UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 903

THE NUSHAGAK DISTRICT ALASKA

BY

J. B. MERTIE, JR.

UNITED STATES
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Game Commission also has a game warden who makes his headquarters at Snag Point, and during the summer the Bureau of Fisheries has men in this district for patrolling the fishing grounds of Bristol Bay to see that the fishing regulations are obeyed.

TRANSPORTATION AND COMMUNICATION

Bristol Bay is closed to navigation in winter, but during the summer Snag Point and Dillingham are served by steamships from Seward and from Seattle. Five monthly trips, in May to September, inclusive, are made by the steamship *Starr* of the Alaska Steamship Co., from Seward to Snag Point. The power schooner *Tupper*, which makes two summer trips from Seattle to Bethel, also puts in at Snag Point. The freight rate in 1935 from Seward to Snag Point, via the *Starr*, averaged for general merchandise about $17 a ton, plus lighterage and wharfage. Lumber, imported from Seattle, sells for $50 a thousand feet; fuel oil for 10 cents a gallon; and coal for $22 a ton, or $1.25 for a 100-pound sack.

For rapid transit, particularly for passengers, a weekly airplane service is maintained by the Star Air Service between Anchorage and Snag Point, the one-way trip taking 3½ hours, as compared with 10 days on the *Starr* between Seward and Snag Point. The airplane one-way fare is $75. The steamship fare is $70. Other airplane companies operating out of Anchorage also make occasional trips to Snag Point. In summer the Star Air Service has an emergency air mail contract for the weekly delivery of first-class mail only, but second- and lower-class mail is delivered by the steamship *Starr*. In winter, however, all mail is transported fortnightly from Anchorage to Snag Point by airplane. The airplane companies also handle express and other packages, charging 38 cents a pound from Anchorage.

An automobile road, surfaced with gravel, was built in the summer and fall of 1934 between Snag Point and Kanakanak. The intervening country is swampy, so that some stretches of the road had to be planked, but in general road building in this district is favored by the presence of plenty of available gravel. A gravel pit was opened about halfway between Snag Point and Kanakanak for the building of this road. Another automobile road has been planned between Snag Point and Mosquito Point, by way of the Wood River Cannery. Even if all of this road is not built, the stretch between Snag Point and the Wood River Cannery will be most useful, not only for those residing at Wood River, but also for the inhabitants of Mosquito Point, who often find the water trip in small boats from the mouth of the Wood River to Snag Point to be hazardous and unpleasant, on account of adverse tides and winds.

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Climatic records

Month	
January	
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[1] Record prior to March 1919 was made at
of Dillingham.

During the field season o
the temperature, using a max

[16] Summary of the climatological
Bull. W, 2d ed., vol. 3, 1926; also Cl

Most of the local travel between Snag Point and outlying points is done either by boat or by airplane. On Nushagak Bay and the Nushagak River many small boats are used. Airplane travel, however, is rapidly becoming a favored mode of transportation, and trappers, prospectors, and cannery people are now using airplanes to an increasing extent, both for local transportation and freighting and for long-distance travel. The airplanes operating in and out of Snag Point are all equipped with pontoons, as there is no landing field at Snag Point, but it is doubtful if a landing field is much desired, as the airplane operators prefer to be on pontoons, because the presence of so many lakes and other bodies of water between Anchorage and Bristol Bay affords a great number of emergency landing fields in case of motor trouble.

CLIMATE

Climatic records have been obtained by the United States Weather Bureau [16] at Dillingham and vicinity since 1881 and at Naknek since 1917. At neither of these places, however, has a continuous record been maintained since the establishment of the stations, but both series of records are adequate for obtaining good averages of the precipitation, snowfall, and mean temperature. The available data up to and including 1933 have been assembled and averaged, and the table given below represents a summary of these data.

Climatic records at Dillingham [1] and Naknek

Month	Mean precipitation (inches)		Mean snowfall (inches)		Mean temperature (° F.)	
	Dillingham	Naknek	Dillingham	Naknek	Dillingham	Naknek
January	1.75	0.53	11.3	7.6	16.3	14.9
February	1.36	1.14	8.9	13.6	16.7	19.1
March	1.86	1.02	13.7	5.2	21.5	21.6
April	1.22	.81	3.9	1.9	29.2	33.2
May	1.62	1.71	2.3	.0	40.9	42.1
June	1.81	1.52	.0	.0	52.0	50.8
July	2.90	3.63	.0	.0	55.2	54.0
August	4.00	4.55	.0	.0	54.5	54.0
September	4.13	3.86	.2	.0	46.8	48.0
October	2.68	2.65	3.2	.2	35.8	35.9
November	1.78	.99	8.9	4.7	24.4	21.7
December	1.41	1.06	13.0	8.8	15.8	15.2
Annual	26.52	23.47	65.4	42.0	34.1	34.2

[1] Record prior to March 1919 was made at Fort Alexander (the present site of Nushagak), 4 miles southeast of Dillingham.

During the field season of 1935 the writer kept a daily record of the temperature, using a maximum and minimum thermometer, which

[16] Summary of the climatological records of Alaska, by sections: U. S. Weather Bur. Bull. W, 2d ed., vol. 3, 1926; also Climatological data, Alaska section, vols. 8–19, 1922–33.

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Bulletin 926

MINERAL RESOURCES OF ALASKA

REPORT ON PROGRESS OF INVESTIGATIONS IN 1939

PAPERS BY
PHILIP S. SMITH, FRED H. MOFFIT
AND F. F. BARNES

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942

even to horses and are avoided by them. In addition to the different grasses and vetches, a variety of *Equisetum* and the leaves of certain willows should also be mentioned as forage plants, for horses eat them with relish and will subsist on them without grass if necessary.

In general, it may be said that feed for stock is plentiful in summer in most parts of the district except the lowlands north of the mountain area. Locally it is remarkably plentiful, as on the bars of Jarvis Creek and the upper Johnson River, which produce an abundance of grasses and pea vine and are a true "horse heaven" in summer. Although the winters are severe, horses have wintered for many years on the bars of some of the streams, where, like the buffalo, they are able to get sufficient food to maintain themselves from one growing season to the next. However, it is doubtful if these bars can support any considerable number of horses the year round without much hardship and hunger.

ROUTES AND TRAILS

Routes rather than trails may well be considered to be the subject of this section since the trails are few and with one or two exceptions are now used so infrequently that they are obscure and not easy to follow. In general, they cross the ridges and drainage lines of the district at right angles so that in places they are either very steep or wet; yet notwithstanding their shortcomings they are of much help to travel with horses or on foot. All lead eventually to the Richardson Highway or the Tanana River.

The Richardson Highway follows the valley of the Delta River through the Alaska Range and is the only feasible land route for approaching the country that lies on the north side of the Alaska Range between the Delta and Robertson Rivers. However, it is not the only means of access. The Tanana River is navigable for small power boats and is used for distributing supplies to the trading stations of the upper river, particularly those at Tanana Crossing and Tetling Lake. By this means supplies for the Geological Survey topographic party of 1936 and hunting parties of earlier years were delivered at the mouth of the Little Gerstle River, where they were then accessible for transport by pack train into the adjacent country on the south.

The present highway took the place of trails that had already been in use for some time. Most of the early prospectors who went into the valleys of the Delta River and Jarvis Creek came from the Fairbanks district before the Richardson Highway was established. Their trails from the Tanana River are not used now, as the highway provides a better mode of travel. At present little prospecting goes on in the district, and most of the traveling is done by trappers and hunting parties. The route used by the Geological Survey field parties is in the main that which has been used by hunting parties in going to

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An alternate route from the Delta
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Jarvis and Riley Creeks and the Johnson River. In parts of this route fairly well defined trails have been made; but as a rule each traveler chooses his own trail as the occasion requires.

A route that has served for travel by horses and even by tractor leaves the Richardson Highway at mile 247.8—3½ miles north of Donnelly Station—crosses the ridge on the east to Jarvis Creek, and reaches that stream 4 miles below the mouth of Riley Creek, to which the bars of Jarvis Creek give easy access. From the mouth of Riley Creek it runs through the timber for a short distance and climbs to the open country of the ridge on the east, which country, though providing no trail, is above timber line and affords good footing for horses. After crossing the open country to the head of Macomber Creek this route leads up to a saddle overlooking the head of the Gerstle River, from which it makes a steep descent to July Creek. The approach to the saddle is gradual for most of the way but ends in a steep pitch at the top. The descent to July Creek, however, is abrupt and, as there is no trail, care is needed to keep pack animals out of danger from loose boulders and rock ledges. From July Creek the bars of the Gerstle River furnish easy going for 8 miles downstream to the old cache on its west bank. Here, at the crossing of Big Gerstle, is a well-defined trail to the top of the ridge on the southeast. Although the trail ends on the brow of this ridge, the bare hilltop furnishes good footing as far as a saddle 3 miles to the southeast, overlooking the valleys of Sheep Creek and the Little Gerstle River. The descent to the Little Gerstle River is by a trail through the timber on a steep mountain side, where care is necessary in places to avoid soft ground. The trail was made for the use of a hunting party and leads to Hajdukovich's hunting lodge on the east side of the Little Gerstle River 1 mile above the mouth of Sheep Creek. Below or north of the hunting lodge the bars of the Little Gerstle River provide a route, indicated by a trail in a few places, to the Tanana River. South of the hunting lodge a soft, swampy trail leads along the east side of the valley to the bars of the Johnson River. Travel on the bars of the west side of the Johnson River is good as far as the glacier, although there is no trail except at one or two points where the river swings against its west bank.

In the highland country between the Johnson and Robertson Rivers there are no trails. The traveler must pick his way as best he can and may travel far to find wood and grass suitable for a camping place.

An alternate route from the Delta River that may be used in place of the one just described starts from the Richardson Highway about 3 miles south of Beales Cache, an old, abandoned roadhouse on the highway near mile 361.5. This route provides a well-defined trail

from the highway eastward as far as Granite Creek or a little beyond, that is, for about 10 miles. The trail is over the glacial moraines and for most of the way gives hard footing and easy travel for horses, although it has a little soft ground on the west side of Jarvis Creek.

From Granite Creek this route leads along the margin of the Tanana lowland area to the cache on the Gerstle River, where it joins the route already described. Inasmuch as any trails that may have existed in this part of the route are now practically obliterated, the traveler can do no better than use his own best judgment in picking a way through timber and swamps and glacial moraine.

The obstacles to travel that are most likely to give trouble in this district are glacial streams, soft ground, and ground strewn with granite blocks or boulders that are overgrown with moss or other vegetation. Inasmuch as the Richardson Highway is on the east side of the Delta River this stream gives no concern to the traveler going east from the highway. Among the remaining streams the Johnson River is the one most likely to cause trouble, for in times of high water it cannot be crossed without some danger of losing horses and packs. In the summer of 1936 the Geological Survey topographic party forded the river at a place opposite the granite point, where the trail from the Little Gerstle River reaches the Johnson River Valley. The high water at that time made it necessary to delay crossing several days before a favorable stage of water was found. The return journey some weeks later was made without difficulty as the water was lower.

Both Jarvis Creek and the Gerstle River afford many places favorable for crossing with horses and ordinarily give little trouble. The Little Gerstle River is a much smaller stream, which for the most part is easily forded.

Quicksand is not present on most of the streams within the mountain area, but soft ground is found in the lowland area. Wet, swampy ground is such a common cause of trouble in pack-train travel throughout most of Alaska that the experienced traveler is constantly on the watch for it. Soft ground, though it may be almost anywhere, is often found along the foot of the hill slopes and along small streams in poorly drained land. Wet ground is likely to be marked by a growth of small willows.

In some parts of the Delta district horses are in more danger from concealed holes between boulders partly or wholly covered with vegetation than from swampy ground. The granite areas have yielded a great quantity of blocks and boulders that rolled down the mountain sides or were heaped together by glaciers. In places where this loose material has been overgrown by vegetation without having the spaces between the boulders filled with gravel or other fine material, a horse stepping into a hole may injure himself.

GA

Although game animals inhabit district, so far efforts to establish th hunting parties from the outside h ful. Some years ago Mr. John Hu cabins to accommodate hunting pa For several seasons these cabins wer in more recent years they have been who were concerned chiefly with get Although much of the district is too hunters in the hunting season, mos winter.

The larger game animals include th and coyote. Sheep are found throu elsewhere the bucks keep to the hig ewes and lambs graze out on the h frequently in view. Caribou, like and are often seen grazing on the ba river bars. Moose do not frequent highland areas but feed near the ma the valleys, where they can quickly f its tracks are common, the moose is most of the time when not feeding in distributed but, so far as observation would indicate, are less numerous Alaska Range in the upper Coppe Wolves and coyotes appear to be m part of Alaska familiar to the wri 1939 the Geological Survey party m as many coyotes. Inasmuch as the at all times during daylight, the nu remarkable. Wolves make a practice doubtless with the intention of pickin nity comes, and will stay for days some difference of opinion exists mals are, it seems reasonable to bel caribou cows without calves and noticeable during the season of 19 wolves and coyotes.

Although the buffalo is protected same sense as the other animals m that the animals introduced on the Creek several years ago by the Biol increased from about 30 to nearly

UNITED STATES DEPARTMENT OF THE INTERIOR
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W. C. Mendenhall, Director

Bulletin 926–D

GEOLOGY OF THE PORTAGE PASS AREA, ALASKA

BY

F. F. BARNES

Mineral resources of Alaska 1939
(Pages 211–235)

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GOVERNMENT PRINTING OFFICE
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ROUTES AND TRAILS

The eastern approach to Portage Pass is readily accessible to deep water vessels by way of Passage Canal. It was possible as late as 1914 to cross from Passage Canal through Portage Pass to Portage Valley by way of a trail over Portage Glacier, but by 1939 recession and ablation of the glacier had made this route impracticable for summer travel. Because of the numerous large crevasses and serac ice on the surface of the glacier and the unscalable cliffs, the 1939 party found it necessary to climb 3,000 feet to the summit of Portage Shoulder to cross from Passage Canal to Placer Creek Valley.

The western part of the pass area can be easily reached, except during extreme high water, by about 6 miles of trail up Portage Creek Valley from the railroad at Portage station. Placer Creek Valley can be reached from the west either by way of a foot trail that climbs to a height of about 1,000 feet over the ridge of Turnagain Shoulder or by boat across Portage Lake.

GAME

Large game animals in this area include mountain goats, moose, and black bears. No mountain sheep were seen in 1939, although they were reported to have been seen near the foot of Portage Glacier several years previously. Goats were seen in considerable numbers on Portage Shoulder and on the ridges south and southwest of Portage Glacier, and moose tracks were abundant along Portage Creek. Black bears were seen in Portage and Placer Valleys.

Of the smaller animals, beavers appeared to be fairly abundant along Portage and Placer Creek, and marmots were numerous at the east end of Portage Pass. Rabbits apparently were scarce or absent.

The only game birds noted were ptarmigan, which were frequently seen at higher elevations.

GENERAL GEOLOGY

PRINCIPAL FEATURES

The distribution of rocks in the Portage Pass area is shown on plate 16. The entire area is underlain by a thick series of altered sediments, consisting of a rather uniform succession of irregularly bedded mudstones and impure sandstones that have been intensely folded, contorted, faulted, and generally metamorphosed to slate, argillite, and graywacke. This series is of somewhat uncertain age but it is known to be at least in part Cretaceous and may be entirely Mesozoic.[6]

Intrusive igneous rocks are rare in this vicinity, the only known occurrences being five acidic dikes near the head of Passage Canal

[6] Capps, S. R., Geology of the Alaska Railroad region: U. S. Geol. Survey Bull. 907, p. 59, 1940.

a small basic dike on the west slope of P
ll quartz nests, seams, and stringers are of w
are particularly abundant in certain zones.
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her common in the graywacke-slate series in
The only other formations exposed in this vicini
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ley floors and deltas and coarse, angular mo
tage and Learnard Glaciers.

GRAYWACKE-SLATE SERIE

CHARACTER AND DISTRIBUTIO

rregularly bedded rocks, consisting principally
argillite but possibly including occasional
ne and conglomerate, are exposed over the ent
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ge in thickness from a fraction of an inch
hough the graywacke beds are commonly 1
se of the slate and argillite 2 to 6 inches th
le is characterized by an absence of recogniza
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in a given locality invariably pinches out o
illite within a few hundred feet. No attemp
ywacke, slate, and argillite separately, altho
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e seen in the field.

GRAYWACKE

The graywacke is a fine- to medium-grained
dium to dark gray, that is composed princip
r, and graphitic material. At many places i
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illimeters in diameter. Epidote, chlorite,
nd in several thin sections, but original ferr
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uartz and feldspar occur as semirounded t
0.5 millimeter in diameter, thickly scattered
rtz, feldspar, sericite, kaolin, and chlorite. T
te, possibly oligoclase in a few thin sect
s considerable alteration to sericite. Much
attered grains or as thin streaks or layers pa
is probably syngenetic, but the occurrence
microscopic veinlets in a few specimens su
of the calcite has been introduced.

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Bulletin 933-B

GEOLOGY OF THE NUTZOTIN MOUNTAINS, ALASKA

BY FRED H. MOFFIT

With a section on the
IGNEOUS ROCKS
By RUSSELL G. WAYLAND

GOLD DEPOSITS NEAR NABESNA

BY RUSSELL G. WAYLAND

Mineral resources of Alaska, 1940
Pages 103-199

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For sale by the Superintendent of Documents, Washington, D. C. . . . . Price 65 cents

insignificant in size if compared with such masses of flowing ice as the Nabesna and Chisana Glaciers. Some of these streams, such as Bonanza and other neighboring creeks, are important for economic reasons, and some are known chiefly because their valleys furnish routes of travel.

The Nutzotin Mountains are physiographically youthful. They have been intensely glaciated in recent geologic time and still retain many small glaciers within their higher parts. Their outlines are rugged, suggesting not only the effects of rapid glacial erosion but also the character of the rocks that compose them. The highest peak of the Nutzotin Mountains within the area shown on the topographic map is Mount Allen, whose altitude is 9,487 feet, or more than 7,300 feet higher than the flood plain of the Chisana River 5 miles to the southeast and 7,300 feet higher than the Nabesna River at the mouth of Platinum Creek. The highest point of the mountains between upper Beaver Creek and the East Fork of the Snag River is 8,600 feet. When compared with the altitude of the forks of the Snag River, which is about 3,200 feet, this shows a difference of 5,400 feet. An examination of the topographic map will make it evident that peaks of 6,000 feet and even 7,000 feet are common throughout much of the district.

ROUTES AND TRAILS

The first prospectors to make their way into the Nutzotin Mountain area came through the Copper River Valley on the west and by the White River on the east. In August 1899, Brooks[5] and Peters met two of these prospectors, E. J. Cooper and H. A. Hammond, on Kletsan Creek, a tributary of the White River. They had come from the Copper River with horses and presumably were the first to bring a pack train through Cooper Pass.

Previous to 1914 some of the prospectors in the vicinity of the White River traveled trails from White Horse, in the Yukon Territory, or came through Skolai Pass from the Chitina Valley. Canadian maps[6] show as "James trail" the route by which William James, who with N. P. Nelson and others discovered placer gold on Bonanza Creek, made his way up Beaver Creek from the White River. Early prospectors in the Nabesna district usually followed the Copper River, just as the first prospectors had done.

[5] Brooks, A. H., A reconnaissance from Pyramid Harbor to Eagle City, Alaska, including a description of the copper deposits on the upper White and Tanana Rivers: U. S. Geol. Survey, 21st Ann. Rept., pt. 2, 1900.

[6] D. D. Cairnes, Upper White River district, Yukon: Canada Geol. Survey, Mem. 50, map 123A, 1915.

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River Ry., in the Chitina Valle
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Within the district there are
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Cooper and Notch Creeks, when
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snow.

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amid Harbor to Eagle City, Alaska, includ-
upper White and Tanana Rivers: U. S. Geol.

Yukon: Canada Geol. Survey, Mem. 50, map

After the Chisana mining camp was established, most of the travel in the district was between Chisana and McCarthy, on the Copper River Ry., in the Chitina Valley. In summer the usual route was through Skolai Pass and in winter over the Nizina and Chisana Glaciers.

At present much of the travel between Chisana and outside points is by airplane in both summer and winter. Mail and many of the supplies needed by the miners are carried by this means. Some freight, however, is still brought from Nabesna by horses in summer and by dog sled in winter. Nabesna is connected with the Richardson Highway by an automobile road and is therefore the most convenient point of entry to the Chisana district.

Within the district there are certain well-established routes of travel. The fairly well-defined depression between the Nutzotin Mountains and the Wrangell Mountains is the natural route for travel from the Copper River Valley to the heads of the Chisana and White Rivers. The trail through this depression leaves the Nabesna River at the old Indian village, about half a mile above the mouth of Cooper Creek, and ascends that creek to Cooper Pass, between Cooper and Notch Creeks, whence it follows Notch Creek to Cross Creek and the Chisana River. Cooper Pass, which has an altitude of 5,000 feet, is the highest ground crossed by the trail between the Copper and White Rivers. Because of this high altitude it is snowed in early in the fall and rarely is clear of drifts before the beginning of summer. It offers two routes for crossing the summit, the "summer trail," which keeps to the northeast of a prominent northwestward-trending mountain ridge, and the "winter trail," which swings around the southwest side of the ridge. The two trails are nearly parallel for about 8 miles and nowhere are more than 1½ miles apart. The winter trail has the easier grades but is not used in summer as the great number of granite boulders on the stream bars makes travel with horses difficult and dangerous. The summer trail necessitates a steep climb by south-bound travellers of more than 500 feet on the north side of the summit, and for more than 1 mile just north of the summit it follows a smooth mountain slope along the south side of a narrow lake where footing is uncertain because of the shallow soil and is especially treacherous if the trail is covered with snow.

This trail leads directly to the town of Chisana on Chathenda (Johnson) Creek, 2 miles east of the Chisana River and 7 miles from the mouth of Bonanza Creek. The distance by the trail and highway from Nabesna, mile 105 on the highway, to Chisana is slightly more than 48 miles. In following this trail it is necessary to ford the

Nabesna and Chisana Rivers, both of which are glacial streams and in times of high water are dangerous if not practically impassable. In addition to temporary high water the Chisana River offers the constant danger of quicksand to those unfamiliar with the crossing. No convenient camping places for parties traveling by pack train are available between the Nabesna River and "the big willows," which are on Notch Creek 8 miles above the junction of Notch and Cross Creeks, as most of this part of the trail is above timber line. Relief cabins on both sides of Cooper Pass, near the points where winter and summer trails join, have been built by the Alaska Road Commission.

From Chisana as center, trails radiate to various places. One leads to Bonanza Creek and the placer camps. The continuation of this trail is across a broad, barren flat to Beaver Creek and then to the practically deserted town of Horsfeld, 5 miles from the Canadian boundary. Timber is absent on this trail between Bonanza and Horsfeld, except for a small patch on the south side of Beaver Creek, near Klein Creek. From Horsfeld old trails lead southeastward down Beaver Creek to Ptarmigan Lake and the White River and northeastward to Baultoff Creek and a point on Beaver Creek near the international boundary. For 3½ miles this latter trail lies on the east side of the boundary but crosses back just below the mouth of Baultoff Creek, where Beaver Creek also swings back to the west side.

From Chisana a trail runs southward by way of the valleys of Bow Creek and Solo Creek to the White River and Skolai Pass and so to the Nizina River and the town of McCarthy, in the Chitina Valley. A trail from Chisana down the Chisana River was formerly in use but has been traveled so little in recent years that it is now almost obliterated. This is true also of the old Indian trail down the south bank of the Nabesna River.

TIMBER AND FORAGE

The Nutzotin Mountain area has the same kind of timber cover that is common elsewhere in southern interior Alaska. This cover consists chiefly of spruce but includes a minor proportion of deciduous trees, such as balsam poplar and aspen, which appear where soil and drainage conditions are favorable. Willows large enough for firewood and tent poles grow along many stream courses but have practically disappeared where camping has been frequent on some of the streams above the altitude of spruce. Carl and Klein Creeks are such places and consequently afford only a scanty supply of firewood to campers between Bonanza and Horsfeld, for this stretch of trail is above 4,000 feet, or above timber line for spruce. In general the timber line is below 4,000 feet, but it is variable and is consider-

Copper Deposits of the Prince William Sound District, Alaska

By FRED H. MOFFIT *and* ROBERT E. FELLOWS

MINERAL RESOURCES OF ALASKA, 1945–46, pp. 47–79

GEOLOGICAL SURVEY BULLETIN 963–B

An account of the present state of the prospects, extent of development, and condition of equipment

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1950

e mainland and the islands are characterized
bsence of relatively level lowland areas other
ains of some of the larger streams. Much of
ve the level of perpetual snow; many valleys
e, which descends to the sea.

William Sound are chiefly interbedded slate
hich are associated basaltic lava flows and
sandstone, and limestone in notably minor
e folded and faulted and have been invaded
nd larger irregularly shaped bodies of light-
hat include granite and related intrusives.
severely folded they are not greatly altered
chistose. The total thickness of the sedi-
n but evidently it is to be measured in thou-
f the rocks also is not definitely known but
sits are now considered to be probably of
n beds on the north side of the sound are
with a high degree of probability.

particular interest because the copper de-
s to indicate an almost certain genetic rela-
es are dark basaltic rocks that commonly
illow structure. This structure and other
ded lenses of shale, indicate that most of the
ut under water and deposited contempora-
he sediments. Greenstones are present in
d but have their greatest areal development
other nearby islands to the southwest. All
ts of possible commercial importance are
eenstone.

OPPER MINING

Prince William Sound began almost as soon
discovered. The early shipments to the
luded only high-grade ores, those averaging
er. Many prospects produced only a few
record is available, but which altogether
significant quantity in relation to the total

Sustained production began at Ellamar
staked in 1897, and ended with the closing
rp. mines at Latouche in 1930.

1930 nearly 214,000,000 pounds of copper
ating companies. Of this quantity, more
ed at Latouche and Ellamar by the Beatson
d the Ellamar Mining Co. Among the 15

companies referred to and in addition to the two companies just mentioned, three companies—the Fidalgo-Alaska Copper Co., the Midas Copper Co., and the Threeman Mining Co.—each produced more than one million pounds of copper.

NORTHEASTERN PRINCE WILLIAM SOUND

PORT VALDEZ

MIDAS MINE

The Midas mine in Solomon Gulch on the south side of Port Valdez, a few miles south of the town of Valdez, is one of the formerly productive mines of Prince William Sound. (see pl. 4.) The mine is the property of the Granby Consolidated Mining, Smelting & Power Co., Ltd., but it had passed through various ownerships before it was acquired by that company.

Solomon Gulch is the valley of a stream some eight miles long that furnishes part of the light and power for Valdez. The mine is near the head of the valley and is connected with the beach by a wagon road and trail. In addition to the necessary buildings for housing and feeding men and protecting machinery and supplies at the mine and at the beach, the mine was equipped with an aerial tram 5¼ miles long. The tram carried ore from the mine to a bunker at the shore of the bay where it was loaded on ships and taken to the smelter at Anyox in British Columbia. For about 5 years these facilities were in use, but in 1920 shipping conditions were such that steamship transportation for ore was not available. Accordingly, operations were ended in the fall of that year, and they have not been resumed. In 1943 the bunker which was of exceptionally good construction was torn down in order to salvage the timbers with which it was built. The approach to the bunker from the shore and all untreated piling had already been destroyed by the waves and teredos, and the tramline had been removed. The buildings at the mine also are in such poor condition that practically the whole installation must be replaced if mining is resumed.

The claims of the Midas property include two ore bodies known as the Jumbo and the All-American lodes. The Jumbo lode is the principal deposit and was the source of the ore shipped to the smelter. The ore occurs in mineralized shear zones in rocks that are dominantly black slate intruded by small bosses, sills, and dikes of greenstone. Argillites, cherts, graywackes, and quartzites are associated with the slates. All are intensely deformed and have schistose phases.

The ore body was exploited from four adit levels, spaced at intervals of 67, 157, and 290 feet from the lowest level or level 4. A raise was driven from the lowest level to a point above level 2 and a

Coal Investigations in South-Central Alaska, 1944-46

By F. F. BARNES, CLYDE WAHRHAFTIG, C. A. HICKCOX, JACOB FREEDMAN, *and* D. M. HOPKINS

With a section on CLAY DEPOSITS ON HEALY CREEK *by* E. H. COBB

GEOLOGICAL SURVEY BULLETIN 963-E

Mineral Resources of Alaska, 1945–46
(Pages 137–213)

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1951

creek, at the mouth of a small stream known locally as Popovitch Creek, is used occasionally by trappers, hunters, and prospectors.

At Healy, on the west bank of the Nenana River opposite the mouth of Healy Creek, the Alaska Railroad maintains a division point. Several families of railroad employees live there. A post office is maintained, and several new railroad buildings, including a hotel, were completed in 1946.

The station of Lignite, 4 miles north of Healy and consisting of a small roadhouse and a few scattered cabins, has a population of less than 10.

ROUTES OF TRAVEL

The only easy access to Healy and Lignite Creeks, except in winter, is by way of Healy on the Alaska Railroad, from which place a spur line extends 4 miles up Healy Creek to the coal mine at Suntrana. From Suntrana a truck road has been completed to the strip-mine areas about 2 miles farther up Healy Creek. Much of this road was constructed along a high bank on the north side of the creek, but parts of it follow the creek bars and are washed out periodically and have to be relocated as the stream shifts its course. The part of the road on the high bank is frequently blocked by slides, washouts, and deposition of alluvial material. To reach this road from Suntrana trucks must ford Healy Creek twice, which cannot be done during periods of high water.

The upper part of Healy Creek is accessible by team and wagon or tractor by way of river bars, except during high water. Extension of the railroad up Healy Creek from Suntrana would be difficult and expensive, because of the narrow, tortuous gorge just above the mine.

Lignite Creek is practically inaccessible except by pack horse or on foot. The head of the creek may be reached with relative ease from Healy Creek by crossing a low saddle about a mile northeast of the mouth of Gagnon Creek. This is part of a trail leading into the Bonnifield gold district, several miles to the northeast.

On foot one can go up any one of several gullies on the north side of Healy Creek, cross the divide and drop down into Lignite Creek, but most of these routes are too steep for horses.

In winter, when the Nenana River is frozen over, tractors and sleds can cross at the mouth of Lignite Creek and traverse the length of Lignite Creek valley.

GEOLOGY

The rock units recognized in the valleys of Healy and Lignite Creeks include the Birch Creek schist of pre-Cambrian age, the coal-bearing formation and the Nenana gravel, both of Tertiary age, and Quaternary terrace gravels. The general character and relations of

Geology of the Eastern Part of the Alaska Range and Adjacent Area

By FRED H. MOFFIT

A CONTRIBUTION TO ALASKAN GEOLOGY

GEOLOGICAL SURVEY BULLETIN 989-D

A summation of geological knowledge of the region, gained in more than forty years of exploration and investigation

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1954

years when roads were few. Thus winter was the best time for transporting supplies and equipment to the placer-mining camps.

As the larger streams get much of their water from melting ice in the high mountain areas they are subject to rapid fluctuations in volume of runoff. In addition to the annual fluctuations dependent on the seasons, they show daily flow maxima following rapid melting as the sun warms the air. These high-water and low-water stages of glacial streams are observed with care by the experienced traveler. Some glacial streams are also treacherous because of quicksands, and some because of boulders and swift water. The crossing of Chisana River for several miles above the mouth of Cross Creek is dangerous owing to quicksand, as would be suggested by the dunes on the flood plain.

Although daily fluctuations in the volume of water in the glacial streams are of importance, great floods take place at times of exceptionally heavy or prolonged rainfall, or after snowfalls followed by warm rains.

ROADS AND TRAILS

The region of the upper Copper River valley and the eastern part of the Alaska Range has been served in past years by the Richardson Highway (pl. 7), which connects Valdez with Fairbanks, and by the Abercrombie trail or Nabesna road between Gakona and the Nabesna River. In 1942 the Corps of Engineers of the United States Army opened for use the Alaska Highway, a pioneer road along the north side of the range, thus giving more ready access to that area. This road is the fulfillment of a plan for an international highway from the United States to Alaska through Canada. Although it had been under consideration for several years, construction was not begun until it became evident that such a road was necessary for the military defense of Alaska. Its course is at the base of the Alaska Range on the south side of the Tanana River from the Delta River to the Tok, but a few miles east of the mouth of the Tok it crosses to the north side of the Tanana River and continues on that side of the valley across the international boundary. East of the Tanana crossing the Fortymile [2] highway provides an all-weather road northeastward to Dawson and the upper Yukon region. East of the international boundary a branch road turns south from the main highway and follows the route of the old Dalton trail leading to Haines on Lynn Canal. Until the Alaska Highway was constructed the little travel along the north side of the range was wholly by small power boats used by the traders and Indians on the Tanana River.

Another highway of great importance to those living in the Copper River valley, as it gives access to the coast throughout the year, is the

[2] Officially designated the Taylor Highway, June 12, 1951.

Glenn Highway connecting th
between Copper Center and Gu
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From the Richardson Highw
Junction on the Alaska Highw
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or Abercrombie trail between
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and its course is nowhere abo
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travel than the Richardson Hi
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Many trails leading to minin
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the old trails are travelled no
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Creek and the Chistochina R
Cooper Pass to Chisana; dow

[1] On June 21, 1951 this road was offi
Highway, but it is referred to through
Alaska-Tok highway.

Glenn Highway connecting the Richardson Highway at mile 116, between Copper Center and Gulkana, with Palmer and Anchorage in the Cook Inlet region. It was constructed by the Alaska Road Commission and was opened for use in 1943.

The roads that have been constructed within the area of the Alaska Range are the Richardson Highway and the Slana-Tok highway.

The Richardson Highway, named for the late Gen. Wells P. Richardson, at one time President of the Alaska Road Commission, who was in charge of the construction and operation of the road for many years, was established as a military trail and telegraph line in early days but was converted to a stage road and later to an automobile road. It affords a summer route from Valdez northward across the Chugach Mountains and the wide Copper River basin, and along the east bank of the Delta River through the Alaska Range. In places it is confined within a narrow canyon with steep rock walls where construction and maintenance are difficult. Much trouble has been caused by the streams of the Castner and Canwell Glaciers and by rockslides elsewhere, but some of the difficulty has been met by relocation and improved construction. The highway through the Delta River [Isabel] Pass is closed to automobile travel in winter.

From the Richardson Highway near Gakona a road extends to Tok Junction on the Alaska Highway, via Slana, Mentasta Pass, and the Little Tok and Tok Rivers. The road follows the old Nabesna road or Abercrombie trail between the Richardson Highway and Slana, a route that was part of the old military trail and telegraph line from Valdez on the coast to Eagle on the Yukon River. It was built by the Corps of Engineers to facilitate construction of the Alaska Highway and to provide a connection between the Tanana and Copper river valleys. Its highest point is about 2,500 feet above sea level and its course is nowhere above timberline; although longer, it furnishes a route through the Alaska Range more favorable for winter travel than the Richardson Highway. Together with the Glenn and Fortymile [Taylor] Highways, it[3] affords an all-weather road from Anchorage and Palmer on the coast to Dawson on the Yukon.

Many trails leading to mining camps or hunting grounds have been laid out and used since the days of the first prospectors in 1898, but highways and the airplane have made most of them obsolete. Few of the old trails are travelled now and some that were well established are grown over with brush and young trees and are almost hidden from view. Formerly there were pack trails to the placer mines of Valdez Creek and the Chistochina River; from the Nabesna River through Cooper Pass to Chisana; down the Nabesna River and the Chisana

[3] On June 21, 1951 this road was officially designated the eastern extension of the Glenn Highway, but it is referred to throughout this report and shown on plates 6 and 7 as the Slana-Tok highway.

River; from Chisana to Horsfeld; from Chisana to the White River; and many others on the south side of the range that were in frequent use though they are rarely trod by horses now. In the early days trails led from the Tanana River to prospects near the head of Jarvis Creek and the hunting grounds at the head of Johnson River, and the Robertson River was reached by a trail from the upper Tok valley; but few trails were established on the north side of the range, as the search for valuable mineral deposits was not successful there.

POPULATION

The total population of the area shown on the two maps accompanying this paper was approximately 400 persons in 1940. This number includes whites and Indians and indicates a population density of about one person to 40 square miles of area. The whites, who are a minority, are gathered for the most part in small settlements near the roadhouses on the highways. Copper Center at the mouth of the Klutina River, mile 103 on the Richardson Highway, is the largest and oldest of these settlements. Gulkana and Gakona were established at about the same time (1898). Paxson and other roadhouses on the highway north of Gulkana were not built till after the route through the Delta River [Isabel] Pass came into use, sometime between 1907 and 1910. Other white settlements are the mining camps, most of which are not occupied throughout the year. They are not permanent settlements or at most are occupied for a limited number of years while mining is in progress.

The Indians, who were formerly more numerous and had their principal dwelling places along the river banks, still maintain their summer fishing camps at the rivers but occupy permanent quarters near the roadhouses or along the highways in winter. The largest Indian village is at Tetlin, in the upper Tanana valley.

The increased strategic importance of Alaska has altered many of the conditions relating to population as just given. Extensive construction projects for the building of roads, pipelines, and airfields brought large military and civilian forces to the Copper and Tanana valleys. New centers of population were established and old settlements were enlarged. Some of this increase in population and change in its distribution is temporary but some of it is permanent and will have a lasting effect on the development of the country.

TIMBER AND VEGETATION

Most of the region under consideration is a rugged mountain land which rises far above timberline. Yet the bordering lowland areas and the major stream valleys are below timberline and support a growth of timber that is good or poor depending on other conditions

such as position with reference to th
the drainage. In general it may
altitude of at least 3,000 feet abov
tional conditions, in a few small
timber thrives even at 5,000 feet.
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gravel terraces bordering the stream
Trees on the poorly drained lowl
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struction such as bridge timbers an
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drained ground. Tamarack grows
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are commonly plentiful in the up
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at any time, stripping them from
head.

Contrary to the belief of many
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summer is over.

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Animal life in an area of such
described in this paper is certa
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animals.