from Russell Glacier, reaching Nizina Glacier opposite  
its tributary Regal Glacier, or about 5 miles from the south end of  
Nizina Glacier and 15 miles north of the mouth of the Chitistone  
River. Skolai Creek receives only a small part of the drainage of  
Russell Glacier, whose waters for the most part flow northeastward  
to form the White River. The principal tributary of Skolai Creek

<sup>5</sup> Capps, S. R., The Chisana-White River district, Alaska: U. S. Geol. Survey Bull. 630, 1916.

is Frederika Creek, a short tributary from the north that arises in Frederika Glacier. Nizina Glacier forms a dam across Skolai Creek and causes its waters to collect in a narrow lake, about 2 miles long at its maximum extent, which breaks out periodically, flooding the Nizina and sometimes causing damage to the bridge near McCarthy.

The Chitistone River Valley offers a more direct route for travel from McCarthy to the White River and the Shushana gold placers than Skolai Creek, but it involves a high climb over the so-called "goat trail" to avoid the canyon above Chitistone Glacier and is less used than the Skolai Valley during those periods when the Nizina River and the ice of Nizina Glacier are favorable for travel, a condition that is sometimes not present for several years at a stretch. The old trail by way of Skolai Creek kept to the west side of Nizina Glacier for several miles from the lower end and then took a course diagonally across the ice to the north side of Lower Skolai Lake, but a new trail along the east side of the glacier has been cut by the Alaska Road Commission and was traveled by several parties in 1927. If this trail is extended, and especially if some work can be done to make it easier to pass Lower Skolai Lake and the canyon between the lake and Frederika Creek, both of which necessitate a high climb over rough country, it will doubtless become the established route to the White River.

## GEOLOGY

### OUTLINE

The rocks that are most widely distributed in this district are sedimentary rocks and bedded tuffs and lava flows. Massive intrusive rocks are not well represented in the area studied and are confined to a small area near Frederika Mountain, another on Skolai Creek, and possibly one other locality. Similar rocks are found in the mountains of lower McCarthy Creek and are shown on the map (pl. 3) but lie outside the area to which most attention was given. The oldest rocks that have been recognized are of Permian age and include a great thickness of lava flows, bedded tuffs, massive limestone, shale, limy sandstone, and grit. The next younger formation is the Nikolai greenstone, of Permian or Triassic age, which is overlain by rocks of Upper Triassic age, which include the Chitistone limestone, Nizina limestone, and McCarthy shale and reach a thickness of at least 5,500 feet. Possibly the Permian rocks underwent some folding before the Upper Triassic sediments were deposited, but the evidence for this is not yet complete. However that may be, both the Permian and the Upper Triassic rocks were folded and subjected to weathering and erosion before the

next younger beds. The Cretaceous sa  
The Cretaceous beds are largely of  
distributed in the Chitina Valley.  
district is probably not less than 2  
but much less so than the older fo  
are open and broad, and in places  
tilting.

After the Cretaceous beds were o  
began in Eocene time, which yield  
flows and tuffs. These surface eff  
posits are extensively developed in  
they make up much of the highland  
a continuous sheet of great exten  
beneath, yet erosion has not only c  
deep valleys in the underlying f  
fresh-water leaf-bearing beds of  
thin coal seams have been found at  
canic rocks and furnish evidence fo  
These beds appear to be small in  
tribution. The Tertiary volcanic rock  
do not lie in their original horizont  
in most places.

Stream gravel and glacial moraine  
waste on the mountain slopes and  
the list of geologic formations know

### STRATIGRAPHY

#### PERMIAN

The Permian rocks of the Nizina  
ing geologically, have never been th  
described in much detail. They cons  
lava flows and tuffs—but are interst  
of limestone, shale, sandstone, grit,  
and composition, which, however,  
uniformly throughout the thicknes  
form an intermediate group, domin  
volcanic rocks above and below.  
are limy in some localities but high  
conspicuous of the sedimentary be  
than 800 feet thick, which is local  
everywhere is abundantly fossilife  
north side of Skolai Creek.