Bulletin No. 280

Series { A, Economic Geology, 68
B, Descriptive Geology, 84

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

THE

RAMPART GOLD PLACER REGION ALASKA

BY

L. M. PRINDLE AND FRANK L. HESS

WASHINGTON

GOVERNMENT PRINTING OFFICE

1906

CONTENTS.

ILLUSTRATIONS.

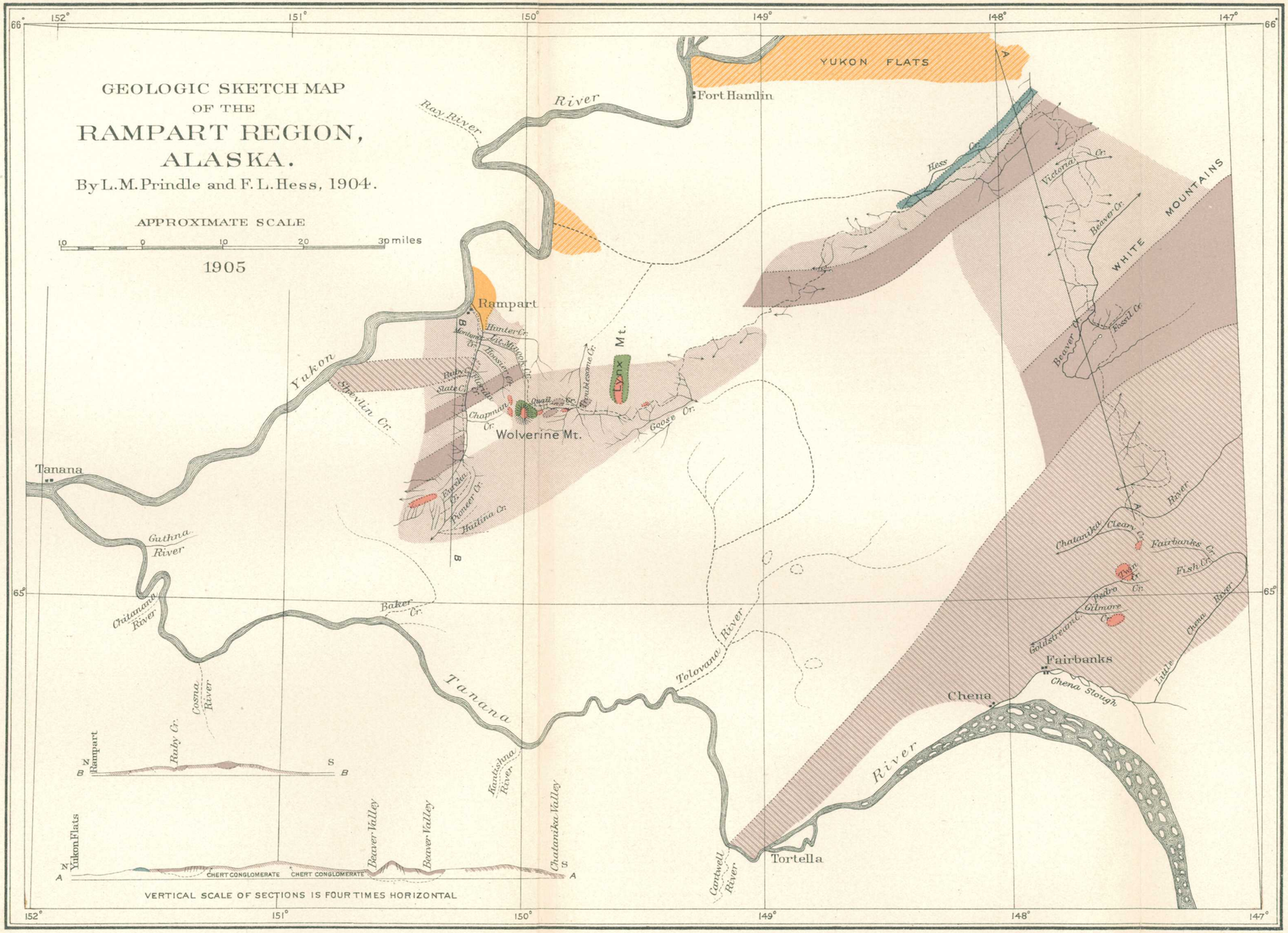
GEOLOGIC SKETCH MAP OF THE RAMPART REGION, ALASKA.

By L. M. Prindle and F. L. Hess, 1904.

APPROXIMATE SCALE

10 0 10 20 30 miles

1905



LEGEND

QUATERNARY
Alluvium

TERTIARY
(Kenai formation)

CRETACEOUS?
Impure sandstone

CARBONIFEROUS
Pennsylvanian?

DEVONIAN
Limestones, greenstones, quartzites, red and black slates

Cherts, slates, and greenstones

PRE-DEVONIAN
Quartzite-schists, quartz-mica schists, garnetiferous schists, and crystalline limestone

Intrusive granitic and monzonitic rocks

A. HOEN & CO. BALTIMORE.

THE RAMPART GOLD PLACER REGION, ALASKA.[a]

By L. M. PRINDLE and F. L. HESS.

GEOGRAPHY AND GEOLOGY.

By L. M. PRINDLE.

GENERAL STATEMENT.

The Rampart region is in the central part of Alaska, near the intersection of the one hundred and fiftieth meridian and the sixty-fifth parallel. It is in the western part of the large area—embracing approximately 40,000 square miles—delimited by Yukon and Tanana rivers and by the international boundary, 300 miles to the east, and is located where the distance in a north and south direction between the two rivers is hardly 50 miles (Pl. I).

The Rampart region is one of the four most important gold-producing regions in this interstream area. The Fortymile, near the boundary, the Birch Creek, and the Rampart regions are adjacent to the Yukon at intervals of about 140 miles westward from the boundary. The Fairbanks region, the most recently developed and at the present time the most productive, is in Tanana Valley about 12 miles north of the river and about 260 miles from its mouth. The Rampart region is about 80 miles northwest of the Fairbanks region, and all the creeks of present economic importance are within 30 miles of the Yukon and belong to the drainage systems of both Yukon and Tanana rivers.

The region has passed through many stages characteristic of the life of a placer camp. Some of the creeks were prospected as early as 1893 and became active producers by 1896, when the region became of equal prominence with the Fortymile and Birch Creek regions. Many were attracted by the favorable results, and during the winter of 1898–99 the town of Rampart, the supply point for the camp, contained about 1,500 people. After the preliminary stage of prospecting and the subsequent excitement of the boom days, with their excess of hopes and population, the camp settled down to the laborious existence of an average producer, influenced from time to time by the discoveries of gold in other portions of Alaska and rewarded occasionally by discoveries in its own territory. During the last two years discoveries have been made which have contributed to the permanence of the camp and illustrated the possibilities still existing in a region which has already been under investigation for several years. The recent introduction of hydraulic methods, too, entailing the expenditure of considerable capital, has given further importance to the locality, which during 1904 had a population of about 300 and a production of approximately $235,000.

[a] An abstract of this paper was published in Bull. U. S. Geol. Survey No. 259, pp. 104–119.

The towns of Eagle, Circle, and Rampart, on Yukon River, and Fairbanks, on Tanana River, have developed as supply points for the mining regions in their vicinity. The town of Rampart, with a population of about 200, is on the south bank of the Yukon, 170 miles below Circle and about 70 miles above the junction with the Tanana, at a point where the Yukon, after pursuing for a few miles a southerly course, bends squarely to the west and sweeps in a deep channel past the hills which bound the south side of the rather open valley. A narrow-terraced slope between these hills and the river is picturesquely occupied along the water front and hillside in the background by the irregular collection of buildings which forms the town. There is an air of importance about the place, and it possesses, also, a kind of dignity which the pervasive majesty of the great river and the vast loneliness of the country through which it flows have conferred upon every one of these small isolated outposts of civilization.

Supplies are received from the outside world by way of either St. Michael or Dawson. By the first course they are shipped by water to St. Michael and carried thence by river steamers up the Yukon, a distance of about 900 miles, to Rampart. By the second course they are shipped from Skagway by the White Pass and Yukon railroad through Canadian territory to White Horse, by river steamer to Dawson, and by the lower river boats, a distance of 500 miles farther, to Rampart. The fact that in the spring navigation opens first on the upper Yukon has led to a preference of the Dawson route when it is desired to have supplies arrive at their destination early in the season. The first-class passenger rate during the summer of 1904 from Seattle to Rampart by way of St. Michael was $127.50; that by way of Dawson was $111. The freight rates have a wide range of variation, according to the kind of material and the time of year. The approximate rates on ordinary supplies by way of St. Michael and Dawson respectively during 1904 were $57 and $106 a ton.

The gold-producing creeks are at distances of 5 to 30 miles from Rampart, and are connected with the town by trails. Minook Creek enters the Yukon from the south about a half mile above Rampart. The main trail follows its valley a distance of about 20 miles to the head, and then passes over the divide at an elevation of about 2,000 feet, and extends to the creeks in the southern part of the region. Side trails leave the main trail at intervals for the various creeks. Supplies are transported over these trails by pack train in the summer and by dog or horse sleds in the winter. The summer rates are 4 to 15 cents a pound, according to distance, and the winter rates to the same localities are 2 to 6 cents a pound. Summer traveling is bad. The trodden muck along the valley sides and bottoms favors the accumulation of water, and the interlacing ditch-like trails entail much hardship upon the pack animals, which flounder along them, and increase the cost of gold production to the miners, none of whom are in a position to improve them. Most of the freighting is consequently done in the winter time. Several outfits at Rampart are in the freighting business, and in both summer and winter make trips at regular intervals to the creeks.

There is a station of the Government telegraph line at Rampart which affords communication by way of the Tanana with other portions of Alaska and the outside at rates which are low in comparison with the advantages which may thus be secured. The mail facilities are improving from year to year and, as the rates on small quantities of light material compare very favorably with the freight rates, this method of obtaining such supplies from the States during the summer season is often utilized and is of considerable benefit to the people.

The four important gold-producing regions of the Yukon-Tanana country have been visited at various times by parties from the Geological Survey, which have been engaged either in mapping these regions and the little-known areas between them, or in studying the gold-bearing deposits and the distribution of the formations which occur in the gold-producing regions. The results have been embodied in

maps and reports, some of which have already been published by the Survey, while others are in preparation.

The Fortymile, Birch Creek, and Rampart regions were visited by a survey party consisting of Spurr, Goodrich, and Schrader in 1896, and the results are to be found in the report of that expedition.[a]

In 1902 Collier, in the course of an investigation of the coal resources along the Yukon, studied the gold placers in the southern portion of the region.[b] Late in the fall of the same year Brooks, near the close of his reconnaissance about Mount McKinley, traversed a portion of the Rampart region.[c]

The work of all these expeditions has resulted in an accumulation of material, partly topographic and partly geologic, which becomes increasingly valuable to the people of the region in tracing the occurrence and distribution of the gold-bearing deposits.

During the season of 1904 the writer, under instructions from Mr. Alfred H. Brooks, geologist in charge, assisted by Frank L. Hess, with a packer, cook, and 7 horses, made a geologic reconnaissance overland from Eagle by way of Fairbanks to Rampart, and it was in the course of this trip that the observations were made and the material was collected which form the basis of this description.

After concluding work in the Fairbanks region the party started overland from Cleary Creek for Rampart on the 5th of August, and on the 26th reached a tributary of Troublesome Creek, in the Rampart region, at a point where the Brooks party had camped two years before. There in 1904 the smoke of a camp fire indicated a zone of prospecting. The remainder of August and the first part of September were spent among the gold placers. On the 20th of September the party started by steamer up the Yukon, and reached Seattle on the 5th of October, only fifteen days from the time of leaving Rampart.

The route chosen by the party lay northwest from Cleary Creek across the White Mountains and the ridges beyond to the southern limit of Yukon Flats, thence southwest to the main divide between the Yukon and Tanana drainage systems, thence west along this divide to the rough hills which mark so conspicuously the location of the Rampart region.

The conditions of travel by pack train in the Yukon-Tanana country are comparable with those prevailing in portions of the States and deserve no special mention. The horses are all used as pack animals and carry generally not more than 175 pounds. The divides are preferred for travel, as they are mostly free from timber and generally afford a firmer footing than the valleys. Some of the lower divides, however, are thickly covered with small spruce, and in a large area east of the Rampart region the moss and grass of the divides form a niggerheaded surface which retards the progress of the pack train. The streams within the hill country occasionally offer better conditions for travel than the divides. They can be crossed and recrossed at will and their gravel-covered bars can be followed sometimes for miles. At times of high water, however, they may impede travel. Grass grows luxuriantly in some of the sunward-facing draws and in portions of the larger valleys, and is generally in good condition from the latter part of June to at least the first of September. Although the horses sometimes have difficulty in obtaining sufficient food, and are sometimes so tormented by mosquitoes as to be unable to eat quietly where there is abundance, they generally end the season in fairly good condition.

The members of the party always received active help from all those among whom their labors were performed, and pleasantly remember many kindly acts of

[a] Spurr, J. E., Geology of the Yukon gold district, Alaska: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 87-392.

[b] Collier, A. J., The Glenn Creek gold-mining district, Alaska: Bull. U. S. Geol. Survey No. 213, 1903, pp. 49-56. Coal resources of the Yukon, Alaska: Bull. U. S. Geol. Survey No. 218, 1903, pp. 41-43.

[c] Brooks, A. H., Exploration in the Mount McKinley region, Alaska: Prof. Paper U. S. Geol. Survey No. —. (In preparation.)

hospitality. Alaska is a land of strong contrasts, and when, in the gloom of a rainy night, amid the dripping brush and running waters of a sodden valley, the cheerful light of a miner's cabin draws the traveler to unaccustomed warmth and dryness, the heartiness of the welcome illustrates most forcibly the hospitable spirit of the people in the midst of the ofttimes stern inclemency of the outer world.

This bulletin is intended to supplement the results of recent work in the Fortymile, Birch Creek, and Fairbanks regions[a] by a similar description of present conditions in the Rampart region and to include also a general description of the areas to the east, where the rocks of the Rampart region have their eastward extension. The writer has had the able assistance of Mr. Hess throughout the field and office work, and the results of the efforts of both in the field have been divided in the office for the sake of greater economy of time in the preparation of this report. Mr. Hess has described the gold placers, while the account of the general economic conditions, the geography and geology, and the supervision of the whole, have devolved upon the writer. His statement of the geology, which is merely preliminary, will be more fully developed in a description of the geology of the entire Yukon-Tanana country which is in preparation.

GEOGRAPHY.

GENERAL DESCRIPTION.

There is a large area north and west of the Fairbanks region which is limited on the north and south by the converging courses of Yukon and Tanana rivers, respectively, and is terminated on the west by their confluence. It is shown upon the accompanying geologic map (Pl. I), which indicates the main drainage lines and the route of the party from Chatanika River northward to the southern limit of Yukon Flats and thence southwest to the creeks of the Rampart region. This map, while only approximately correct, in so far as it is based upon the work of the party in which distances were estimated by pacing, directions by pocket compass, and altitudes by aneroid barometer, represents with fair accuracy the general relations of the narrow belt of country traversed to the larger area of which it forms a part.

The surface of this area presents the same kind of features as those to the east, but there is considerable difference in their development, due partly to the narrowing space between the two rivers and partly to difference in the bed rock. There is the ridge and valley feature which occupies the greater part of the area and the flanking lowlands, on the north the Yukon Flats, and on the south the flat area drained by tributaries of the Tanana.

The ridges show a general uniformity in height of 2,000 to 2,500 feet, but some rise conspicuously above their surroundings to an altitude of nearly 5,000 feet and others become broader and lower and merge into the valleys on each side.

The divide between the drainage systems of Yukon and Tanana rivers throughout the Yukon-Tanana country has an extremely irregular course, due to the extensive ramifications of many streams among ridges of nearly equal height, and in this western part of the country in addition to the irregularity of direction there is a great variation in altitude. It is in places a prominent sharply defined ridge, while in other localities it becomes a low flat, separating with broad indefiniteness the waters which linger on its surface.

The features of greatest prominence are the White Mountains, extending northeast and southwest through the eastern part of the area, and the high group of hills 50 miles west of the White Mountains, in the vicinity of Rampart. The country between these two main features comprises many ridges, which toward the north are in general higher and break off with abruptness to Yukon Flats. The southern

[a] Prindle, L. M., Gold placers of the Fortymile, Birch Creek, and Fairbanks regions, Alaska: Bull. U. S. Geol. Survey No. 251, 1905.

limit of the hill country is less abrupt and the ridges merge gradually into the lowlands of the Tolovana.

The valleys, too, exhibit as much variation as the ridges. There are deep, steep-walled canyons which lead away their waters quickly, and there are open spaces where the waterways are only slight depressions in a rolling surface having an almost imperceptible grade. The streams throughout this country often pursue most irregular courses before they finally extricate themselves from the many ridges and become identified with their respective drainage systems. The important tributaries of the Yukon are Beaver Creek, Hess Creek, and Minook Creek; those tributary to the Tanana are Tolovana River and Baker Creek.

The hill country gives place along an east-and-west line which crosses the Yukon a short distance above Fort Hamlin to one of the most striking features in the interior of Alaska—Yukon Flats. From the base of the overlooking ridges, 1,500 to 2,000 feet above them, they extend northward toward the plateau country fronting the Rocky Mountains and eastward far out beyond the sky line. The sparsely timbered surface is somewhat uneven and broken where minor ridges run out into it from the base of the hills. It is dotted with a few small lakes, and the minor streams which furrow deeply the northern slopes of the hills run irregularly across it in no well-defined valleys of their own. Through it all can be seen long lines and crescent-shaped areas of water where the many interlacing channels of the Yukon spread widely over the great surface. The lowlands along the southern border of the hill country, the Tolovana and Baker flats, although occupying large areas, are local features less sharply differentiated from the hills and more closely related to their respective drainage systems.

RELIEF.

The distance in a straight line from a point on Chatanika River about opposite the mouth of Cleary Creek to Yukon Flats is about 60 miles, and the section may be roughly divided into three parts—the country from Chatanika River to Beaver Creek, the White Mountains in the space between the two parts of Beaver Creek, and the ridge country between the northern part of Beaver Creek and Yukon Flats.

A space 20 miles wide between Chatanika River and Beaver Creek is occupied by the broad ridge which separates the tributaries of the two streams. This ridge extends in a northeast and southwest direction and has an elevation of about 1,000 feet above the valleys on each side. It is very unsymmetrical. The southeast slope is rather steep and is worn by short tributaries of the Chatanika into minor lateral spurs, which descend abruptly to the valley. The northwest slope presents a striking and unexpected contrast. Long, broad, lateral ridges extend their dark, spruce-clad, undulating surfaces with gradually diminished height toward the steep-sided serrate ridges of the White Mountains and finally 15 miles away merge into the open valley of Beaver Creek. These ridges, so uniform in height and even in outline, are separated by wide, shallow, sparsely timbered valleys of equal uniformity, occupied by small, weak streams which flow with gentle gradients for several miles to Beaver Creek.

The White Mountains (Pl. II, *A*, p. 10), as seen from the highest parts of this ridge, rise abruptly from the somber foreground which extends with apparent continuity to their base, and not till the explorer reaches the edge of Beaver Valley does he understand their true relation to it and to the country to the south. They extend in a northeast and southwest direction a distance of 50 or 60 miles and form perhaps the most persistent group of ridges in the Yukon-Tanana country. They rise 2,000 feet or more above the base and increase in height toward the northeast, where some of the highest points have an altitude of about 5,300 feet. To the southwest they narrow rapidly to a single, knife-edge ridge, which terminates at Beaver Creek about 35 miles nearly north from Fairbanks. The uneven ridges exhibit a great variety of

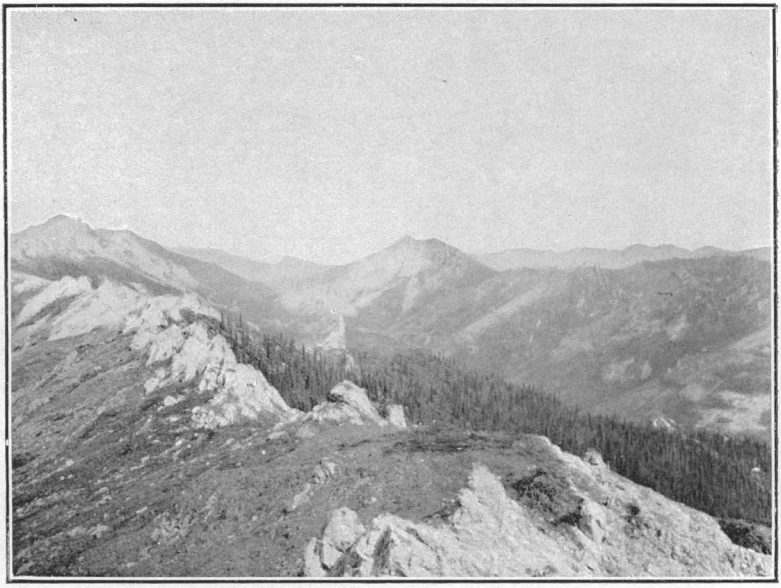
topographic detail. The edges of upturned limestone beds have been reduced by weathering to more or less disconnected, precipitous, shattered masses which rise in places to heights of several hundred feet above the general outline and impart to the range a peculiarity of form almost as striking as that of color. The rocky slopes are made less precipitous by the piles of débris into which they plunge, and these in turn run out into a gradually sloping more or less extensive base covered with the vegetation of the tundra and flattening until it merges with slight abruptness into the valley of Beaver Creek. The rocky slopes above are furrowed with steep rock-strewn gulches which are mostly dry. In the lower part these gulches become narrow valleys inconspicuously sunk in the surface and carrying ordinarily but little water.

Southwest of the White Mountains, across Beaver Valley, bare even-topped ridges, nearly uniform in height, form the background of the amphitheatral area around the bend of Beaver Creek and extend northward to become laterally adjacent on the west to the terminating ridge of the White Mountains. A few jagged points project inconspicuously from the level of these ridges and seem to indicate the continuation in this direction of the formations so accentuated to the northeast and to emphasize the loss of topographic individuality that has been sustained. A few miles west of the southern part of the mountains the country opens widely toward the southwest, where a broad low divide, with an altitude of approximately 1,500 feet, separates the Beaver waters from streams tributary to the Tanana.

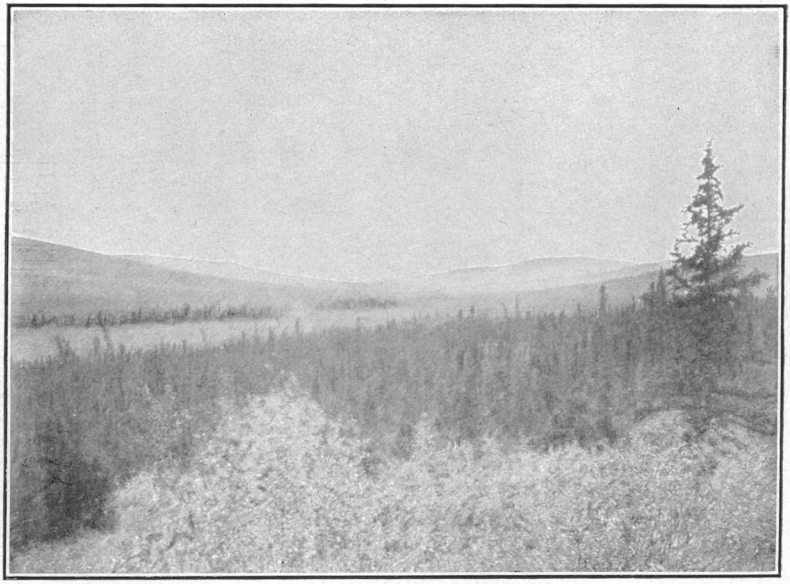
Northwest of the White Mountains, between Beaver Creek and Yukon Flats, in a distance of about 20 miles, there are several nearly parallel ridges, the trend of which is at first northeast parallel with the White Mountains, but changes gradually as they are crossed from one to the other northward until the trend of the ridges near the Flats is approximately east and west. The ridges are of various heights, with an average of perhaps 2,500 feet, and have a somewhat uneven outline. Between the steep-sided prominent ridge which forms the northern limit of Beaver Valley and the equally prominent ridge which overlooks the Flats there is the divide which separates the headwaters and tributaries of three important streams—Beaver Creek, Hess Creek, and Tolovana River. This divide, in comparison with the ridges which start from it and gain in prominence down their respective drainage systems, is low and inconspicuous and shows an area of open country where long, bare, gradual slopes present the clean-cut appearance of meadows freshly mown (Pl. II, *B*). The drainage is marked by lines of green traced along the flatly intersecting bases of the slopes, vivid in color toward the sources of the streams where only willow patches grow and of a more somber shade lower down the valleys where scattering groups and lines of spruce are delicately outlined against the brownish background.

Northward the country rises gradually to the level of an even-topped east-west ridge 2,000 feet in height, surmounted by a few steep-sided domes of greater height, and then descends by intermediate flanking ridges with more or less abruptness to the Flats. The northern and southern slopes of this ridge are deeply cut by minor tributaries and toward the west it terminates finally as a spur between Hess Creek and one of its northern tributaries. The flanking ridges on the north replace it and, with approximately the same altitude, continue westward toward the Yukon at Fort Hamlin.

The main divide between the Yukon and Tanana drainage systems is about 25 miles south of the Yukon and extends in a nearly westerly direction toward the hills of Rampart. There are no topographic features of special interest. The divide is in places a well-defined ridge sharply differentiated from its surroundings; at other localities it is less conspicuous than the numerous long lateral spurs which descend irregularly from it toward the valleys of Hess Creek and Tolovana River, and at one locality, as far as could be observed, the headwater streams from the north and south



A. VIEW NORTHEASTWARD ALONG THE RIDGES OF THE WHITE MOUNTAINS.



B. VIEW SOUTHEASTWARD TOWARD THE HEAD OF GOLDEN CREEK.

seem to have so far reduced the space between them as to interlock in a rather extensive flat at an altitude of approximately 1,500 feet, where a few scattering lakes indicate the indefiniteness of the drainage.

From the White Mountains and from the commanding ridges of the Fairbanks region can be seen a group of hills 50 miles or more to the west, which rises abruptly from the indistinct level of its surroundings so that it forms the most conspicuous topographic feature in all the far western section of the Yukon-Tanana country. This group resolves itself on nearer view into the main divide between the Yukon and Tanana drainage systems and two prominent extensions from it to the north—Lynx Mountain, a ridge several miles in length, and Wolverine Mountain, a massive peak which gives to the Rampart region a maximum relief of over 4,000 feet with reference to the level of the Yukon at Rampart.

This portion of the divide contrasts strongly with that immediately to the east. It is higher, sharper, and rougher, extends in a northeast-southwest direction with a minimum altitude of about 2,000 feet, and separates with no indefiniteness the waters which flow to the north and to the south toward Yukon and Tanana rivers. Long, rough, lateral spurs extend northward toward the Yukon, and their steep sides are deeply cut until there is presented a repetition of sharp spurs separated by deep narrow canyons, which has justified the name "Troublesome country," commonly applied to a part of this region. South of the divide there is less complexity. Long, more gradually sloping ridges separate the more open valleys and merge finally into the extensive flats of Tolovana and Baker valleys. This difference in topographic expression so frequently observable on the northern and southern sides of the Yukon-Tanana country is here in the narrower space between the two rivers brought thus into sharper contrast.

The name Lynx Mountain has been applied to the southern end of a ridge about 30 miles southeast of Rampart, which extends northward from the main divide a distance of about 5 miles, has an altitude of approximately 4,000 feet, and is topographically distinct from its surroundings. The outline is irregular, developing in places into rugged, angular points. The upper slopes are steep and have furnished much material for the extensive accumulations of talus below. Along the greater part of the eastern base they plunge deeply into narrow canyons. Toward the southern end of the eastern base, however, the undulating surface of the main divide roughens in proximity to the ridge, and throws a wave-like prominence high up along the slope, the brown moss-covered surface of which contrasts strongly with the rock-strewn slopes above. Off to the east is the even surface of the broad divide. The southern termination of the ridge and a part of the western base are flanked by a slightly concave graded slope, the even surface of which is marked by ripples of fine rock waste. As the main divide extends round the southern end of the ridge the drainage is mostly toward the Yukon, and numerous tributaries of Hess Creek drain northward from both sides.

Wolverine Mountain is the crowning point of a bulky mass in the main divide, 8 miles west of Lynx Mountain and about 12 miles southeast of Rampart. It has an altitude of approximately 4,640 feet and towers several hundred feet above adjacent parts of the ridge. The western slopes descend with steep but more or less regular grades to valleys which carry the drainage toward the Tanana. The northern slopes are steeper. Sharp spurs with a concave outline plunge in divergent courses toward the valley 2,000 feet below and divide into minor steeper spurs which buttress the mountain side. The spurs become more rounded and more divided toward the base and extend thence northward with more gradual slopes about 1 mile to the main drainage line. The edges of the upper spurs are shattered into piles of fragments, and the débris-laden slopes of neighboring spurs steeply intersect to form the gulches which furrow conspicuously the northern face.

DRAINAGE.

The drainage systems are represented on the accompanying map in various stages of incompleteness, but with sufficient detail to show their general relations. Tolovana River, tributary to the Tanana, with its long and widely divergent branches, occupies the central and largest part of the field. On the east Beaver Creek in flowing to the Yukon follows a peculiar V-shaped course between tributaries of the Tolovana. On the north and west are Hess and Minook creeks flowing west and north respectively at right angles to each other to the Yukon, while in the southwest the short irregularly fan-shaped system of Baker Creek carries to the Tanana the drainage from the southern slopes of the main divide.

Tolovana River has several far-reaching tributaries which approach closely the Birch Creek and Fairbanks regions on the east and the Rampart region on the west. On the north they drain a large area between the systems of Hess and Beaver creeks. Chatanika River, which is the most important tributary from the east, has its sources far to the northeast opposite the headwaters of Birch Creek. It enters the southeastern portion of the area and is closely identified with the Fairbanks region since Cleary Creek, an important gold producer, is a tributary. The stream is comparatively straight and flows southwest toward the Tolovana. About 50 miles below the source, near the mouth of Cleary Creek, it is comparable in size with Little Chena near the mouth of Fish Creek, having a width of 100 to 200 feet, and at ordinary stages of the water it is easily fordable on foot. The valley is open and of low grade and the stream keeps mostly to the steep northwestern side. On the southeast long lateral spurs from the distant ridges merge gradually into the flat valley. The tributaries are small and short. The valleys of those from the northwest are narrowly V-shaped; those from the southeast are more open and their stream flats grade gently into that of the Chatanika. Sixty miles to the west another tributary of the Tolovana, Goose Creek, receives the drainage from the deeply furrowed slopes south of Lynx Mountain and flows in a northeasterly direction until it almost breaks in upon the tributaries of Hess Creek, when it bends gradually to the south and southwest to form an important tributary of the main stream. There are several streams between Beaver and Hess creeks, which flow in narrow V-shaped valleys southwestward toward the Tolovana. These probably unite to form tributaries of considerable size before reaching the lower valley.

The valleys of all the tributaries coalesce finally into a flat which forms a great embayment extending northeastward from the river's mouth far into the hill country toward the Yukon. The surface of this flat is partly covered with large areas of grass and is flecked with lakes, some of which are of considerable size. Patches of timber run out into it from the lower slopes of the ridges and dark lines of timber crossing it indicate the drainage lines, where streams flow inconspicuously with a deep, sluggish current in channels lying 20 feet or more below the even surface.

Beaver Creek has a peculiar relation to the drainage system of the Tolovana. It flows with the tributaries of the latter as if it were one of them and then turns northward from among them to the Yukon. It heads far to the northeast opposite the headwaters of Preacher Creek, flows southwest close along the eastern base of the White Mountains in the same direction as the Chatanika, but about 15 miles farther to the west, turns sharply round the southern termination of the mountains, flows northeast along their western base nearly parallel with its former course to Yukon Flats, and crosses this great lowland in a circuitous course north and west to the Yukon. The length of the southwestward flowing portion is probably at least 30 miles; that of the northeastward flowing portion is much greater. The distance from the mouth of the creek along the many wanderings across the Flats to the point where it emerges from the hills is reported to be nearly 200 miles. Where crossed by the Survey party at two localities east and west of the White Mountains the creek

is comparable in size with Chena River a few miles above the point where it is joined by West Fork. The stream has a width of 200 to 300 feet or more at ordinary stages of the water and is easily fordable on foot. The volume of water is at times large enough to permit prospectors to travel downstream in rafts from a point about 5 miles above the sharp bend round the White Mountains, but on account of the shallowness of the water at the riffles considerable difficulty is probably experienced in this method of navigation. The creek meanders in a low-grade open valley. Above the bend the stream keeps close to the eastern base of the White Mountains and the valley is mostly on the eastern side where it extends back flatly nearly 2 miles to the base of the gradually sloping ridges. After rounding the southern termination of the White Mountains, however, the valley contracts to a width of about one-fourth of a mile, and flows for about 4 miles between the narrow ridge of the White Mountains and the ridge of the same height which extends northward from the plateau-like country to the southwest. Rounding the northern termination of this latter ridge the stream turns to the left in a northerly course and then to the northeast again to flow in wide meanders through a beautiful flat valley that is limited on the east by the broad slopes of the White Mountains and on the west by a steep ridge, which becomes more broken and more prominent toward the northeast, in harmony with the increasingly imposing character of the stream, which flows closely along its eastern base.

Most of the tributaries of Beaver Creek in the portion of the valley traversed by the Survey party are small. Two tributaries drain the southern part of the White Mountains, and one of these has been called, for purposes of description, Fossil Creek, from the occurrence of fossiliferous limestone pebbles in its valley. The single narrow limestone ridge which terminates the White Mountains is accompanied farther east by a parallel ridge of shorter southern extent. The view from this ridge shows between the two a low-grade valley 2 miles wide, extending northeastward a distance of nearly 10 miles, drained by a stream which flows along the western side close to the base of the limestone ridge. From the base of the ridge on the east broad flat spurs separated by open depressions so shallow as hardly to be noticeable extend westward to the stream. On close examination the apparently continuous valley is seen to be composed of two parts—a lower, drained by a stream which seems disproportionately small for the size of the valley, and which has its rise in a few small stagnant ponds strung longitudinally along its course about 5 miles from Beaver Creek, and an upper, drained by a stream of about the same length, which runs at first southwestward, in line with the stream of the lower portion of the valley, and then turns abruptly westward to flow to Beaver Creek through a narrow canyon which interrupts inconspicuously the continuity of the limestone ridge.

This upper part of the valley has been reduced somewhat below the level of the lower part, but not to an extent appreciable in a general view of the valley. The case is one of stream diversion where a minor tributary of the Beaver has cut through the limestone ridge and diverted to itself the waters of the upper portion of a valley which used to drain southwestward along the eastern base of the limestone ridge all the way to Beaver Creek. The diversion of the drainage from the upper valley has weakened the stream which occupies the lower portion of the valley, and its forceless character is indicated by the string of small ponds along its present headwaters.

The tributaries of Beaver Creek from the east and south enter through open flat valleys. The valleys of tributaries from the west become more canyon-like toward the northeast, and there are none of importance until Victoria Creek is reached. This creek is reported to be 50 miles or more in length and to flow in its lower part in a comparatively narrow canyon. The branching headwaters are small streams, colored brown by vegetation, which flow in valleys, whose wide sweeping slopes are

mostly bare of timber. On this creek, close to its junction with Beaver Creek, near the southern limit of Yukon Flats, some prospecting was being done in the fall of 1904.

Hess Creek is about 60 miles long, flows in a general westerly direction, and enters the Yukon about 25 miles above Rampart. Its headwaters are closely associated with those of Beaver Creek and the Tolovana. Its northern tributaries penetrate far into the narrow belt of ridges between it and Yukon Flats. The southern tributaries head far back in the main divide opposite those of the Tolovana, and in places are most closely associated with those of the latter stream; westward near the Rampart region they interlock with the tributaries of Minook Creek. This stream, where crossed by the Survey party in 1904, was nearly the size of the Chatanika and was easily fordable on foot. It flows meanderingly in a fairly flat valley with a maximum width of perhaps 2 miles. The main valley is limited on the north generally by rather steep slopes. The southern side of the valley has apparently more tributaries and has been much dissected by them into numerous long ridges which extend in most irregular courses northward from the main divide. The valleys of these southern tributaries in the area between the headwaters and Lynx Mountain are often open and form large, ill-drained spaces where lakes are common.

The most important tributary in the vicinity of Rampart is Troublesome Creek. It heads in the main divide opposite the headwaters of the Tolovana and flows in a general northerly direction a distance of 30 miles or more to Hess Creek. The valley is of the canyon type, with a narrow flat at the bottom, over which the stream flows in a meandering course. This stream is probably comparable in size with Minook Creek. Our knowledge of it is confined mostly to the upper portion of the valley, where it is formed by minor tributaries from the east and west, which drain the slopes of Lynx and Wolverine mountains and the portion of the divide between these prominent points. They are deeply incised within the inclosing ridges and their minutest ramifications are to be found in the steep, narrowly V-shaped gulches which furrow the northern slopes of the divide and the flanks of the two imposing prominences. The heads of the minor valleys are in some cases open park-like spaces of small extent, which contrast strongly with the inclosing rock-strewn slopes.

The two most important tributaries in this upper part of the valley are Gazzam or Quartz Creek from the east and Quail Creek from the west. The first is a small creek which heads in the main divide near the southwest base of Lynx Mountain and flows at first northwest and then west a distance of about 5 miles to Troublesome Creek. The upper portion of the valley is open and is formed on the east by the beautiful slope at the base of Lynx Mountain; the western side of the valley is steep and a few small tributaries are received from V-shaped canyons. The valley narrows about 2 miles below the head to a steep-walled canyon deep within the ridges of either side. Quail Creek is the most important tributary of the upper valley. It is formed by two forks from the south and west, which join about a mile west of the Troublesome. The southern fork receives the drainage from the divide and the eastern flanks of Wolverine Mountain. The western fork heads opposite Hoosier Creek and flows in an easterly direction a distance of about 5 miles to the junction of the forks. The eastern part of the valley has a gradual northern slope, while the southern side is comparatively abrupt. Toward the headwaters the valley is more symmetrical. There are many small tributaries from the northern slopes of Wolverine Mountain, and most of these enter through narrow valleys. As on Hess Creek, benches are developed in places along the sides of the valley at a height of 400 feet or more above it.

Minook Creek, tributary to the Yukon, is the most western of the important streams in the Yukon-Tanana country and shares with Baker Creek, tributary to the Tanana, the prominence resulting from the occurrence of gold in the drainage areas of these two streams. Minook Creek, which lies about 12 miles west of Troublesome

Creek, heads at a point about 25 miles south of Rampart and flows in a northerly course through a narrow valley. West of the valley a steep slope rises to a height of 1,000 feet or more above the stream. The eastern side of the upper portion of the valley is formed by a similar slope. In the lower part of the valley, however, the eastern slope is formed by the abrupt streamward-facing slope of a flattened area which, where it breaks off to the stream, has an elevation of about 500 feet above it and slopes gradually upward toward the base of the hills and widens to the north until it attains a maximum width of about 3 miles. The significance of this flattened area or high bench, as it is called by the miners, with reference to Minook Creek, will be considered elsewhere in this report. It suffices here to say that it is one of the products of valley development in the region, and that its relation to Minook Creek is similar to that of the small, low benches which occur in the valley of the present stream, being really a portion of an older valley in which the present canyon has been cut. The most important tributaries from the east are Hunter, Little Minook, Little Minook Junior, Hoosier, Florida, and Chapman creeks. The most important from the west are Ruby, Slate, and Granite creeks.

Minook drainage in general may be described as a system deeply sunk within the inclosing ridges, draining with the ramifying headwaters of the eastern tributaries the rough country in the vicinity of Wolverine Mountain, to the south interlacing closely with the headwaters of Baker Creek and to the west draining a narrow strip of country extending backward only a few miles from the main valley.

The Baker Creek system is of a different character. Baker Creek is formed by the union of tributaries which converge from an irregularly fan-shaped area extending to a distance of about 20 miles north of Tanana. The main stream flows for the greater part of its course in a southeasterly direction close to a low ridge which limits the valley on the south and then turns abruptly through the ridge to flow for the rest of its course southwest toward the Tanana. The flat valley, known as Baker Flats, extends northward 6 miles or more to the southern limit of the hill country and forms a feature similar in character to Tolovana Flats.

The tributaries are mostly from the north, and the most important of these northern tributaries or their branches are the Hutlina, Pioneer, Eureka, Glenn, Rhode Island, Omega, and Thanksgiving creeks. They rise to the east opposite the headwaters of the Tolovana, farther west receive the drainage from the southern slopes of Wolverine Mountain, and still farther to the west drain the southern slopes of the main divide opposite the headwaters of Minook Creek. They flow in southwesterly courses and beyond the edge of the hills partly unite and partly find their way by indefinite courses to Baker Creek. They exhibit at first the characteristics of the streams of the northern slope, flowing deep below the inclosing ridges in narrow steep-walled canyons. The valleys widen rapidly, however, and their lower open parts merge with gentle gradients into Baker Flats while the long even-topped ridges between them descend somewhat more abruptly to the same level.

A most striking detail of form development which finds constant repetition is the unsymmetrical cross section of the valleys. The southeast side descends steeply a distance of several hundred feet to the stream, while the northwest side rises gradually for a distance of a half mile or more back from the stream and then ascends somewhat more steeply to the ridge line and descends abruptly to the neighboring parallel stream. Benching has been associated with this unsymmetrical development of the valleys, and the gradual northwestern slopes have afforded conditions favorable for the retention of gold-bearing gravels at elevations of 200 to 300 feet and more above the present level of the streams.

The main features of the Baker system are the long, even-topped ridges extending southward from the main divide, inclosing the unsymmetrical valleys, the gradually sloping benches of the lower valleys, and, beyond the terminations of the ridges and the benched areas of the lower slopes, Baker Flats.

VEGETATION.

The high ridges are mostly bare of trees and covered only with the brownish vegetation of the tundra. The lower ridges are often covered with a dense growth of scattering spruce. The timber, however, is confined generally to the main valleys, where it is most thickly concentrated in scattering bunches along the water courses. Spruce is the most important tree and frequently attains a diameter of two or more feet. Birch and poplar are associated with it, and in the larger valleys there is a small proportion of tamarack. Willows and alders grow abundantly near the streams. There is said to be good timber in the lower valley of the Chatanika, and some good timber is known to occur in Tolovana Valley. Beaver Valley, where crossed by the Survey party, contained but a small amount of timber suitable for mining purposes, and the part of the valley observable from the surrounding hills showed but small areas of timber. The low ridges forming the eastern side of Beaver Valley east of the White Mountains present in places the appearance of a well-timbered country, but are in reality covered only with a thick growth of small spruce. The upper valley of Hess Creek and the open valleys of its tributaries contain also abundant small spruce with some larger timber near the streams. The valley of Minook has contained considerable timber of sufficient size for mining purposes, but there is only a small amount of such timber left. The valleys of the southern slope facing Baker Flats contain but little timber of large size, and thus far the resources of Hutlina and Baker valleys, where there is said to be some good timber, have been but little utilized. The main supply for the Rampart region must come from Yukon Valley or be imported, and lumber in 1904 was worth as high as $100 a thousand. Timber for fuel purposes is abundant in most of the valleys and on the lower slopes.

Feed for horses can generally be found on the sunward-facing slopes of the main valleys, where there is often a luxuriant growth of grass among the birches. Grass grows abundantly on portions of the high bench near Rampart, and there are large grass-covered areas in Tolovana Flats. Vegetables can be grown easily, and at Hot Springs, a locality near the Tanana, they are raised in large quantities and sold to the miners. The Government has an experimental farm on the north side of the Yukon opposite Rampart. Blueberries and cranberries are almost always to be found in abundance, and at one locality in the Rampart region currants and red raspberries were being preserved for winter consumption.

GEOLOGY.

GENERAL FEATURES.

The bed rock in the western part of the Yukon-Tanana country, while including some small areas of metamorphic schists, is made up mostly of sedimentary rocks, less metamorphosed than the schists lying to the east. The prevailing color is black from the large amount of carbonaceous matter present in the slates, but associated white limestones often become prominent and in the White Mountains through their color and topographic development emphasize the lithologic change from the quartzite-schists, quartz-mica-schists, and gneisses of the Fortymile, Birch Creek, and Fairbanks regions to the younger-looking rocks of the western areas. A considerable variety of igneous rocks occur in the vicinity of Rampart, and greenstones are common throughout the area. The general strike of the rocks is northeast and southwest. They have everywhere been closely folded and the folding seems to have been most intense in the Rampart region, where there has been further deformation of the rocks, resulting in some cases in brecciation.

STRATIGRAPHIC SUCCESSION.

The variety of the rocks and the close folding which they have undergone have rendered difficult the attainment of definite knowledge regarding their sequence, thickness, and contact relations. Their areal distribution, so far as observed in the narrow belt of the country traversed, is shown on the accompanying geologic map (Pl. I), and the provisional order of stratigraphic succession is outlined in the following tabular statement:

Provisional tabular statement of stratigraphy.

Age.	Formation name.	Contact relation.	Lithologic character.
Quaternary	Recent		Stream gravels.
	Pleistocene		Bench gravels.
Tertiary	Kenai	Unconformity to Paleozoics.	Conglomerates, sandstones, and consolidated clays.
Cretaceous?			Black carbonaceous sandstones and slates.
Pennsylvanian or Permo-Carboniferous.			Gray, greenish, and black shales with thin siliceous beds.
Devonian	Rampart and possibly other formations.		Gray and blue, partly siliceous limestones, greenstones, quartzites, and slates.
			Conglomerates and fine fragmentals, slates, and interbedded limestones.
			Cherts, slates, and greenstones.
Pre-Devonian	(Fortymile and Birch Creek.)	Unconformity	Crystalline limestones.
			Quartz-mica and garnetiferous schists.
			Quartzite schists.

The oldest rocks are believed to be the schists, predominantly quartzite-schists, which occur southeast of the White Mountains in the ridge which forms the western limit of Chatanika Valley, and the garnetiferous quartz-mica-schists with associated highly crystalline limestones which occupy a small area in the Rampart region along Minook Creek in the vicinity of Ruby Creek. Their age is unknown, and they are referred in this report to the pre-Devonian. The rocks from the White Mountains westward, inclusive of the Rampart region, are mostly of Paleozoic age, and the evidence of the few fossils collected indicates the presence of both Devonian and Carboniferous rocks. There is a possibility that some of them are Silurian, but in the absence of positive criteria for their further separation only two divisions have been made. Those regarded as Devonian include a variety of rocks differing greatly in lithologic character and occurring throughout most of the area. Cherts, slates with interbedded coarser fragmentals, greenstones, limestones, and quartzites are the most characteristic types. Along the northern edge of the hill country and at one locality south of Hess Creek fossils determined as Carboniferous were obtained, but the extent and contact relations of the Carboniferous rocks have not yet been determined. The rocks provisionally classed as Cretaceous are of doubtful age. They occur on Wolverine and Lynx mountains. On Wolverine Mountain fragmentary fossils were found which indicate an age not older than the Lower Cretaceous. The Kenai rocks occur along the Yukon and to a short distance up the valley of the Minook. High gravels, regarded as Pleistocene, are found locally along the larger streams to heights of 400 to 500 feet above them. The present valleys are occupied by stream gravels covered generally with muck and moss, and the thickness of the entire deposit, so far as developed on the gold-producing creeks, rarely exceeds 20 feet, but exceptionally is of much greater depth.

SEDIMENTARY AND METAMORPHOSED FORMATIONS.

PRE-DEVONIAN.

The most characteristic rocks in the eastern portion of the Yukon-Tanana country are gneisses, quartzite-schists, quartz-mica-schists, garnetiferous and hornblende schists, and crystalline limestone. In the Fortymile region the last three types predominate and have been called[a] by Spurr collectively the Fortymile formation; in the Birch Creek region and in the recently developed Fairbanks region the quartzite-schists and mica-schists, with occasional thin interbedded highly crystalline limestones, constitute the most common rocks and have been called by the same author the Birch Creek formation. They are considered by him older than the Fortymile schists. The age is not known, and for the purposes of this report they are both referred to the pre-Devonian.

The western limit of the large areas of these highly metamorphosed schists is in the ridge limiting on the northwest the valley of Chatanika River. The ridge is formed of the typical schists with some schistose limestone and graphitic schists, and like the rocks in the Fairbanks region the dip is generally low, a common attitude and one indicating not necessarily simplicity of structure but oftentimes a folding so extreme that the rocks have been folded upon themselves until the dips are often nearly horizontal. The first indication of a change in lithologic character was found in the occurrence a few miles nearer the White Mountains of a feldspathic schist, and then about 3 miles farther to the northwest overlooking Beaver Valley outcrops of a rather coarse-grained, greenish, impure, feldspathic quartzite showing no schistosity and dipping steeply to the west. The northwestern limit of the old schists is apparently somewhere in the intervening densely spruce-clad areas.

No more schists were observed until reaching the Rampart region, where on Minook Creek a small area of garnetiferous quartz-mica-schist with associated marbles occurs. This is apparently best developed on Ruby Creek, where the garnets of the schist accumulate rapidly in the sluice boxes. This formation of schist and limestone crosses the Minook at Hopkins Bridge with a northeast strike and a low dip to the southeast. Eagle Rock, about 1 mile below the bridge, is a bluff, 100 feet or more in height, composed of highly crystalline, banded limestone. There are minor folds and a general low dip to the north. Although the area is small and the marbles resemble somewhat other crystalline limestones in the vicinity they are so much more highly metamorphosed than any of the other rocks and are so closely associated with garnetiferous schists which are not known to occur elsewhere in the region that both the limestone and the schists stand in contrast to the adjacent rocks. The contact relations were not observed, but these rocks are believed to be unconformable with and older than the adjacent rocks to the north and south. Their resemblance to some of the schists and marbles of the Fortymile region is a striking one. They apparently strike off northeast under younger rocks.

No rocks were observed in the areas between these two occurrences of schist which suggest a correlation. Further investigation may reveal the horizontal equivalency of some of the highly metamorphosed schists with less metamorphosed rocks of known age, but all that it seems possible to do at present is to place them by themselves and call them pre-Devonian.

DEVONIAN.

Between the two areas of schists above described, the one the westward extension of the schists of the Fairbanks region, the other a small area the limits of which are not yet known, are the rocks most of which are regarded provisionally as Devonian. The bulk of the formation, as already mentioned, is made up of cherts, slates

[a] Spurr, J. E., and Goodrich, H. B., Geology of the Yukon gold district, Alaska: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 140–155.

with alternating beds of conglomerate, arkose, and quartzite, limestones, and largely tuffaceous greenstones. These rocks may be roughly divided into at least two groups according as cherts, slates, greenstones, and conglomeratic rocks, or massive limestones with greenstones, slates, and quartzites predominate. It is believed that those forming the first division are older and it may become advisable on more detailed work to make a separate formation of them. The term "Rampart series" has been used by Spurr[a] in grouping similar rocks occurring in other parts of the Yukon-Tanana country. In those areas, however, diabase, tuffs, and green slates are most abundantly developed, and carbonaceous slates and limestones, although frequently present, are of minor importance. In the areas under consideration, while the greenstones are found throughout, black slates, cherts, and massive dark- and light-gray limestones are more common and more strikingly characteristic of the formation. A section of these rocks is encountered in traveling from Chatanika River northward to the southern edge of Yukon Flats, a distance of about 60 miles, and this section, although incompletely studied, has afforded some material regarding the structure and age of the rocks which compose it.

The general strike in the southern part of the section is about N. 50° E. and it is instructive to note that the direction of structure which is so strongly emphasized topographically in the Alaska Range is here repeated. In the northern part of the section the strike is more nearly east and west. The rocks are closely folded and in most cases their attitude is nearly vertical. There is a distinct symmetrical arrangement with reference to a northeast-southwest axis, and, so far as our present knowledge extends, this symmetrical disposition of the rocks seems to be a fact of importance in regard to their structure and succession. This repetition is most noticeable in the occurrence of limestone. The White Mountain limestones with associated greenstones, flanked on the southeast by red and black slates and prominent masses of impure quartzite, find a repetition 15 miles to the north in another limestone belt less conspicuous topographically than that of the White Mountains, with a similar association of rocks and flanked also on the northwest by similar slates and quartzites. The rocks of the middle portion of the section are slates, greenstones, and cherts, and, although the relations are not clear, there are two main areas of cherts about 3 miles apart with black, purple, and greenish slates and some greenstones in the intervening space. In passing northward from the northern belt of cherts toward the northern belt of limestones there are conglomerates containing abundant chert pebbles. In passing southward toward the limestones of the White Mountains there are also chert conglomerates with pebbles an inch or more in diameter associated with finer rocks containing grains of chert and fragments of slate. Black slates are also common and thin beds of conglomerate are interbedded with them. The slates are closely succeeded by the limestones on either side and, although the direct relation of the two was not observed, it is believed that the limestones are younger than the rocks above described. The quartzite flanking the limestone on the north, which is very similar to other quartzites apparently interbedded with the limestones, contains occasional fragments of chert and it seems best for the purposes of this report and until further knowledge is available to consider the flanking slates and quartzites as partly of the same age as the limestones and partly younger.

Fossils found in the limestones of the White Mountains have been determined as characteristic of early to middle Devonian, and some of them are possibly of Silurian age; but the stratigraphic association makes it probable that all the remains belong approximately to the same horizon and the determinations point more definitely to the Devonian. No fossils were found in the limestones of the northern belt, but the rocks and their associations are very similar and no reasons were found for assigning them to a different position.

---

[a] Spurr, J. E., Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, pp. 155–169.

If this interpretation of the section is correct the purple, green, and black slates and cherts with associated greenstones are probably the oldest rocks in the region and may possibly belong to the Silurian, but from the fact that wherever they have been found to occur they are intimately related to limestones, which, where determinable, have been found to be Devonian, it seems best at present to call them all Devonian.

The contact relations of these rocks with the rocks to the north and south of them are not clear. On the south the red and black slates with massive greenish quartzite form a ridge just west of Beaver Creek between Beaver Creek and the White Mountains, and outcrops of the quartzite occur sparingly southeast of Beaver Creek, where their attitude is nearly vertical. At the northern end of the section the relations are different. Fossils determined as Pennsylvanian or Permo-Carboniferous were found in a low, outlying ridge overlooking the Flats, and across a narrow valley on the south are black slates and cherts at the base of a high ridge, the topmost points of which are quartzites containing occasional chert pebbles interbedded with red and black slates and some dark limestones. All of these are regarded as Devonian.

The evidence at hand seems sufficient only to justify the statement that in the section from Chatanika River to Yukon Flats there is a large area of closely folded rocks, mostly of Devonian age, flanked on the south by highly metamorphosed schists and on the north by slates partly similar lithologically to the Devonian slates, but containing Carboniferous fossils. Any interpretation of the section on the basis of our present knowledge is open to objections. For example, dips were observed in the White Mountains which indicate a local anticlinal structure, but the folding has been so close that only more detailed studies of the structure supported by more than the fragmentary paleontologic evidence at our disposal will afford the basis for a reasonable approximation to the truth. The present hypothetical interpretation of the section is regarded as a temporary basis only, the first at hand, perhaps, for the preliminary description of the material occurring in this area. Whether it shall be found sufficiently strong to be given the dignity of a permanent basis in the explanation of the structure or must be replaced by one better able to bear the accumulating weight of evidence is, for the purposes of this report, immaterial.

Passing to the Rampart region there is found a variety of rocks like those already described. The disturbance which they have undergone has been greater and intrusion by igneous material more active. Folding has been intense, many of the rocks have been greatly sheared and in some cases brecciated by the forces to which they have been subjected. A section northward from Baker Flats to Rampart is shown in Pl. I. The strike of the rocks is nearly east and west. The garnetiferous mica-schists and marbles of Ruby Creek, considered as pre-Devonian, are followed on the north by cherts and greenstones and on the south by rocks including slate, chert, sheared chert conglomerate, fine-grained rocks having the same composition as the chert conglomerate and also sheared till they have been rendered schistose, massive quartzites, and siliceous limestones, in places much brecciated. Here, also, the succession seems to be from chert and slates through chert conglomerate to fine slate and limestones.

There are other localities in the Rampart region where a partial succession has been observed. The main divide to the east of Lynx Mountain is composed mostly of chert flanked by chert conglomerate, and at one locality near the southeastern base of Lynx Mountain there are fine exposures showing at the base a conglomerate containing sheared chert pebbles several inches in diameter, changing gradually to alternating beds of finer material. At a locality not far from this gray slates were observed highly folded and cleaved and pitching eastward. These slates contain thin beds of quartzite a few inches to a foot or more thick which contain grains of chert.

In Troublesome Valley the succession seems to be the same. A section southward

between Troublesome and Hunter creeks shows greenstones, cherts, sheared chert conglomerate, and slates, with disconnected limestone masses in which fossils determined as Devonian were found. The chert conglomerates are frequently found in close association with the limestones, and at the locality where Devonian corals were collected conglomerate with chert and quartz pebbles is found in close association with the limestone, which also contains quartz pebbles.

Most of the rocks encountered in the Rampart region are a continuation along the strike of those occurring in the section from the White Mountains nearly to Yukon Flats. There are the same lithologic types, the same associations, and, so far as the meager fossil evidence is available, it corroborates the relationship of the rocks in the two areas.

Following is the list of fossils collected by the party. The determinations were made by Mr. E. M. Kindle, of the United States Geological Survey:

Fossils from the White Mountains.

4 AP 240. This lot contains two corals, a *Michelina* and a *Zaphrentis*, neither of which is specifically determinable. Horizon probably Devonian.

4 AP 241. *Favosites* near *epidermatus* occurs in this collection indicating a horizon of Middle Devonian age.

4 AP 242. Specimens of a coral comparable with *Favosites winchelli* comprise the collection from this locality. Horizon probably middle Devonian.

4 AP 243, 245, and 246. These several lots represent the same horizon. The fauna as represented in the collection comprises a single species of brachiopod *Gypidula* of *pseudo-galeatus*. The horizon represented is either late Silurian or early Devonian, probably the latter.

4 AH 186. Includes only poorly preserved specimens of *Cladopora*. Probably of middle Devonian age.

4 AH 193. The fossils represented are *Cytherella* sp., *Cladopora* sp., and *Ptilodictya?* cf. *frondosa*. The horizon is probably Silurian.

4 AH 194. *Favosites* near *limitaris* occurs in this lot, indicating a horizon probably near middle Devonian.

4 AH 195. Contains an undetermined *Stromatopora*. Age probably Devonian.

Fossils from the Rampart region.

4 AP 303. Two poorly preserved specimens of *Aulacophyllum* comprise this lot. The horizon represented may be either Devonian or Silurian, so far as the evidence from this material indicates.

4 AP 317. Minute fragments of small corals in a breccia comprise this lot. Fossils too fragmentary for determination of the age.

CARBONIFEROUS.

At the extreme northern limit of the hill country, in a minor ridge bordering Yukon Flats, there are greenish, grayish, and black slates, with siliceous material, scattered fragments of which were found to contain fossils indicating a Pennsylvanian or Permo-Carboniferous age. At another locality, about 15 miles to the southwest, just south of Hess Creek, fossils also regarded as Carboniferous were found in soft black carbonaceous shales. At both localities the rocks are in close association on the south with cherts and slates, and it is possible that some of the cherts may be of Carboniferous age. All that can be affirmed at present is that in the northern part of the area there occur Carboniferous rocks, whose extent and relations to the rocks of Devonian age are not yet determined.

The following fossils, determined by Mr. George H. Girty, were collected at the two localities and the discussion of them is quoted from his report.

Fossils from near Yukon Flats and from Hess Creek, Alaska.

4 AH 213.

Stenopora, two sp.
Fenestella sp.
Rhombopora sp.
Rhombopora sp.
Productus ? sp.
Lima ? sp.

4 AP 270.

Fistulipora sp.
Stromatopora ? sp.
Coral sp.
Fistulipora sp.
Fistulipora ? sp.
Rhombopora sp.
Rhombopora sp.
Spirifer n. sp. ?
Hustedia cf. H. compressa Meek.

4 AP 277.

Coral ? sp.
Lithostrotion ? sp.
Fistulipora 3 sp.
Rhombopora sp.
Polypora ? sp.
Archimedes ? sp.
Productus sp.
Euomphalus sp.

The presence of the form identified as *Hustedia compressa* seems to show that lot 270 belongs in the Pennsylvanian, perhaps in the Permo-Carboniferous. The ages of the other lots, although without much doubt being Carboniferous, are less certain. While probably no species is common to all three collections, yet in a general way the facies is much the same, and it is quite possible that all represent the same fauna.

It will be observed that only in one case have the forms collected been identified specifically. In many instances the material is too imperfectly preserved to admit of more than the genus being determined. In others the species are distinct from those of the Mississippi Valley sections, and entirely new unless some of them have been described in European and Asiatic publications not included in my bibliography and therefore difficult of reference.

I have consulted freely with Mr. Bassler wherever the Bryozoa were concerned.

CRETACEOUS.

High up on the flanks of the Wolverine and Lynx mountains are black, rather massive, impure sandstones and shales. In the sandstones of Wolverine Mountain, which form great rock piles along the upper parts of the spurs at an altitude of over 1,000 feet above the base of the mountain, were found fragments of dicotyledonous leaves and a part of an indeterminable bivalve. The shales, also, were found to contain a few obscure plant remains. The only positive result obtained is the fact that there are rocks occupying the highest parts in the area, which are at least as young as the Lower Cretaceous and far younger than the rocks of the lower slopes of Wolverine Mountain, where limestones were found containing corals, the stratigraphic value of which is sufficient only to determine the age as either Silurian or Devonian. They rest on the upturned edges of the older rocks and have themselves undergone considerable deformation. Just how much is to be included with these rocks has not been determined. The associated black, carbonaceous, slaty shales are like those closely associated with the rocks regarded as Devonian. The black, sandy beds, in which the fossils were found are unlike those observed elsewhere and resemble the Upper Cretaceous rocks which occur lower down the Yukon. They are entirely different from the Kenai rocks near Rampart and are referred provisionally to the Cretaceous.

TERTIARY.

Rocks determined as Kenai occur along the Yukon above Rampart and are found also for a short distance up the valley of Minook Creek, where they contain a small amount of coal. There are conglomerates, sandstones, and clays resting unconformably on the older rocks. The degree of consolidation is hardly sufficient in some cases to withstand the pick, and prospect holes have been sunk into this formation under the impression that the material belonged to the stream deposits. These rocks are folded, but otherwise are little changed.

QUATERNARY.

The changes in elevation with reference to sea level which the Yukon-Tanana country has undergone have left at various altitudes benches, sometimes of considerable extent, which stand generally in a definite relation to the present drainage lines. An accompaniment of benching has been the deposition upon some of the benches of gravel deposits, part of which are regarded as of Pleistocene age. Benches are prominently developed along Hess Creek and its tributaries, along the Minook, and along the tributaries of Baker Creek. The deposits of the high bench of the Minook, approximately 500 feet above the present stream, are of interest with reference to the occurrence of gold in the tributaries of Minook Creek. The bench gravels of the Baker drainage have proved in some places to be of great economic importance. The description of these gravels and the deposits of the present streams is given elsewhere in this report in the account of the gold placers.

IGNEOUS ROCKS.

The eastern part of the Yukon-Tanana country is characterized by an abundance of intrusive and extrusive rocks of varied composition. There are several batholithic masses varying in composition from granite to quartz-diorite, with numerous apophyses in the country rock. Acid granitic rocks are abundant, and occur commonly in small dikes, some of which are comparatively fresh, while others have been rendered schistose along with the country rock. These become less abundant toward the west and seem to disappear. In the Birch Creek and Fairbanks regions the most common rock of igneous origin is biotite-granite. After crossing the White Mountains no rocks of igneous origin except greenstones were encountered until reaching the immediate vicinity of Rampart. That region has been an area of great igneous activity, in which granitic rocks and more basic granular rocks are common, occurring as small intrusive masses and narrow dikes, and their extrusive representatives are also to be found in small amount. The igneous rocks will not be considered in detail, and only such description will be included as seems necessary for the purposes of this report. They may be grouped roughly as granitic rocks with their surface representatives, monzonitic rocks, greenstones, and basalt with associated glass. The most characteristically developed of them are the greenstones which occur throughout the area. The basaltic rocks so far as observed have but a limited distribution.

GRANITIC ROCKS.

The granitic rocks are not of common occurrence. The most extensive mass observed forms a part of the summit of Wolverine Mountain, where it occupies an area about 1,000 feet wide. It is a porphyritic, massive, gray rock composed chiefly of quartz, phenocrysts of orthoclase a half inch or more in diameter, considerable plagioclase, some biotite and hornblende, and a little pyroxene. The rock is finer grained toward the margin. The slates in contact with it have been indurated and their fracture surfaces are flecked with the products of metamorphism, chiefly andalusite.

A similar rock occurs west of the mountain near the saddle where the trail passes through the ridge to descend toward the Hutlina. This is also a gray porphyritic rock, but the porphyritic feldspars sometimes an inch or more in diameter have a tabular development. The proportion of pyroxene is greater, there is less quartz, and the composition of the rock is transitional to that of the monzonitic rocks. Rocks similar in composition to those of Wolverine Mountain occur also in Lynx Mountain along with monzonitic rocks, but their outcrops were not observed.

A siliceous rock occurs west of Minook Creek about 7 miles from Rampart. It is a finely banded, grayish-brown rock and has been complexly folded on a small scale,

so that in a hand specimen most intricate foldings may be observed. Brecciation has been common, and the interstices of the fragments have been filled with ferruginous matter. The banding resembles sedimentation, but under the microscope the rock is found to be composed almost entirely of minute spherulites clouded with a very minute development of graphic intergrowths. The rock forms a sharply pointed prominent hill rising about 200 feet above the valley. Its relations to the surrounding rocks are not known, but small dikes of a rock composed essentially of quartz and feldspar phenocrysts occasionally occur in a fine-grained, partly graphic groundmass, and it is possible these are derived from the same magma.

MONZONITIC ROCKS.

The most common intrusive is a monzonitic rock which varies in color from dark brown to nearly black. It is a medium to fine-grained rock and the coarser varieties show abundant plates of reddish-brown mica, the most striking mineral present. All the minerals of this rock are fresh and include about equal proportions of an orthoclastic feldspar and of plagioclase which is embedded in the irregular limpid mottled grains of potash feldspar, abundant pale-green monoclinic pyroxene, biotite, and a small proportion of olivine. Hypersthene occurs frequently, its small prisms often fringing the grains of olivine. There is some apatite and often much magnetite.

This rock occurs in Lynx Mountain and in the ridge at the head of Glenn, Rhode Island, and Omega creeks, where it forms a mass of considerable extent. The numerous small dikes of minette-like rock in the slates, from 1 foot to 3 feet thick, containing prominent plates of bleached biotite and a large proportion of nearly colorless prismatic crystals of monoclinic pyroxene, are probably to be referred to this type.

The coarse granular type is similar in composition and texture to the rock found in 1902 by the Brooks party at one locality on the eastern side of the Alaska Range, and this occurrence in the Rampart region is the only one thus far found in the Yukon-Tanana country.

GREENSTONES.

The greenstones include serpentine, altered gabbro, diabase, basalt, and much tuffaceous material, and have frequently been intruded by fresh diabasic rocks. Some show clearly their mode of origin. Others are indefinite aphanitic chert-like rocks. They occur throughout the area from the White Mountains to Rampart. Their dark color contrasts strongly with the associated limestones of the White Mountains; they form the prominent ridge across Beaver Valley to the west of these mountains, and occur in the area between this ridge and the Flats. Farther west they become prominent in the ridge north of Hess Creek. In the Rampart region they form the bed rock in the lower part of Troublesome Valley and are the most widely distributed rocks in the lower valley of the Minook below the mouth of Florida Creek.

The greenstones are partly intrusive and partly extrusive to the rocks in which they occur. Those in association with the limestone are, so far as has been observed, parallel to the structure, and furthermore some of them are altered basalts containing numerous amygdules filled with calcite. Diabasic intrusives occur cutting the serpentine, and in the Rampart region intruding the Rampart slates.

BASALT.

A fresh olivine basalt occurs on Minook Creek about 1 mile above the mouth. On Hunter Creek, a short distance above the mouth, and apparently related to the basalt in their occurrence, are volcanic glasses containing basic feldspar phenocrysts.

SUMMARY.

The greater part of the area is occupied by closely folded sedimentary rocks, and most of these are regarded as of Devonian age. Folding and metamorphism appear

to have been most active in the Rampart region, and some of the rocks have been rendered somewhat schistose, and others have been brecciated by the forces which have been at work. The igneous rocks include both intrusives and extrusives, and are present in great variety and abundance in the Rampart region.

Most of the gold-producing creeks tributary to Minook Creek from the east head in areas composed of slates, quartzites, feldspathic quartzites, chert, and sheared chert derivatives, and flow in the lower parts of their valleys through areas of greenstone, which are largely tuffaceous. The schistose, fine-grained fragmentals, alternating with the slates and quartzites, form the greater part of the bed rock in the valleys of the streams tributary to Baker Creek. The same rocks strike off northeastward and occupy large areas in the valleys of the headwaters of the Tolovana, which were traversed by the Brooks party in 1902, and still farther in the same direction are found in the White Mountain section. There is no essential difference in the bed rock of the northern and southern sides of the divide in the Rampart region, except that the greenstones are confined mostly to the northern side in the lower part of Minook Valley below Florida Creek. Victoria Creek, a tributary of Beaver Creek, where prospects were reported in the fall of 1904, heads in an area of chert, slates, and greenstones, like those of the Rampart region.

The occurrence of gold has not been traced to a definite relation to any particular bed rock or to the quartz seams, which are rather common in the slates. Many of the dikes are more or less mineralized, and some of them are reported to carry values. The light-colored acid dikes of the Fortymile region, with their associated quartz veins, were not observed in the Rampart region. The slates contain generally a large amount of carbonaceous matter, and anthracitic material is common in some of the small quartz seams. Pyrite is often found in both the slates and the quartz seams. On creeks where the conditions are apparently least complex the only rocks observed are the carbonaceous slates with quartz seams, which occasionally are a foot or more in thickness, and the monzonitic intrusives in the ridge about the headwaters. The nuggets have frequently a considerable quantity of quartz attached, and it seems probable that the gold has been derived from the small quartz seams. The only general fact which seems to emphasize itself is that the occurrence of gold in quantities of economic importance is limited to an area where deformation of the rocks has been intense and where there has been much igneous activity.

THE GOLD PLACERS.

By FRANK L. HESS.

GENERAL STATEMENT.

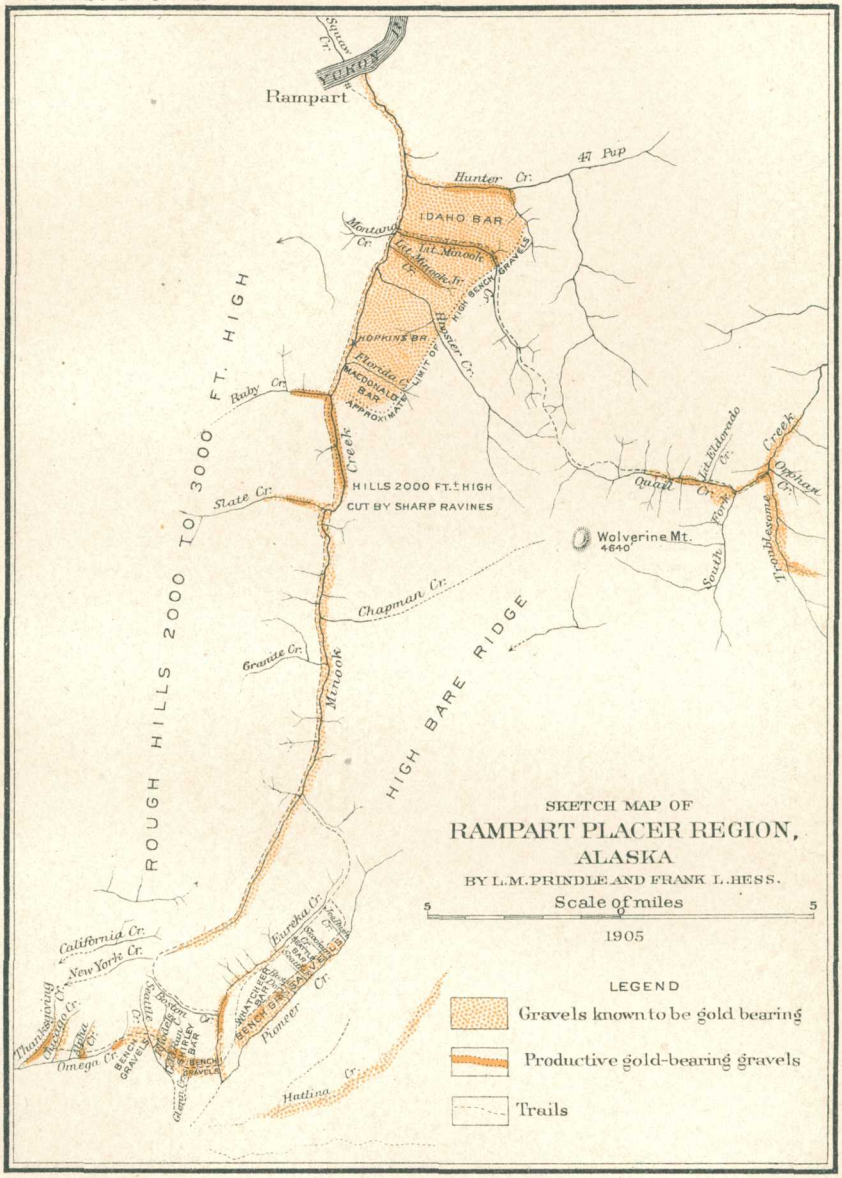
The placers of the Rampart region were studied by the Survey party for ten days during the first part of September, 1904. Every working claim was visited except those on Gunnison Creek, but in a number of cases where claims are worked only during the winter the operators could not be seen. Foot traverses were carried over the region and a sketch map was made (Pl. III). The time allowed only a hasty reconnaissance, though if it had been possible to know the dates of arrival and departure of the boats more time could have been put upon the study of the region. The miners met were universally generous, hearty, and hospitable, ready to help whenever possible with information or otherwise, and the work was thus made much more effective and pleasant.

The placer diggings near Rampart may be grouped according to the drainage systems to which they belong. The three general groups, Minook Creek, Baker Creek, and Troublesome Creek, are separated by a divide having the general shape of a Y whose stem runs northeastward between the Minook and Baker Creek drainage, whose left arm runs nearly northward from Wolverine Mountain, about 13 miles southeast of Rampart (Pl. III), and whose right arm runs nearly eastward, from the eastern base of the mountain. Between the arms, extending northward, is the "Troublesome country", as the region surrounding the creek of that name is known from its steep, rocky ridges and deep, narrow valleys. Each group embraces only the diggings located on the creek that gives the group its name, or upon its tributaries.

In the Minook Creek group most of the gold-bearing creeks are on the east side, nearer the left-hand arm of the Y, only a few diggings being on the west side of the creek. In the Baker Creek group the diggings now known are on the side nearer the Y, and in the Troublesome Creek group the only diggings known are on the west side of the creek, on branches flowing from the left arm of the Y. The extreme length of the area containing known gold-bearing localities is about 30 miles and its greatest width is about 12 miles, the total area being probably less than 350 square miles.

Winter prospecting is being done on Squaw Creek, a tributary of the Yukon about the size of Minook Creek, which enters the river nearly opposite Rampart.

The first placer claim in the Rampart region was located and worked in 1896 on Little Minook Creek by F. S. Langford, though gold had been previously discovered by John Minook, a Russian half-breed, who seems to have sluiced out a small amount of gold, and for whom the creek was named. Some prospecting had probably been done along Minook Creek a number of years before. Since the first systematic work in 1896 the region has been a constantly productive one. Though the


Rampart
Hunter Cr.
47 Pup
IDAHO BAR
Montana Cr.
Little Minook Cr.
Little Minook Jr.
HIGH BENCH GRAVELS
HOPKINS BR.
Hoosier Cr.
Florida Cr.
MACDONALD BAR
APPROXIMATE LIMIT OF
Ruby Cr.
Minook Creek
HILLS 2000 FT.± HIGH
CUT BY SHARP RAVINES
State Cr.
Wolverine Mt.
4640'
Quartz Cr.
Little Eldorado Cr.
Orchard Cr.
South Fork
Troublesome Cr.
Chapman Cr.
Granite Cr.
ROUGH HILLS 2000 TO 3000 FT. HIGH
HIGH BARE RIDGE
California Cr.
New York Cr.
Eureka Cr.
Pioneer Cr.
Omega Cr.
Hatlina Cr.
SKETCH MAP OF
RAMPART PLACER REGION,
ALASKA
BY L. M. PRINDLE AND FRANK L. HESS.
Scale of miles
5 5
1905
LEGEND
Gravels known to be gold bearing
Productive gold-bearing gravels
Trails

amounts taken out have not been so large as those mined at places in the Klondike district or at a few of the claims near Nome, yet a number of creeks in this region produce a fair amount of gold. At first Little Minook and Hunter creeks were the only producers, and during 1897 no new ground seems to have been found, but in 1898 a small amount was taken out of Quail Creek. Afterwards gold was discovered upon Little Minook Junior, Hoosier, Ruby, and Slate creeks of Minook Creek Valley. In the meantime prospecting was carried on over the divide on the south, and deposits along Baker Flats were discovered. In fact, each year has shown some new source of production, and it seems likely that more may still be found. The output to the fall of 1904, from the best available data, was $1,112,000, and that for the year ending at the same time was about $232,900.

As Rampart lies only about 1 degree south of the Arctic Circle, the cold of winter is severe and the open season is comparatively short. During the early part of June thawing is generally so far advanced that some preliminary work and sluicing can be done. Cold snaps are likely to make the work intermittent at first, but the latter part of June and all of July and August can be depended upon for outside operations. Frosts are likely to occur the first part of September, though mining can sometimes be carried on during practically the whole month. In 1904 the sluice boxes froze up on the 5th of September, and after that date there were only a few days on which sluicing could be done.

The surficial deposits are always frozen, and the limit of the frozen ground has not yet been reached, but there are channels in the frozen gravels through which water circulates freely at all seasons. Large masses of ground ice often occur in the muck, though none are found in the gravels. The depth of the alluvial deposits sometimes exceeds 100 feet, but it is generally less than one-fifth of that amount.

The larger part of the mining has been carried on by drifting and open cuts, depending on the season and the local conditions; but during the season of 1904 two hydraulic plants began active operations, and two more were under construction. Ordinarily, wherever the gold-bearing alluvials are of sufficient depth they are mined by drifting during the winter and the dirt taken out is washed in the spring. In some cases the presence of water interferes very seriously with the drift mining and renders gravels otherwise workable comparatively valueless. Drifting can not ordinarily be carried on in the summer time, because the warm air melts the ground and causes it to cave. In thawing the ground for drift mining steam points have generally superseded wood fires, though the latter are still sometimes used.

During 1904 wages were $5 and board for a 10-hour day. This is equivalent to $6.50 to $9 a day, varying with the locality. The men who work for wages are generally strong and healthy and render a full equivalent for their pay.

The currency of the country, as in the early stages of most placer camps, is gold dust. The different values of the gold from the different creeks makes the fixing of the price at which it should pass rather difficult, and the result is that, while some gold passes considerably below its value, some passes at more than it is actually worth. The gold assays from $14.88 to over $19 per ounce, and passes at $15.50 to $18 per ounce.

MINOOK CREEK GROUP.

This group includes the placers of Minook Creek and its tributaries within limits of 5 to 13 miles from Rampart. Most of the diggings, and much the richest so far discovered in the group, are upon the east side of the valley, and none have been found in the main valley above the mouth of Slate Creek, 11 miles from Rampart.

The hills are generally rounded or flat-topped. The valleys are canyon-like, with steep walls 500 feet or more high, and benches are prominent features of the topography. The larger streams have cut their valleys down to a grade varying from 40 to 80 feet to the mile. The watershed of Minook Valley is narrow on the west, sometimes

not over a half mile or a mile wide, and is probably at no place over 4 miles wide. On the east it is 5 to 7 miles wide through the greater part of the length of the creek.

The total production of the Minook Creek group has been about $702,600, of which $75,500 was produced during the winter of 1903–4 and $10,900 during the summer of 1904, making a total for the year of $86,400.

The surficial deposits are derived from the country rocks, mostly slate, quartzite, and greenstone, and reach occasionally a depth of over 100 feet, though usually much less than that, and there is generally a large proportion of muck.

MINOOK CREEK.

General description.—Minook Creek empties into the Yukon just east of Rampart, and is about 25 miles long. Near its mouth it is a shallow stream 50 or 60 feet wide, with a flow of possibly 200 second-feet or 8,000 miner's inches. It flows in a northerly direction through a deep valley whose width varies from a few hundred feet to about a half mile. The creek receives a number of large tributaries from the east—Hunter, Little Minook, Little Minook Junior, Hoosier, Florida, Chapman—and a number of creeks whose names are unknown. From the west it receives Montana, Ruby, Slate, and Granite creeks and a few small tributaries. Granite Creek, about 17 miles from the Yukon, is the largest western tributary, carrying probably 30 to 40 second-feet; Minook Creek carries perhaps 40 to 50 second-feet at the junction. These approximate estimates are given to convey some idea of the comparative sizes of the streams.

Aneroid barometer readings by Mr. Arthur J. Collier[a] showed a descent of about 760 feet from the "106 road house," about 1½ miles above Granite Creek, to the Yukon. As the distance is about 18 miles, these readings indicate a gradient of about 42 feet to the mile. In the next 3½ miles above he noted a rise of 240 feet, showing a gradient of about 68 feet to the mile. According to Mr. M. E. Koonce,[b] of Rampart, the creek has a fall of about 40 feet in the vicinity of the mouths of Ruby and Slate creeks. Aneroid barometer readings of Mr. L. M. Prindle and the writer showed a somewhat higher grade for the central portion of the creek. It seems likely that Minook Creek has an average gradient of somewhat over 40 feet per mile from the Yukon to Slate Creek and a somewhat steeper gradient above Slate Creek.

Just below the mouth of Slate Creek the Minook spreads into a number of branches in a wide gravel flat. This flat, which is typical of many Alaskan streams, is probably due to a change in the grade of the creek. The stream here is unable to carry the gravels of the swifter water above, and so spreads them upon the flat. Here are found the so-called "winter glaciers," which sometimes last through the short summers. In 1904 a quarter or half acre of ice still remained when the September frosts occurred. This ice owes its origin to the fact that the channel which carries the water is greatly contracted by freezing in the fall. The resulting hydrostatic pressure cracks the ice and the water overflows and freezes. This process is repeated until a considerable thickness of ice is accumulated.

The valley is V-shaped in cross section, and the eastern slope is often benched, while the western is more abrupt and has remnants of benches at but few places. Five well-marked benches rise at irregular intervals above the floor between Little Minook Junior Creek and Hoosier Creek (fig. 1), the highest of which is about 500 feet. These benches are features of much importance in both the physiography and economic geology of the region. Important gravels cover the highest one, which lies on the east side of the Minook and extends from Hunter Creek to about a mile above Florida Creek. It will be described later. A small remnant of the same bench is found on the north side of the mouth of Montana Creek and another on

[a] Personal communication. In giving aneroid barometer readings their lack of reliability is recognized in all cases.

[b] Personal communication.

the north side of the mouth of Ruby Creek. Other remnants are found on the north side of the mouth of Chapman Creek, and at a point about 4½ miles above the Chapman on the same side of Minook Creek. The last two benches show no gravel. On the west side of the creek but few remnants of benches are found. One, about 50 feet high, extends to a little above the mouth of Hunter Creek, and is probably an extension of a corresponding bench on the south side of the Yukon. It seems probable that all of the benches of Minook Creek may be more or less closely correlated with the benches of the Yukon. In the vicinity of the mouth of Slate Creek is a bench cut in the upturned slates and thin-bedded quartzites to a depth of 12 to 16 feet and covered by 4 or 5 feet of gravel and a foot or more of muck. No gravel has yet been found upon the benches of intermediate height, but further investigation may show its presence.

In its upper course the creek flows somewhat north of east for about 2 miles, and here the topography of its valley is altogether different from that of the lower part. The north side is a long, gentle slope with a greater rise in the upper part, while the south side is steep and the stream flows near its base. The asymmetry of this part of the valley is repeated in Eureka, Pioneer, Hutlina, Omega, New York, California, and many other creeks of the region whose valleys lie in parallel or nearly parallel directions.

The rocks in the upper part of the valley are mostly closely folded slates and limestones. Garnetiferous schists occur at Ruby Creek, and greenstones form the bed

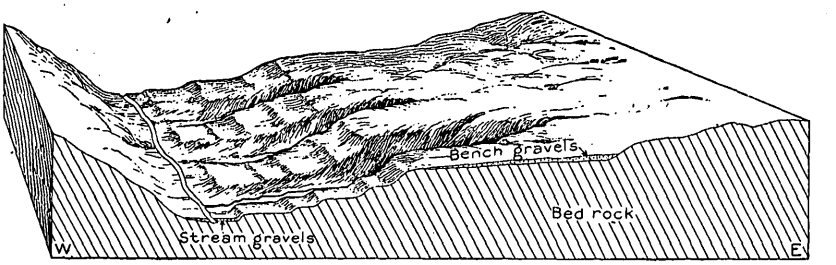


FIG. 1.—Diagrammatic sketch of Minook Valley.

rock of the lower valley except near the mouth, where they are partly covered by the Kenai rocks.

The alluvials of the valley are said to be 10 to 12 feet thick and consist of the usual muck (soil mixed with much vegetal matter), peaty soil, and gravel, with much angular débris at the foot of many of the hillsides. In the middle part of the valley they consist of about 5 to 6 feet of muck and the same thickness of gravel. The muck thickens toward the sides while the bed rock remains about level. The gravel deposits are derived from local bed rock and contain large numbers of smoothly rounded quartzite bowlders from a few inches to 3 feet in diameter, whose source has been a mystery to many. Some of these bowlders have undoubtedly descended to the present creek bed from the high benches already referred to, in whose gravels they are abundant.

The outcrop of quartzite near the "72 road house" would in itself seem sufficient explanation for the bowlders below, but above this point the thinner quartzite beds have added many more to the stream. The quartzites are so hard and their abrasion is so slow that while the other rocks wear into sand and small pebbles, or decompose and are swept away, the quartzite bowlders remain and make up a continually larger proportion of the gravels.

Mining.—Minook Creek has not produced a large amount of gold. The wide valley, large stream, and heavy gravels have made mining difficult, so that men

with the limited means of the ordinary prospector have found it more advantageous to work the smaller streams. The total production to 1904 is placed by miners of the region at $9,900. The gold produced is said to have been taken from the central portion of the valley, partly from bar diggings and partly by drifting, but in general the gravels do not seem to be rich enough for working by pick and shovel methods.

Nothing was learned of the occurrence of gold in the gravels of Minook Creek above the mouth of Slate Creek, except that colors have been found throughout its length. Below the mouth of Ruby Creek colors of gold are said to have been found in the gravels of a bench on the west side of Minook Creek, a few feet above the present stream, but not in paying quantity. The débris here is largely a graphitic slate somewhat schistose and highly impregnated with pyrites. An assay[a] of some of the material gave a trace of silver.

Two small areas worked in the gravels between Ruby and Slate Creeks are said to have given values of about $3 per square yard of bed rock; another small area is said to have given $4 per square yard, and nuggets of values up to $90 are reported to have been found. The gold is stated to be practically all upon bed rock. The width of the gravel in which gold is found is not known, but it is supposed to occur throughout the gravels which floor the valley for a width of half a mile.

A company has been formed to hydraulic this portion of the creek; considerable preliminary work has been done, some pipe, lumber, etc., were on the ground September 20, 1904, and a large amount of pipe and other supplies for the company were brought to Rampart by the steamer *Susie* on her last trip up the Yukon for the season.

Several schemes were on foot for working the gravels in the lower part of the valley near the mouth of Hoosier Creek. One proposition was to work them with a dredger, and another with power scrapers. Little was learned of either plan, but from the roughness of the bed rock dredging would seem a difficult undertaking, except in the limited area in which the bed rock seems to be the Kenai sediments.

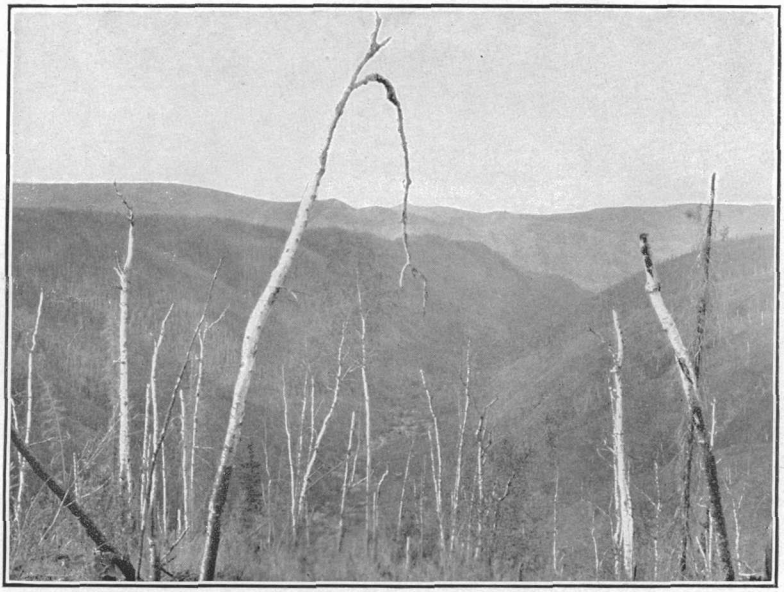
HIGH BENCH.

The high bench mentioned on the east side of Minook Creek, the most prominent feature of Minook Valley, needs to be treated here, as on its gravels depends probably in large measure the richness of most of the placers of the Minook region.

This bench, starting at a point about a mile above the mouth of Ruby Creek and about 9 miles in a straight line above the mouth of Minook Creek, continues to Hunter Creek within about 3 miles of the Yukon (Pl. IV, *A*). The eastern line bounding the bench runs about N. 60° E.; so that between Hunter Creek and Little Minook Creek the bench has a width of between 2½ and 3 miles. At its extreme eastern side the bench has a height of about 800 feet above Minook Creek, and it slopes toward the west until the height above the stream is only about 500 feet. The surface of the bench is remarkably smooth and continuous between the various streams that have cut across it, and resembles a plain through which deep ditches have been cut. It seems to narrow somewhat and crosses Hunter Creek at the mouth of "47 Pup" continuing in a northeast direction toward the Yukon. Although the writer was unable to follow the bench farther than Hunter Creek, miners assured him that they were able to trace it beyond in a northeast direction by gravels on the surface.

The gravels contain chert, diabasic and metamorphic rocks, vein quartz, and some other pebbles with many heavy quartzite bowlders (Pl. IV, *B*). They are exposed on the sides of the valleys of the different creeks cutting the bench and have rolled down into the present stream beds where the great number of large quartzite bowlders make considerable trouble for the miner.

[a] Burlingame, E. E., & Co., Denver, Colo.



A. VIEW WESTWARD FROM IDAHO BAR DOWN LITTLE MINOOK CREEK.

Showing portion of high bench and intermediate bench.

B. GRAVEL OF HIGH BENCH OF MINOOK CREEK EXPOSED IN TUNNEL ON IDAHO BAR.

The origin of these gravels has been puzzling to the miners and prospectors. Their great width and depth, their position so far above the present gravels of Minook Creek, and the presence of the great quantity of heavy quartzite bowlders, where the bed rock would afford no such material, have made it seem to many miners necessary to assume that some larger stream, possibly the Yukon itself, once flowed across the country. This view received some support from the apparent course of an old channel either toward or from the northeast, while the present stream flows somewhat west of north from the mouth of Hunter Creek.

The data at hand suggest that Minook Creek while flowing toward the Yukon to the northeast of its present course, when the land stood at a lower altitude, had formed a flood plain of approximately the dimensions of the present high bench. With the elevation of the land along the Yukon, the effects of which are to be seen over hundreds of miles, the mouth of Minook Creek may have been raised through local variations, its grade may have been lessened, and the former flood plain may have had the gravels under discussion deposited over it. As the elevation went on, the creek was forced to the west and finally found a new outlet to the Yukon. The elevation continued, and Minook Creek cut downward, leaving its gravels on a bench above it. The elevation did not, perhaps, proceed steadily but periodically, and thus intermediate benches were formed.

The smaller creeks, Hunter, Little Minook, and Hoosier, all give some support to this hypothesis. By reference to the map (Pl. III, p. 26) it will be noticed that each of them, upon reaching the edge of the bench gravels, sharply changes its course and flows westward through the high bench. In the case of Hunter Creek and Little Minook Creek the change in direction amounts to about a right angle, while with Hoosier Creek the angle is less acute but still noticeable. The eastern limit of the bench gravels probably marks the mouths of the various streams when this line represented the course of Minook Creek. As the course of Minook Creek was shifted to the west the tributary creeks followed under the influence of the same force that shifted the larger stream. The age of the bench is probably Pleistocene, as is shown by vertebrate fossils found in the gravels of Little Minook Junior Creek, which seem to be the oldest gravels of the streams cutting the bench.

Gold has been found in the bench at many places, and between Little Minook Creek and Hunter Creek a large amount of prospecting has been done. This portion of the bench is known as "Idaho Bar." One shaft near the middle of the divide toward their eastern edge is said to have shown the gravels to be over 100 feet thick. Many other prospect holes have been sunk in them at various places, and tunnels were run above Little Minook Creek at their eastern edge. Three claims upon this portion of the bench have been patented. From the bottom of one prospect hole, between Little Minook Junior Creek and Hoosier Creek, $27 was reported to have been taken, but drifting failed to show pay. Above Florida Creek, in the small area of high gravels known as "Macdonald Bar," prospect holes gave colors but no pay Apparently the gravels of the bench are nowhere rich enough to pay for drifting, although if it were possible to get hydraulic water to them cheaply they might, perhaps, be worked at a profit. The aneroid barometer readings, though not very reliable, suggest the possibility of bringing water from a point 3 or 4 miles above the mouth of Granite Creek under sufficient head to work at least a part of these gravels, if prospecting should show them to be rich enough to warrant the expense.

CREEKS CUTTING THE HIGH BENCH.

Hunter, Little Minook, Little Minook Junior, Hoosier, and Florida creeks cut through the high bench just described. Of these, Little Minook Junior and Florida creeks have their channels in large part or wholly within this area, while, as already noted, the other creeks lie partly outside and change their courses noticeably upon reaching it. The three longer creeks head close together in the hills which extend

northward from Wolverine Mountain and divide the Minook drainage from that of Troublesome Creek. Their valleys, even at the heads, are so steep that the trails leading out of them are exceedingly difficult to travel.

Hunter and Hoosier creeks not only have had a sufficiently large flow to cut their canyons, but they did it quickly enough to have since had opportunity to widen them, while Little Minook Creek with its smaller volume has not yet graded its valley sufficiently to do so much side cutting, and Little Minook Junior and Florida creeks lack much of having cut their beds down to grade.

HUNTER CREEK.

General description.—Hunter Creek is the first tributary of any size above the mouth of Minook Creek. It is between 12 and 15 miles long, carries probably a little over 40 second-feet, and flows in a steeply walled canyon-like valley through its whole length. In its upper 7 or 8 miles it flows almost north until it comes to the line of the high bench, when it turns at a right angle and flows west to Minook Creek.

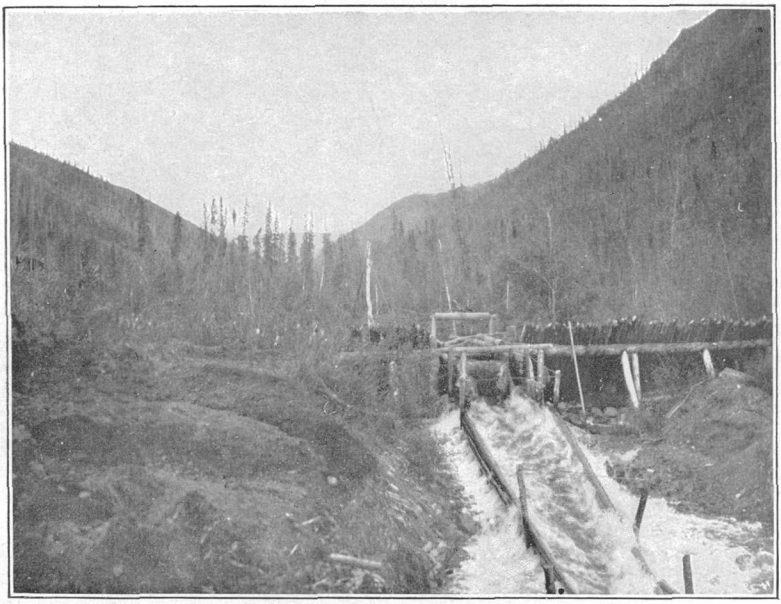
Through the upper part of its course it is a crooked stream with a narrow V-shaped valley, probably indicating a rejuvenated drainage, while at its turn into the high bench the course becomes almost straight, showing a young, rapidly cut valley. It has but one tributary below the bend—Dawson Creek—entering from the south about 4 miles above the Minook. In the lower part of the valley of Hunter Creek the two sides are unlike. On the south side the upper 300 or 400 feet of the valley wall is very steep, almost precipitous. The descent then becomes gentler and forms a broad bench which slopes easily to the creek where it ends abruptly with a face 15 to 40 feet high. This bench is probably to be correlated with the lowest one on Minook Creek. It is covered with gravel, varying in thickness from 5 or 6 feet to 15 feet, and with muck varying in thickness from 1 foot near the creek to 40 feet or more near the hillside.

The creek flows tortuously through its bench, retaining the meanders it had before the bench was formed, and generally is close to the north side of the valley, but occasionally, as about 4 miles above the mouth, it wanders toward the south side, cutting away most of the bench. The valley has a grade in its lower part of 75 to 80 feet per mile.

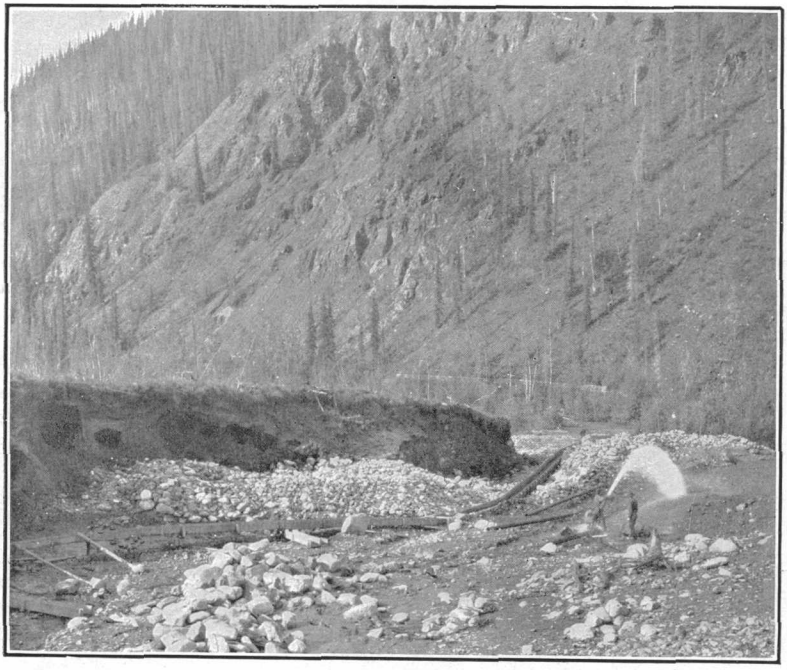
Gold was discovered in Hunter Creek Valley by William Hunter (for whom the creek is named) in 1896, at a point about 1¼ miles above the mouth. Few definite data were obtainable concerning the gold production of the creek, but it is believed to have been approximately $24,000, of which $3,000 was produced during the winter of 1903–4 and $3,000 during the summer of 1904, a total for the year of $6,000. Hunter Creek has so far not proved to be a rich creek, though gold has been found in the gravels of both the bench and the present stream bed.

At the head of the creek the bed rock is mostly Rampart slate and quartzite; tuffaceous greenstones which predominate in the lower part of the valley are overlain near the mouth by Kenai sandstones and conglomerates. The tuffs contain some rounded pebbles, and a hole 228 feet deep was sunk in them under the impression that they belonged to the frozen muck and gravels of the creek. The rocks are much jointed and contain many small veins of quartz and calcite. Pyrite occurs at many places.

The gravels of the creek are 2 to 12 feet thick and are mostly diabase, slate, and chert pebbles from the bed rock, with many heavy bowlders of quartzite, occasionally reaching 3 feet in diameter. These larger bowlders are residuals from the gravels of the old bench through which the valley is cut. Much of the diabase gravel is angular or subangular. The muck over the gravel varies in thickness from 1 foot in places along the stream to 40 feet or more where the small streams pour their débris upon the valley floor.



A. AUTOMATIC DUMP GATE DISCHARGING, CLAIM NO. 3 BELOW, LITTLE MINOOK CREEK.



B. HYDRAULICKING ON HUNTER CREEK ABOUT 4 MILES ABOVE THE MOUTH.

The ground ice is shown by the darker places in the bank on the left. The bowlders have come from the high bench of Minook Creek, through which Hunter Creek cuts.

Mining.—During the summer of 1904 work was being done on Discovery claim, about 1¼ miles above the mouth of the creek; and on No. 17, a claim about 4 miles above the mouth. Several claims between these were being prospected.

On Discovery claim a flume 2,000 feet long, 30 inches wide, and 20 inches deep carried water to a bench about 16 feet above the creek. The bench was covered by 5 to 6 feet of gravel and over this was 1 to 4 feet of muck. The muck and gravel were practically all sluiced off, and the loose bed rock in which the gold is found to a depth of about 18 inches, was shoveled into sluice boxes. The bed rock is partly a diabase and partly a much-folded brown, cherty shale standing on edge. The large bowlders were moved by hand. Three men ground-sluiced an area 75 by 150 feet in thirty days. The gold is mostly bright, smooth "pumpkin seed," with a few small rough pieces (Pl. VI.) A considerable amount of small barite pebbles and some hematite occur in the concentrates.

On claim No. 17-A a hydraulic plant was installed during the season of 1904. About a mile of combined ditch and flume had been put in, about 3,000 feet of which was flume, 32 by 18 inches, delivering 300 inches of water under a head of about 75 feet. A No. 1 Hendy Giant with a 3-inch nozzle was being used (Pl. V, *B*).

In working the ground the niggerheads and moss are torn up with a team and harrow and washed off with the nozzle. The ground is then left for a week, during which time the muck will thaw 1 to 2 feet. This is then washed off. The process is repeated until the top is removed. The remaining gravel thaws much more rapidly than the muck. It is found that the gravel can thus be thawed and made ready for sluicing much faster than a hydraulic giant working steadily can wash the gravel into the sluice boxes. In one instance an area 125 by 250 feet was worked out in 40 days. The gravels are 2 to 12 feet thick, averaging about 6 feet, and are covered by 1 to 40 feet of muck. The maximum thickness was found at the mouth of a small tributary gulch where the gravel is mixed with angular fragments of rock. The muck contains much ground ice, which thaws readily when hydraulicked. The ice occurs occasionally as "dikes." One such was encountered over 400 feet long and 2 feet thick, intersecting the surface layer of muck and a flat lenticular mass of ground ice down to the gravel, making a depth of 12 to 15 feet.

The gold is found through the lower 3 feet of gravel and in the rough broken bed rock, which is made up of diabase and thin-bedded quartzite. It is bright and smooth, and nuggets up to 10 ounces in weight have been found. There is a small amount of rougher gold. Colors of gold are said to occur throughout the length of the creek, but no workable deposits have been found above the eastern limit of old gravels on the high bench already described. The larger part of the gold has probably been reconcentrated from this bench. The smaller portion of rough gold has probably a local source in the rocks of the creek valley. Drifting is done in the winter at a number of places on the creek, but little information could be obtained as to results.

LITTLE MINOOK CREEK.

General description.—Little Minook Creek empties into Minook Creek about 5 miles from the Yukon and about 1½ miles above the mouth of Hunter Creek, and has so far been the largest producer of the region. In drier years it carries scarcely a sluice head of water. It has a grade of 100 feet or less per mile in the lower 3-mile section to which all the mining has been confined, and its course is remarkable in being nearly parallel to Hunter Creek, though considerably shorter, as it has a length of only about 8 miles. Like Hunter Creek it makes a sharp bend upon entering the high bench about 3 miles from Minook Creek. Above this bend Little Minook Creek has a maturer character, as shown by the more crooked valley and greater number of tributaries, while in its course through the bench it has a straight sharply V-shaped valley

(Pl. IV, p. 30) cut to a depth of 500 to 700 feet, and so narrow that for over three months of the winter the sun can not be seen from the bottom of the valley.[a]

The creek follows closely the southern side of the valley through its lower 3 miles, and mostly the western side above this. It seems likely that the greater accumulation of talus on the north side of the creek is due to the greater amount of sunshine it receives, resulting in a greater amount of breaking down of bed rock by alternate freezing and thawing.

Gold was first discovered upon the creek in the early nineties by John Minook, who is reported to have taken out some gold near the mouth of the creek. The first claim, however, was located and worked by Mr. F. S. Langford in 1896, since which time the creek has been worked continuously. The total production of the creek is calculated, from the best ascertainable figures, to be $486,100, of which $40,000 was taken out during the winter of 1903–4 and $2,900 during the summer of 1904, making the output for the season of 1904 $42,900.

Little Minook Creek heads among slates and quartzites cut by small decomposed acid dikes. A little over a mile below the head, the creek is crossed by a belt of clayey, nonfossiliferous limestone, accompanied, as is often the case with the Rampart rocks, by green fine-grained slates. Below this there is an indistinct series of interbedded quartzites, cherts, siliceous shales, and some sandstones, all greatly contorted and accompanied by large masses of greenstones which form probably the larger part of the bed rock of the lower valley. At the foot of the valley walls the exposure of igneous rocks seems to be greater than in their upper parts; that is, erosion seems to have exposed larger masses of igneous rocks. Small veins of quartz and calcite occur in the rocks, but none of great extent. The rocks of the valley have a considerable impregnation of iron pyrites, the oxidation of which has stained them the familiar rusty brown of iron oxide.

The placer deposits are all in the stream bed. The valley has been cut down so quickly that no bench deposits have formed. The alluvial deposits of Little Minook Creek vary in thickness from 7 to 25 feet, of which gravel forms 3 to 12 feet, and muck, though occasionally absent, generally 3 to 16 feet. The deposits are shallowest in the lower part of the creek. The gravels contain fragments of many rocks, of which diabase is probably most abundant, but slate, grit, and much vein quartz also occur, and there are many large quartzite bowlders from the bench above. Much of the gravel, as would be expected in a weak stream, is subangular.

In the gravels mammalian bones are said to be found, although none were seen by the writer. In places clear ice is uncovered in digging, the structure of the alluvium showing how sudden floods had drifted detritus over the ice in the spring, and had thus preserved it. Locally there is much wood in the muck.

Occurrence and character of the gold.—Values are found in the lower part of the gravels through a thickness of 1 to 3 feet, and a width of 50 to 200 feet. The gold frequently occurs in the bed rock, particularly the broken diabase, to a depth of 1 to 2 feet. The pay streaks extend up the creek only as far as the creek has cut through the high bench gravels, a distance of about 3 miles. There are sixteen 1,000-foot claims within these limits.

The creek has been well prospected throughout its length, and although colors are found there is no pay above the line of the high bench. A small amount of gold, in which were some large nuggets, has been found in the gulches leading from the high bench. The amount of gold carried by the gravels varies greatly, but in the pay streak probably runs from $2 to $10 per square yard. The gold is generally smooth, chunky, and bright (Pl. VI, j, k, l, p. 38), and shows a large amount of wear. In the upper part many nuggets are found weighing 1 to 12 ounces apiece, but the gold gets finer downstream until near the mouth it is nearly all flat, smooth,

[a] Peck, C. W., and Laboskie, Wallie, personal communication.

bright, and even in size, looking like golden bran when seen in quantity. There is a very small amount of rough gold, probably of local origin, but the larger part is probably reconcentrated from the old bench gravels of Minook Creek. The gold of the creeks cutting this bench is said to assay over $19 per ounce. This would make it of about the same value per ounce as the Koyukuk gold. The gold is taken in trade by the stores at $18 per ounce. Some small nuggets of copper and a small amount of silver have been found with the gold.

Mining.—Most of the claims are worked by drifting in the winter, though the three lower ones are worked during the summer by open cuts. On the latter the muck and gravel are first ground-sluiced off within 1 or 2 feet of bed rock by means of a dam and automatic gate (Pl. V, *A*, p. 32), and the remaining gravels are then shoveled into the sluice boxes. The drifted pay gravels have often been "coyoted" or "gophered;" that is, holes have been sunk here and there without system until, although there is probably much pay still left, the ground is frequently almost unworkable on account of the ice in the old holes which floods the new workings when thawed by a steam point. When workings are filled with water, the mass is said to freeze on the top, sides, and bottom, while the central part remains unfrozen through several years. Much of the ground is worked on "lays" or leases, the lessees paying from 25 to 55 per cent of the gross output, an amount that is apt to leave the worker little for his labor if things do not run very smoothly. Freight rates are 2 cents per pound in winter and 4 cents per pound in summer.

The remaining gold in Little Minook Creek would seem to be best recovered by working the claims in cooperation as one company, for it is certain that some of the richer claims can no longer be profitably worked by drifting. The quickest, but an initially expensive, mode of working would be to hydraulic the gravels by bringing water from Minook Creek. A ditch 10 miles in length above the mouth of Little Minook Creek would probably give a head of over 100 feet and plenty of water at the upper limit of the pay gravels. A way requiring less capital, but much slower, and the one that will likely be carried out in the end, is the ground-sluicing of the claims, successively, from the mouth of the creek upward, by means of dams and automatic gates, but as the claims belong to different parties, some of whom are unwilling to sell, there will probably be only a small amount of work carried on along the creek for a number of years to come.

LITTLE MINOOK JUNIOR CREEK.

General description.—Little Minook Junior Creek, between Little Minook and Hoosier creeks, is about 2½ miles long. Its valley lies wholly within the high bench of Minook Creek. It is a weak stream, generally dry during the summer, and rarely carries a sluice head of water. With a valley of hard rocks it has not been able to cut its bed down to the depth reached by the larger tributaries of Minook Creek. In the lower half the grade of the creek is torrential and the valley is narrow with steep sides. In the upper half the grade is much easier and the valley is wider with gentler slopes, especially on the north side. The rocks of the valley are the same as along Little Minook Creek. The lower part is entirely in diabase.

The total output of the creek was estimated by Mr. Donald McLean at about $150,000, and the output for the year 1904 at about $17,000.

The steep grade of the lower part of the creek has allowed little accumulation of alluvium, but in the upper part the deposits have reached a depth of 12 to 30 feet, of which gravel forms the lower 4 or 6 feet. The gravels are angular and largely composed of diabase with well-washed quartzite bowlders from the bench gravels through which the stream has cut.

In the gravels are many bones of bison, musk ox, mammoth, and horse. A very fine specimen of the skull of *Bison alleni*, with the shell still upon the horns, was taken out of Mr. Donald McLean's claim, No. 25, near the head of the creek, by Mr.

McLean and Mr. Thos. Evans. This is the only specimen of this species that has been reported from Alaska. It was carefully removed and is now in the National Museum at Washington. Some teeth obtained by Mr. C. W. Peck from gravel next to bed rock on the same claim and referred to Dr. T. W. Stanton for identification were called by him "horse teeth of Pleistocene or more recent age."

Mining.—There are twenty-nine 500-foot claims upon the creek, numbered from the mouth upward, the upper 9 or 10 of which are said to have paid wages or more upon working. The pay streak is 30 to 60 feet wide and 1 to 6 feet thick, averaging probably 3 feet, but gold is sometimes found through the whole thickness of the gravel. The gravels were reported to carry $10 per square yard on one claim, which is probably the highest value on the creek, the values on other claims running down to amounts too small to pay for working.

The gold is similar to that of Little Minook Creek, mostly smooth and bright with a little that is rough. It is generally coarse and chunky, nuggets sometimes reaching 3 ounces in weight. The larger part of the gold is undoubtedly reconcentrated from the high bench of Minook Creek. The small amount of rough gold has probably had its origin in the bed rock.

The gravels have been mined by drifting with steam points, but advantage was taken of the wet season of 1904 and some ground sluicing was done in gravel and muck 16 feet thick. Trees and brush in the lower part of the creek were cleared away in preparation for further ground sluicing. The cost of mining by drifting is 50 per cent or more of the output, but as there is so little water it has been the only feasible mode of work. The creek is considered to be nearly worked out.

HOOSIER CREEK.

Hoosier Creek flows into Minook Creek from the east side between 5 and 6 miles from the Yukon. It is a stream of about the same volume as Hunter Creek and has a valley of about the same gradient and general section, but it shows no sign of the bench that appears along Hunter Creek. Like Hunter and Little Minook creeks, its course bends to the left upon entering the area of the high bench of Minook Creek, although in a less degree.

The production of Hoosier Creek is unknown. There is assigned to it but $500 in the table (p. 169), $227 of which was in one nugget. Other small amounts have been taken out, but the production has not been large, and it has been almost impossible to thoroughly prospect the creek on account of live water in the gravels.

The bed rock is similar to that of the other creeks cutting the bench. Quartz veins up to 18 inches in width occur in the diabase, and there is some pyrite distributed through the rocks. The alluvial deposits vary in thickness from 6 to 15 feet, of which 1 to 9 feet is gravel, averaging probably about 6 feet, and 1 to 10 feet is muck, averaging perhaps 6 or 7 feet. There is thought to be a pay streak about 100 feet wide whose length coincides with the distance the creek flows through the high bench, but the gravels of the valley are broader than those of the other creeks described, and with the live water the pay is hard to locate.

Two miles above the mouth of the creek a hydraulic plant has been installed and had just gotten in shape to begin work at the end of the season of 1904. A combined ditch and flume 4,300 feet in length delivered 500 miner's inches of water under a head of about 80 feet. A hydraulic elevator is used to dispose of the tailings.

FLORIDA CREEK.

Florida Creek is only about 2 miles long, lying in the high bench of Minook Creek about 2 miles south of Hoosier Creek. Ordinarily it is dry during the summer and fall. The gradient of the stream is high and the valley narrow. The bed rock is almost entirely of diabase. The alluvial deposits are narrow, but in places reach a

depth of 15 or 20 feet. Nuggets up to $33 in value have been taken from the creek, but so far as known not more than a total of $2,000 has been obtained, though the stream has been well prospected. The first prospect showed up so well that miners at once located the whole of the creek, and a number of good cabins were erected on the different claims. Some ground sluicing was done on the lower part of the creek during the season of 1904, but no other work was done.

ORIGIN OF THE GOLD.

The great difference in the richness of the several creeks flowing through the high bench of Minook Creek, and the variation in the richness of claims and size of nuggets on the same creek within the limits of the bench, show that the gold is not evenly distributed through the gravels of the bench. Thus Hunter Creek has so far shown no rich claims, while Little Minook Creek has been very rich in places, and along the latter the gold is very coarse on the upper claims but grows much finer toward the mouth (Pl. VI, j, k, l, p. 38), showing that probably the larger part of the gold in the lower portions of the stream has been washed down from the upper claims. The gold in the bench gravels was probably concentrated from local gold-bearing zones in the rocks worn away above the level of the high bench. How great a thickness of these rocks was disintegrated and carried away can not be told, but there may have been many hundred feet. The rocks were probably the same as those now forming the bed rock. The gold in the bench gravels is said to be well worn, but gold found in the gravels of a stream as large as Minook Creek is generally well worn, and in this case we have no clue as to the length of time through which wearing may have continued.

OTHER TRIBUTARIES OF MINOOK CREEK.

RUBY CREEK.

Ruby Creek flows into Minook from the west side about 9 miles from the Yukon. It is a stream carrying 300 to 500 miner's inches (7.5 to 12.5 second-feet) of water, with a grade of about 150 feet per mile in the lower part. In this part the valley is broadly V-shaped, with steeply sloping sides. The upper part was not seen.

The first pay was taken out of the creek in 1901, and the total product is said to have been $13,000 or $14,000, although this estimate may be a little high. About $5,000 was reported during 1904. No pay has been found above 1½ miles from the mouth of the creek, but it is claimed that no holes have been sunk to bed rock on account of the live water in the gravel.

The bed rock is the calcareous schist, garnetiferous mica-schist, carbonaceous slate, chert, and grit, intruded by greenstones (diabase?). The bedded rocks strike almost north and south across the creek with the dip downstream (east). The alluvial deposits are 6 to 10 feet thick and 300 to 500 feet wide. In some places there is almost no muck and nowhere is its depth more than about 4 feet. The gravels are 5 to 7 feet in thickness and the total thickness of muck and gravel is 6 to 10 feet, averaging nearer the lower figure. No large chert or quartzite bowlders are seen as in the creeks cutting the high bench. There are some gneiss pebbles, which indicate the probable presence of gneiss on the creek. The gravel is comparatively fine but contains a few bowlders a foot or more in diameter.

The gold is all on bed rock and is distributed through the whole width of the gravels. The only gold seen came from a point about one-half mile above Minook Creek. It was somewhat iron stained and in general rougher than the gold of the creeks cutting the high bench. The larger pieces were very smooth, but the smaller pieces were rough and most of the gold is rather flat. The gold is said to be rougher in the claims below. Nuggets up to about 2 ounces in weight are obtained. In the concentrates with the gold are large quantities of garnets that sometimes reach 1 inch

in diameter. A handful of garnets was obtained from a pan of dirt. There are so many of them that they give considerable trouble by filling up the spaces in the riffles and must be cleaned out once or twice a day. Some barite is said to be present, and an occasional silver nugget appears, one weighing 2 ounces having been reported. The silver nuggets are very rough.

It seems likely that the origin of the gold is in the local bed rock, which along this part of the creek is a carbonaceous slate of irregular cleavage. In places much pyrite is distributed through it. The creek has been worked during the summer by open cuts and in the winter by drifting, but it has probably paid little, if anything, more than wages. Preparations were being made to install a hydraulic plant, and a mile of steel pipe, consisting of 720 feet each of 20, 19, 18, 17, 16, 15, and 14 inch pipe with branches of 11-inch pipe for an elevator, and 7-inch pipe for a giant, was to be put in. It was said that it would deliver the water under a head of 154 feet.

SLATE CREEK.

Slate Creek, a western tributary of Minook Creek, about 12 miles from Yukon River, is about 4 miles long and is said to always carry at least a sluice head of water. It has a grade in the lower portion of about 150 feet to the mile, and the valley is narrowly V-shaped.

The creek has been worked only since 1902. Freights from Rampart are 8 cents per pound in summer and 4 cents per pound in winter.

The bed rock in the lower part is much-folded shaly limestone, green and purple slates, and cherty beds, with a northeast strike. The main rock of the valley is a dark graphitic schistose slate which breaks into pencil-like fragments and contains many quartz seams. Most of the work has been done nearly 2 miles above the mouth by drifting in the winter. The deposits here are 26 feet thick.

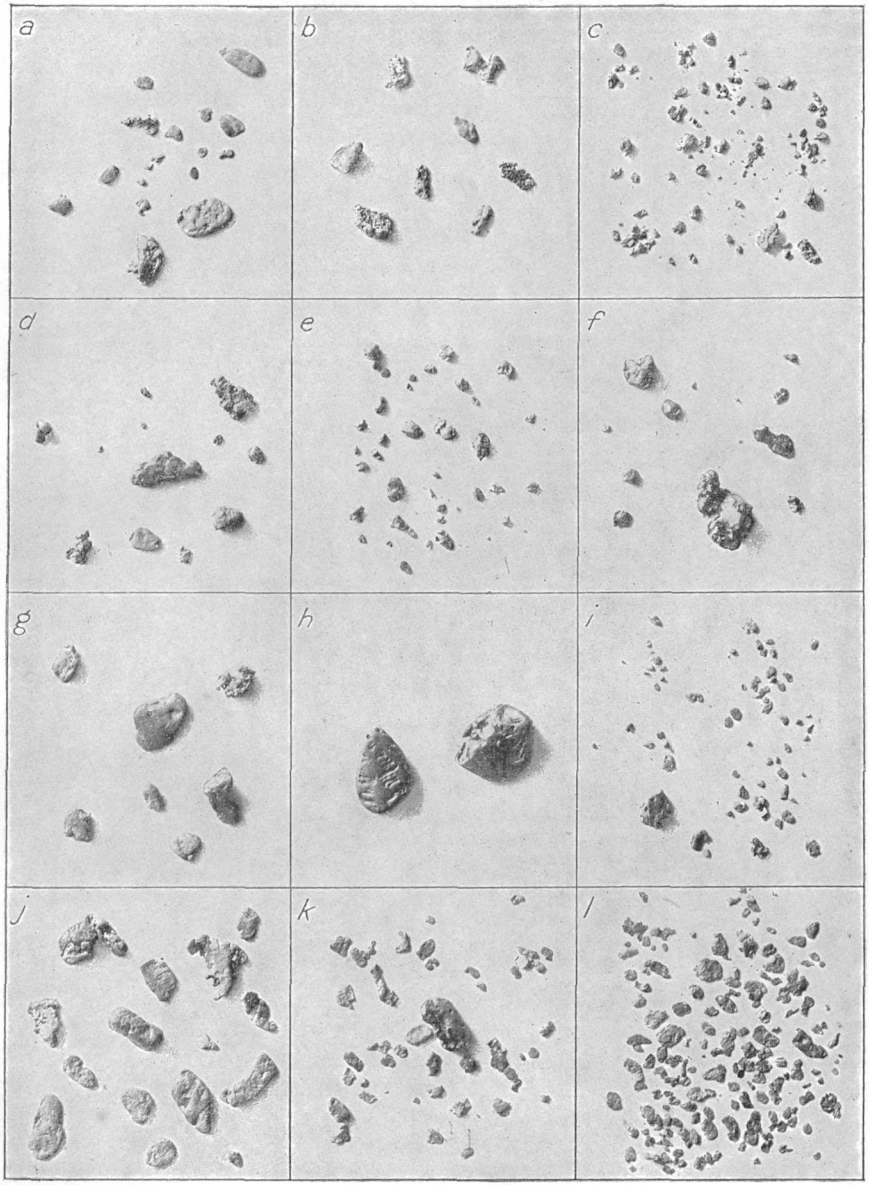
Gold is found in as much as 3 feet of gravel and to a depth of 1½ feet in bed rock and over a width of 50 feet. An $8 piece is the coarsest thus far taken out. Silver is a common associate (Pl. VI, b), and an 8-ounce nugget has been found. Copper also is said to occur in the gravels. The absence of garnets indicates that the schists of Ruby Creek do not extend into the valley. The gold in this case has probably been derived from the small stringers common in the bed rock.

THE BAKER CREEK GROUP.

GENERAL DESCRIPTION.

The Baker Creek diggings are situated from 28 to 32 miles by trail almost south from Rampart, and occupy a narrow belt with a northeast-southwest extension of about 9 miles. Along Baker Creek itself there have been no placers discovered so far, all at present known being on the tributaries flowing from the divide separating the Minook and Troublesome drainages from that of Baker Creek. The principal diggings are located along Pioneer, Eureka, Glenn, Gold Run, Omega, and Thanksgiving creeks.

The topography is strikingly different from that of the other two areas. Baker Creek flows along the southwestern side of a large flat, 7 to 9 miles broad in its widest part, and perhaps 10 miles long, its longer extension being northeast-southwest in the line of flow of Eureka and Hutlina creeks. Instead of sharp canyon-like valleys the streams flow through open valleys, and where they flow in general parallel to the Baker-Minook divide—that is, approaching a northeast-southwest or an east-west direction, the southern bank is steep while the northern one is gently sloping, the creeks flowing close to the steeper side. Even along the broad Baker Flats this feature is still prominent. The north side is a long gentle slope toward the divide, rising more sharply in its upper part, while across the flats the southern side may be seen rising abruptly from the valley floor.



GOLD SPECIMENS.

a. Gold from Discovery claim, Hunter Creek.
b. Native silver from Claim No. 10 above, Slate Creek.
c. Gold from Shirley bar.
d. Gold from Claim No. 1 above, Thanksgiving Creek.
e. Gold from Claim No. 3 above, Thanksgiving Creek.
f. Gold from Claim No. 11 above, Omega Creek.
g. Gold from Seattle bar.
h. Gold from Discovery claim, Doric Creek.
i. Gold from What Cheer bar.
j. Gold from Claim No. 8 above, Little Minook Creek.
k. Gold from Claim No. 3 below, Little Minook Creek.
l. Gold from Claim No. 4 below, Little Minook Creek.

All the specimens are natural size.

The main streams of the Baker Creek gold area are: Eureka Creek, lying next to the Baker-Minook divide, flowing southwesterly for about 5 miles, then turning to the south; Pioneer Creek, flowing parallel to Eureka between 1 and 2 miles to the southeast and joining it on Baker Flats; Rhode Island Creek, flowing in a southerly direction, about 1½ miles west of Eureka Creek; and Omega Creek, in the western part of the gold area. Into these creeks flow all of the smaller creeks of the area along the Baker-Minook divide. The streams are all small, many of the smaller ones being ordinarily dry during the summer and fall. The gradient of the larger streams is comparatively low and it is with difficulty that water is carried to the benches.

The only practical trail to and from the Baker Creek area is from Rampart along Minook Creek, a trail that in most parts of "the States" would be considered practically impassable during the summer time. Most of the way it is soft and miry. The pack horses sometimes sink to their girths, floundering and wallowing their way through. As a choice, there is the bed of Minook Creek along which, if the creek is not too high, the horses can make their way on the bars and through the icy water; but at best this trail is hard on the animals. The foot traveler can not take the creek bed, and if he carries a pack, as he often does, he must make his way along the mucky trail. Over this trail all provisions for the camps are carried. Freight rates, until the summer of 1904, were 25 cents a pound in summer and 6 cents in winter, and it is said that one man had to pay freight on 47 pounds of "grub" and 53 pounds of box and packing at the higher rate. During the summer of 1904 freight rates came down to 15 cents a pound, but the packers declared they could make nothing at that rate, and this is probably true, as hay and oats when cheapest are $100 a ton. There is another trail to the mouth of Baker Creek, but it is said to be bad and is not used.

Lumber is high, most of it being shipped from the States of the Pacific slope. Some is whip-sawed along Baker Creek in the winter, which costs about 20 cents a foot, board measure. It would seem that a small sawmill operated through a portion of the year would be a paying investment, as there is said to be plenty of timber along Baker Creek for local needs.

The total production of the region is estimated to have been about $406,100, of which $84,700 was produced during the winter of 1903–4 and $61,300 during the summer of 1904. These figures are probably under rather than over the actual amount.

Gold was discovered in the Baker Creek area on Eureka Creek, where mining was begun during the winter of 1898–99 and a small amount was taken out. On Glenn Creek gold was discovered in July, 1901, on the benches along Pioneer Creek in 1902, on Thanksgiving Creek in February, 1903, and other discoveries were made during the summer of 1904. Prospecting is in active progress in other valleys of the vicinity, and it is altogether possible that new discoveries may be made.

The rocks of the Baker Creek group show less variety than those of the Minook Creek group. In the gold-bearing region the rocks are schistose arkoses with interbedded slates and with quartzites, the latter in thin strata, generally 1 to 3 feet thick. Both slates and schistose beds are generally graphitic. The strike is northwest and the dip about vertical. No igneous rocks occur except along the top of the divide, where there are some dikes and masses of a monzonitic rock. Quartz occurs generally only in small veins, and these are not prominent. In places there is a considerable amount of pyrite in the rocks in small crystals and grains, but no large masses or veins have been seen.

THE CREEKS AND BENCHES.

EUREKA CREEK.

General description.—Eureka Creek, on which gold was first discovered in this area (in February, 1899), flows southwestward along the foot of the Baker-Minook divide. It runs in a straight southwest course for about 4½ miles, then turns and runs south 2½ miles to its junction with Pioneer Creek. It has a number of small tributaries from the northwest side, but none from the southeast. The largest is Boston Creek, about 2 miles long, which joins Eureka Creek at its bend. The other tributaries are mere rills. Eureka is a small creek carrying barely a sluice head of water above the mouth of Boston Creek during the ordinary seasons. From aneroid barometer readings the gradient of the stream is about 100 feet per mile. The valley slopes gently to the divide on the northwest side, but on the southeast side the slope is almost precipitous, rising 400 to 600 feet above the valley. The creek flows close to the foot of the steeper side.

The gravels of the creek are not much worn, as is characteristic in weak streams, and have been left for a considerable distance, in places at least 500 feet, up the slope of the hill as the stream bed has moved to the southeast. The bench gravels, like those of the present stream bed, are made up entirely of the country rocks. The deposit varies in thickness from 5 to 18 feet, and the overlying muck varies from nothing to 8 feet, the distribution being rather irregular. The total thickness varies from 5 to 20 feet. The gravel contains a considerable amount of very sticky clay, which makes sluicing difficult. The clay seems to come from the decomposition of both the arkose and the slates.

Mining.—Only one claim above and one below the mouth of Boston Creek have so far been made to pay, but prospectors on the bench gravels about 2 miles above the mouth of Boston Creek reported that they had found gold in sufficient quantities to pay for ground sluicing, if not for drifting. On this part of the bench it is 8 feet to bed rock near the creek, and 450 or 500 feet back from the stream it is 20 feet. The elevation above the creek at this distance, as shown by the aneroid barometer, is 70 feet.

The gold is said to be in the lower 18 inches of gravel and in a foot of bed rock. Along the creek the bed rock is largely blocky, and in it gold is found to a depth of 3 feet; but it is not found at such depths where the bed rock decomposes into clay. The gold may be distributed through the gravels to a depth of 4 or 5 feet, but it is generally close to bed rock, which must be scraped.

The larger part of the mining has been done by drifting, but on Discovery claim, just below the mouth of Boston Creek, an open cut is being worked. The muck and upper gravel are ground sluiced through sluice boxes, so as to save any fine gold that may be in them, and the lower gravel is shoveled in. Fifty-seven 12-foot boxes are used, 37 of which contain pole riffles and 2 contain Hungarian riffles. The lower boxes are lined with sheet iron to facilitate the movement of the gravel. Some gold is probably carried off by the sticky clay in spite of the length of the sluice box.

PIONEER CREEK.

General description.—Pioneer Creek heads against the Baker-Minook divide, flows around the head of the Eureka, and then, at a distance of 1 to 2 miles, flows parallel to the main course of that creek. After traversing 7 or 8 miles it joins Eureka Creek and they are said to lose themselves on Baker Flats. Pioneer Creek is larger than Eureka Creek; probably it never carries less than three or four sluice heads of water, and its gradient along its lower course is about 60 feet per mile. The valley is similar to that of Eureka Creek. Its northwest side is a gentle slope running back for about a mile, and the southeast side is of almost precipitous steepness, but not so high.

On the gentle slope of the northwest side there are perceptibly flatter places or benches, but only one of these is persistent. This bench is traceable along Pioneer Creek for over 4 miles. Its northeast end is but little above the present level of the creek while its southwest end is about 250 feet above the creek. Over this bench and covering much of the slope below is a deposit of auriferous gravel left by the creek as it moved to the southeast. The different diggings upon it are known as "bars."

Five small tributaries, Doric, Boothby, Seattle Junior, Skookum, and Joe Bush, flow across this bench at right angles to the course of Pioneer Creek. Near the upper end of the bench at Joe Bush Creek prospect holes showed a well-defined old stream channel. Upstream the bench rises so that a ditch supplying water to What Cheer Bar is below the workings at Seattle Bar, but crosses the bench and is on the upper side when it reaches What Cheer Bar. There can be no doubt that the bench is of stream origin.

Like many other Alaskan creeks Pioneer Creek was staked and then each man waited for his neighbor to do the hard work necessary to locate the pay streak, if there were one. Meanwhile the claims lapsed and were then restaked by other parties, and pay was discovered on What Cheer Bar in 1902. After this discovery pay was found on Doric Creek and at several other points along the bench.

The production of Pioneer Creek Valley to the end of the summer of 1904 was about $35,800.

The bed rock is the same as on Eureka Creek, schistose-arkose, with interbedded slates and thin beds of quartzite. The arkoses sometimes become very graphitic, particularly on Doric Creek. The general strike of the rocks is N. 70° or 75° E., with a steep northerly dip. There is some quartz in small veins and stringers, and on Doric Creek at places there is considerable pyrite distributed through the rocks. The pyrite is often oxidized, so that only small holes lined with iron rust indicate its former presence. On Doric Creek inclusions of a carbonaceous substance the size of a walnut occur with small quartz seams. Little is known of the alluvial deposits along the creek bed. The deposits on the gentle slope already referred to are 3 to 12 feet thick. They consist of the usual muck and gravel, and extend over 2,000 feet back from the creek.

What Cheer Bar.—What Cheer Bar is located in the lower part of Pioneer Creek Valley, about a mile from Eureka Creek, 2,000 feet from Pioneer Creek, and 250 feet above the latter. The season of 1903 was spent in putting in about 4 miles of ditch, with the necessary flumes. This ditch carries about three sluice heads of water to the upper edge of the workings. The ground is excellent for ditching, compared with other Alaska localities, for there is little ground ice and the soil is tenacious enough to make good banks. The bed rock is much jointed and broken and exhibits fine examples of creep, the rock leaning downhill and gradually blending with the gravels.

The average depth to bed rock is about 12 feet. The overlying material is composed of 1 to 1½ feet of muck, 3 feet of rather fine flat wash, 5 feet of medium-sized yellowish gravel, and 3 to 4 feet of rather heavy wash, including some bowlders of vein quartz 2 feet or more in diameter. There are some bowlders of conglomerate similar to that found in Quail Creek, in Troublesome Valley, and it is probable that beds of it outcrop on the headwaters of Pioneer Creek. Most of the gold is found in the lower part of the gravels and the upper 1 or 2 feet of bed rock. It is well worn and bright (Pl. VI, i, p. 38), and probably comes from the bed rock in the vicinity. The largest nugget found weighed somewhat less than 2 ounces and was worth $28. It contained considerable quartz. The gold is taken in trade at $15.50 per ounce.

The muck and upper gravel are ground sluiced and the lower gravel and upper bed rock shoveled in. The water could not be used until August 15, and only fifteen days were available for washing. Fifteen men were employed.

Seattle Bar.—Seattle Bar is about 2½ miles farther northeast on the same bench, on the northeast side of Seattle Junior Creek, and about the same distance back from Pioneer Creek as What Cheer Bar. Pay was discovered here in the spring of 1904. The depth to bed rock is about 9 feet and the bed rock and gravel are similar to those of What Cheer Bar. The gold occurs in the lower foot of gravel and the upper foot or more of bed rock. It is bright, chunky, and well worn. Some of it is rather flat, but all is easily saved. The largest nugget obtained was worth $9.40. Water is obtained for sluicing by a ditch and hose from Skookum Creek, which in a dry year will furnish but a scant supply.

Doric Creek.—Doric Creek is a small tributary of Pioneer Creek about three-fourths mile above What Cheer Bar, and is dry most of the summer and fall. It has an open valley, at its greatest depth probably not over 50 feet below the level of the bench. Gold was discovered here in 1902, and in the winter of 1903–4 a portion of the valley about one-fourth mile from Pioneer Creek was found to be very rich. As with other weak streams its wash shows almost no wear, but there is also a large amount of more rounded gravel from the bench through which it has cut.

Only one claim has produced much gold. Some pay was found on the lower part of the next claim above, but none in the upper part. The richness of the deposit is probably due to the reconcentration of the gold from the gravels of the bench. The ground is worked by drifting during the winter, and the largest bowlders are left in the drifts. It is worthy of note that a large degree of the success obtained in locating this claim was attributed to the remarks upon concentration in the Survey report on the Nome region,[a] which apply with much force to many of the deposits of the Rampart region.

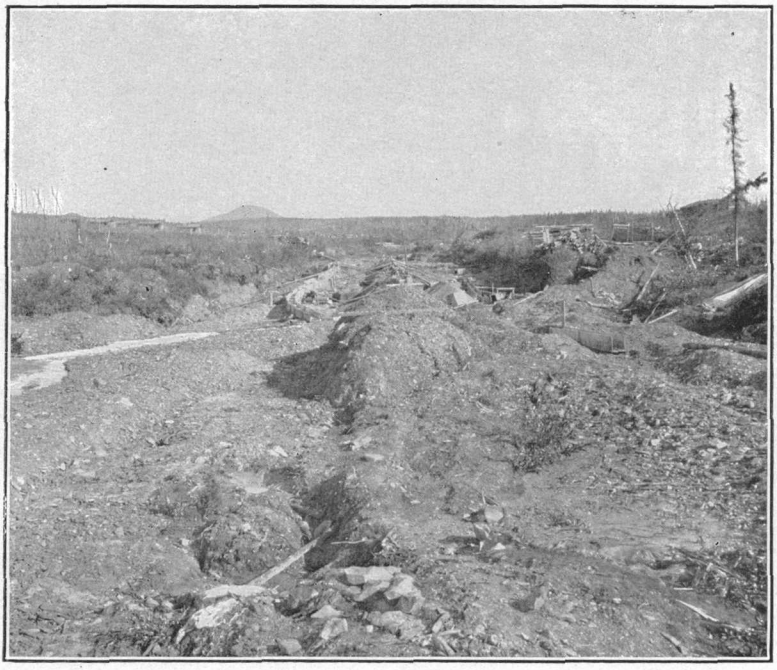
Other bench gravels.—A mantle of gravels similar to that which covers the gentle slope on the northwest side of Pioneer Creek bends around a spur from the divide on the west side of Eureka Creek and continues to Omega Creek, a distance of about 2½ miles. Beyond this point it has not been traced. In the space described the gravels are cut by Glenn Creek, Gold Run, Rhode Island Creek, and Seattle Creek.

SHIRLEY BAR.

The bench gravels have been prospected at many places and shown to carry gold, but at only one point outside of the creeks crossing them have they proved sufficiently rich to pay for working. This place, known as Shirley Bar, is located between Glenn Creek and Gold Run. It is at an elevation of about 200 feet above the lower workings on Glenn Creek, and was first worked in the fall of 1901. The bed rock is the same schistose arkose, slate, and quartzite. The wash is small and subangular, with a few quartzite bowlders and some monzonitic rocks from the divide above. The gravel varies in thickness from 2 feet at the lower side of the claim to 7 or 9 feet in the middle and 5 feet at the upper end. The gold is bright, rounded, and "shotty," well distributed through the gravel, and, though it seems strange, the nuggets come from near the surface. There are few large pieces of gold, the largest nugget taken out weighing a little over 1¼ ounces.

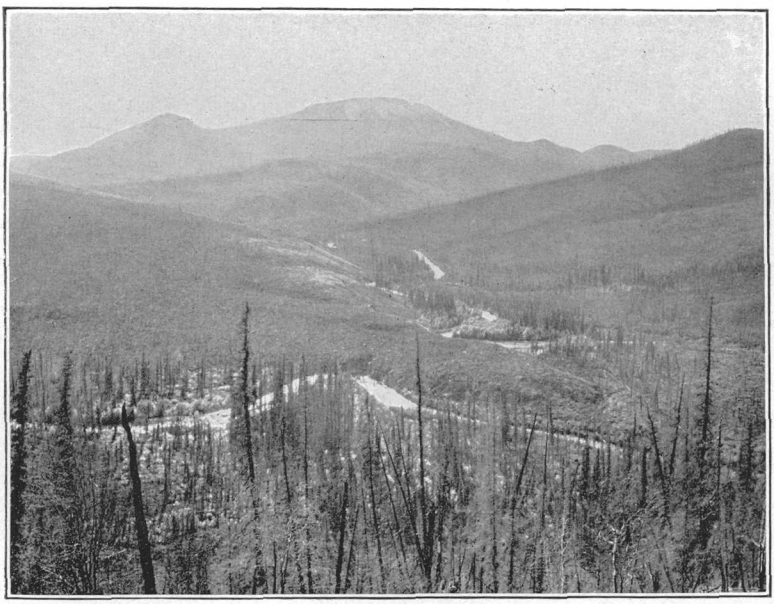
A ditch from Rhode Island Creek, 1 mile long and capable of carrying 2 sluiceheads of water (about 100 miner's inches), has been dug; but water is so scarce that it is collected in a pool after being used and pumped back to the sluice boxes. For this purpose a 30-horsepower boiler, two twinned 4-horsepower upright engines, and a 4-inch centrifugal pump are used. Seven men have been employed on the claim during the season.

[a] Brooks, A. H., and others, Reconnaissances in the Cape Nome and Norton Bay Regions, Alaska, in 1900; a special publication of U. S. Geol. Survey, 1901, pp. 149–151.



A. VALLEY OF GLENN CREEK.

Looking north, showing sluices, etc.



B. VIEW WESTWARD UP QUAIL CREEK FROM THE EAST SIDE OF TROUBLESOME CREEK.

Wolverine Mountain in the background.

GLENN CREEK.

General description.—Glenn Creek is located about 1 mile west of Eureka Creek, and flows across the bench gravels. It is about 3 miles long, running almost south down the slope from the Baker-Minook divide. The valley is shallow and open (Pl. VII, *A*), probably not over 50 feet below the bench. It is practically dry during ordinary summers, but during the wet summer of 1904 it carried water sufficient for sluicing.

Gold was discovered on Glenn Creek by Messrs. Beardsley, Belsea, and Dillon in July, 1901. The total production up to the fall of 1904, according to the most reliable information obtainable, had been about $277,500, not including the output of one claim known to have produced a considerable amount. During the year ending with the fall of 1904 $50,500 is known to have been produced, and this again does not include some smaller outputs. Of the 1904 output $11,000 was obtained by drifting during the winter of 1903–4 and $39,500 during the summer of 1904.

The bed rock is similar to that on the other creeks. The alluvial deposits are 7 to 9 feet thick and are in large part composed of the angular fragments usually found in so weak a stream, with rounded material from the bench through which it flows. There are occasional small bowlders of monzonitic rock from the divide above.

The quartzite interbedded in the softer slates has given rise to a peculiar condition in the gravels of the lower part of the creek. On claim No. 1A a section of the gravels shows about a foot of muck under which is a discontinuous layer of angular quartzite blocks 8 to 10 inches thick and 2 feet or more broad, showing no water wearing. Under these is a thickness of about 2 feet of washed gravel and fine broken slate lies below this upon vertical strata of slate which strike about northeast. These angular blocks of quartzite on top of the gravel have been very puzzling. It is likely that they are to be explained by the supposition that the creep, which acts very strongly here, has broken down a thin bed of quartzite that can be seen on the side of the claim, and as the creep has moved the gravels the blocks of quartzite have been broken off and have crept with the gravels.

Mining.—The pay seems to have been mostly, if not wholly, in that part of the creek which cuts the mantle of gravel covering the hillside. The pay streak is said to vary in width from 50 to 100 feet. In places it was very rich; one pan taken by the writer gave about $3.75. Many pans of $10 and upward were said to have been taken. At one place fine gold could be seen all through the broken slate. On this claim the pay was in the lower 3 feet of gravel and 2 feet of the bed rock. A plat 20 by 48 feet yielded $4,000 to 4 men working three and one-half days.

The gold is bright, clean, generally worn, and fine, but "shotty" and easily saved. Such nuggets as are found generally contain considerable quartz. The largest nugget found weighed nearly 6 ounces. It was bright, clean, beautiful gold, and showed the impression of large quartz crystals. It is said to assay a little over $16 per ounce.

A small ditch 1 mile long brings about a sluice head of water from Rhode Island Creek. Another ditch dug to bring a sluice head or more from Boston Creek was just ready to use when freezing began in the fall of 1904. An average number of 24 men are said to have been employed during the year. Some drifting is to be done this winter (1904–5), but it is said that most of the ground fit for drifting has been worked out, the remaining pay gravels being too shallow to give a good roof. The creek is probably more than half worked out.

GOLD RUN.

A creek, about 1½ miles long, flowing into Rhode Island Creek 1 mile west of Glenn Creek, is called Gold Run. It carries little water at any time and is practically dry during the summer and fall. The valley is shallow and open and the lower part

is cut through the gold-bearing gravels covering the extension of What Cheer Bar. The creek was staked in the spring of 1899 and the first work was done during the winter of 1900–1901. There are six claims, each 500 or 1,000 feet in length, upon the creek, but only the lower four have so far been producers. The total production during the winter of 1903–4, as reported by the miners, was about $16,000, not including the output of one claim, which was probably small. The production of former years is estimated at about $9,000.

The bed rock of the lower part of the creek is a graphitic schistose arkose, which in places becomes slaty. The rather well-rounded gravels are of slate, quartzite, and grit, 16 to 18 feet deep, with a covering of about 2 feet of muck. The creek is difficult to work on account of the live water in the gravels. Through part of their length the gravels are frozen on the bottom and thawed for several feet above, so that drifts must be timbered throughout. The pay frequently goes down into the bed rock 3 or 4 feet.

The gold is generally bright, fine, and somewhat worn. One nugget weighing nearly 4 ounces has been taken out. When poured out of a sack[a] or pan part of it rolls almost like shot, owing to its rounded form. This characteristic is common to a large part of the gold of the Rampart region, but particularly so of this area, and is due to its crystalline form. The crystal faces are often observable on the pieces. The placers of the creek are probably derived largely from reconcentration of the gold from the gravels of the bench through which the creek has cut its course, and in part from the local bed rock. The creek is probably more than half worked out.

RHODE ISLAND CREEK.

Rhode Island Creek is somewhat larger than Gold Run and heads nearer the top of the ridge. Its general conditions of bed rock, gravel, etc., are similar to those of Gold Run, below the mouth of which Rhode Island Creek flows close against a bluff on its western side, while its eastern side rises more gently.

Considerable work has been done on the creek, but during the summer of 1904 no claims were worked. The output is unknown. Miners on other creeks are of the opinion that the gravels would pay for working if water for hydraulicking could be obtained.

SEATTLE CREEK.

Seattle Creek, although the longer stream, is called a tributary of the Rhode Island. It probably carries less than a sluice head of water during an ordinary season. The bed rock in the lower part is graphitic schistose arkose. The gravels contain bed-rock fragments, quartzite, vein quartz, and graphitic slate, and are rather fine. They are said to be 8 to 30 feet thick and covered with 1 to 3 feet of muck. They are well frozen and have no live water. About $100 was taken out in the course of prospecting during the winter of 1903–4. The gold is said to be bright, fine, and shotty. Prospecting was to be continued during the winter of 1904–5.

BENCH WEST OF RHODE ISLAND CREEK.

A spur on the west side of Rhode Island Creek, similar to the one on the west side of Eureka Creek, has a well-defined bench cut upon it, extending about one-half mile to Omega Creek Valley. The bench is about 300 feet above the bed of Rhode Island Creek and is covered with subangular gravel, through which gold is said to be found. It is about on a level with Shirley Bar.

OMEGA CREEK.

General description.—Omega Creek, another small stream, heads in a ridge about 2 miles southwest of the head of Minook Creek and about one-half mile west of Seattle

[a] Known among miners as a "poke."

Creek, flows almost south for one-half mile or more, and then swings gradually to the west. As soon as it takes a westerly course the shape of its valley becomes similar to that of Eureka Creek, having a steep hill on the south, against which the stream flows, and on the north side a gentle slope to the ridge above, rising more steeply in its upper portion.

Gold was discovered in Omega Creek in 1899, but the first pay was found in 1901. The creek has been worked in only a small way, and the production has been small. The bed rock is a black, fissile, much-broken slate, and a yellowish, somewhat schistose arkose. It has a strike of N. 70° E., with a high northerly dip. The gravel is about 7 feet deep, very angular and fine, and is made up of the country rock with a small amount of quartzite. There is little or no muck over the gravel, but there is a sticky clay through it which probably carries off some of the fine gold.

Values and mining.—The pay is known to extend for about 1 mile down the creek from a point due west of the mouth of Seattle Creek. The width of the pay is unknown. One cut 30 feet wide has been taken out, and it is known that the pay extends to both sides, rising on a low bench on the right (northwest). This cut is at the upper end of the pay streak. The gold is distributed through the gravel both top and bottom. It is "shotty" and coarse, and much of it is very rough. Many pieces show crystal faces, and all the larger pieces and many of the smaller pieces contain quartz. In color the gold is more brassy than most of the gold of the region. A great many small crystals of pyrites occur in the concentrates with the gold. So far the claim has been worked only by an open cut, but some of the gravel was thought to be deep enough to be workable by drifting and this method was to be tried during the winter of 1904–5. The water supply is small and a dam has been put in to collect the water so that sluicing can be carried on about half the time during an ordinary season.

CHICAGO CREEK.

Chicago Creek is a small rivulet flowing down the northern slope to Omega Creek about 2½ miles west of the mouth of Seattle Creek. Pay was reported to have been discovered near its mouth during the summer of 1904, and it was the intention to work it during the winter.

THANKSGIVING CREEK.

Thanksgiving Creek is a small tributary of Omega Creek, between 4½ and 5 miles west of Eureka Creek. It occupies a shallow, open depression in the southern slope of the ridge, on the north side of Baker Flats, and can hardly be said to have a valley in its lower part. It is almost dry in the summer and fall. Gold was discovered on it in February, 1903. The combined output of Omega and Thanksgiving creeks has been about $18,200.

The bed rock is exposed only in the diggings, but where seen was a yellowish, somewhat schistose arkose. The gravel varies in depth from 6 to 18 feet where the creek is worked, though it is said to be deeper farther downstream. It is composed of subangular pieces of quartzite, schistose arkose, vein quartz, slate, and a small amount of monzonitic rock. The overlying muck is 1 to 4 feet in thickness.

The gravel is peculiarly mixed with a sticky yellow clay, which in places seems to be half ice. In some of the deeper holes there is 10 feet of this mixed clay and ice. It can not be worked with wood fires, for when melted it runs down upon the fires and quenches them. In open cuts the sides when melted move together like a mass of yellow tar. In some of the holes the section is said to show 10 to 12 feet of finely mixed yellow clay and ice, of which 5 feet is fully half ice and below this there is 6 feet of subangular gravel. The pay streak varies in width from 25 to 45 feet, and is 1½ to 9 feet thick. Gold is sometimes distributed through the yellow clay and colors always occur through the mixture of clay and ice. At one place where

the pay is found through 7 feet of the ice-clay mixture, when the mass is thawed the pay sinks to the lower 4 feet. If the clay is dried it is difficult to part the gold from it, and at one claim, on which open-cut work was progressing, angular pieces of sheet iron like saw teeth were driven into the poles used in the sluice boxes to break up the clay. The iron pieces were left projecting about three-fourths of an inch, and 25 were used to a 6½-foot pole. The device is said to work well.

The gold is generally rough and somewhat iron stained, but some of it is smooth, bright, and "shotty." Some "black sand" is said to be with it in the concentrates. Mr. R. H. Wright picked out 8.48 ounces of the smooth, bright gold, and the United States Assay Office at Seattle gave it a value of $15.64 per ounce. In it there were 1.68 ounces of silver and 0.4 ounce of impurities; 32.03 ounces of the gold as it came from the sluice boxes contained 6.38 ounces of silver and 2.41 ounces of impurities, and had a value of $15.17 per ounce. Each assay gives about 20 per cent as the silver content of the gold.

Water for sluicing is brought from Eureka and Chicago creeks, but the supply is scanty. The probabilities are that the production of gold upon Thanksgiving Creek will increase considerably, but as in most of the diggings of the Baker Creek group more water is needed.

HUTLINA CREEK.

Hutlina Creek is a large tributary of Baker Creek, several miles southeast of, and having a generally parallel course to Pioneer Creek. As seen from Glenn Creek its valley and that of its principal tributary are shaped similarly to those of Pioneer and and Eureka creeks, and prospectors confirm this impression. A stampede to the Hutlina occurred in 1902, and it is reported that colors and occasionally good prospects were found, but live water in the gravels prevented their being worked without machinery. The bed rock is said to be similar to that of Pioneer Creek. At the time the Geological Survey party left Rampart, September 20, 1904, several prospectors were going into the valley with tools and provisions to prospect the benches during the winter.

WATER FOR HYDRAULICKING.

A large part of the gravels of the creeks and benches of the Baker Creek area, while they will not pay for shoveling in, would probably pay for working if water for hydraulicking could be obtained at a reasonable cost. But, as has been said, the creeks of the region are small and furnish hardly enough water for ordinary sluicing operations.

Miners say that Hutlina Creek would furnish plenty of water for hydraulicking, but the distance it would have to be carried is variously estimated at 8 to 15 miles. Were water brought from this creek it would have to be piped through a large part of the distance to retain the head. In connection with hydraulic mining in this region the writer can do no better than quote the remarks of Mr. L. M. Prindle[a] upon the subject:

Outlook for hydraulic mining.—The installation of a hydraulic plant in any of the placer regions of the Yukon-Tanana country involves the expenditure of an amount of money several times in excess of that required for similar work in the States and should be preceded by much careful preliminary study of all the conditions. The transformation of available water supply into a powerful tool of excavation and transportation and the use of this tool in the most skillful and efficient manner are among the most important problems of mining. Lack of knowledge and skill may be covered by the results where the ground is very rich, but with ground like that under consideration the possession of these qualities or the lack of them may make all the difference between success and failure. Directors and stockholders of companies planning such work should insist upon and be constantly ready to bear the expense of the intelligent study of conditions and careful management of operations.

[a] Prindle, L. M., and Hess, F. L., The Rampart placer region, in Report on progress of investigations of mineral resources of Alaska: Bull. U. S. Geol. Survey, No. 259, 1905, pp. 104–119.

GENERAL CONCLUSIONS.

The rocks of the Baker Creek area are interbedded schistose arkoses, slates, and quartzites, with the arkoses forming the larger part. The arkoses and slates are often graphitic. Igneous rocks were found only along the crest of the divide, and not in large quantity. When compared with the Klondike or the Nome gold-producing regions, the small amount of metamorphism and mineralization and the scarcity of quartz veins and stringers are very noticeable.

The source of the gold is probably local, and the richer placers are generally in the vicinity of graphitic phases of the rocks. There is frequently reconcentration from older gravels where the streams cut across gravel-covered benches and hillsides. The gold, though generally close to bed rock, is sometimes distributed through a considerable thickness of gravel and muck. It often occurs in small crystals, and is thus shotty and chunky and easy to save. Large nuggets are rare. It contains a large amount of silver, so that its value per ounce is much lower than that of the gold of the Minook Creek area, running from $14.88 to a little over $16. There are few minerals accompanying the gold, a little pyrite, magnetite, and hematite being the only ones noticed.

The creeks are all small and some have been half worked out or more, but new deposits have been discovered each year and more will probably be found. Water for working the claims is scarce, and, although some ground which will not pay for shoveling in would probably pay for hydraulicking under favorable conditions, water in adequate quantity and under a sufficient head can not be obtained without considerable expense. One of the greatest needs is a good road from Rampart, and until that is made supplies must continue excessively high.

THE TROUBLESOME CREEK GROUP.

GENERAL DESCRIPTION.

The Troublesome Creek group is situated between the arms of the Y formed by the divides separating the drainage basins of Minook, Baker, and Troublesome creeks. It is 18 or 20 miles southeast of Rampart. Troublesome Creek, rising among the hills east of Wolverine Mountain, flows northeast to Hess Creek, a tributary of the Yukon. The tributary valleys are often narrow and shut in by hills with steep sides and ridges, closely resembling each other, and making traveling so difficult that the country has come by its name honestly.

So far pay dirt has been found upon two creeks, Quail and Gunnison, though colors are found through the gravels over a wide area.

The rocks include all the varieties present in the Rampart formation, but slates are characteristic of the upper valley and greenstones of the lower. The slates have been intruded by a variety of igneous dikes. The creeks have cut benches upon the hills, but to a less degree than in Minook Valley.

CREEKS PROSPECTED.

QUAIL CREEK.

Quail Creek heads opposite Hoosier Creek and flows eastward into Troublesome Creek, having a length of between 5 and 6 miles (Pl. VII, *B*, p. 42). A large branch known as South Fork joins Quail Creek about a mile above Troublesome Creek. Between the two branches is a gravel-covered bench 400 feet high, upon which colors have been found, and which is being prospected. Parts of this bench occur at various places farther up Quail Creek. On the north side of Quail Creek is another bench about 50 feet above the creek, and this too is being prospected. In one hole bed rock was reached at 29 feet. There were 19 feet of muck and 10 feet of well-washed gravel. Colors were found all through the gravel, but no pay.

A number of igneous dikes which cross the lower part of Quail Creek show considerable mineralization by metallic sulphides. An assay of a porphyry gave no gold, but 0.52 ounce of silver[a] per ton.

The creek was located in 1898, and it is said that it was desired to call the stream "Ptarmigan" Creek, but as no one in the party could spell ptarmigan it was named "Quail," the spelling of which was easier. Some gold is said to have been taken out in that year, and a little was taken out during the summer of 1904. The total is thought to be about $3,300.

There seems to be a considerable accumulation of gravels at some places, while at others the bed rock rises to the surface. The gravels are of the country rock, with many bowlders of porphyritic granitoid rocks.

A number of miners were fixing up old cabins and building new ones, and getting ready to prospect the creek during the winter.

GUNNISON CREEK.

Gunnison Creek is located a few miles farther down Troublesome Creek on the same side as Quail Creek. Miners are said to have worked upon it during the summer of 1904, and to have taken out some gold, but no further particulars were learned. The creek was not visited by the Geological Survey party.

GENERAL SUMMARY.

The alluvial deposits formed from the rocks of the valleys in which the deposits occur are found both in stream channels and on benches, and are probably all of stream origin. They are of Recent and Pleistocene age, and their thickness is generally near 5 feet, but varies from 5 to 100 feet.

The gold is generally found in the lower 2 or 3 feet of the gravel and upper 1 or 2 feet of the bed rock, but on Shirley Bar and Omega Creek it is in places distributed through the whole depth of the gravel, 5 to 7 feet, and on Omega Creek the gold is found not only in the gravel but through several feet of intimately mixed ice and clay.

The placers are of two general types as regards their origin, placers of ordinary concentration from the disintegration and wearing down of the bed rock, and placers formed through reconcentration of the gold in older gold-bearing gravels by the cutting of streams. The bench gravels of the region and the placers of Ruby and Slate creeks belong to the first class. To the second class belong the placers of the creeks cutting the high bench of Minook Creek and the placers of Doric, Glenn, and Seattle creeks and Gold Run. The other placers of the region probably belong to the first class, although there may be some reconcentrated gold in Thanksgiving and Quail creeks.

The gold of the reconcentrated placers is generally smoother and brighter than that from the others, contains less quartz and iron, owing to abrasion and oxidation, and is thus higher in value per ounce, though the higher value of the gold of the Minook group is principally due to its containing less silver than the gold of other creeks. There is much crystallization in the gold, particularly of the Baker Creek group, where the gold contains a large percentage of silver. It is notable that along Minook Creek, where the gold contains so little silver, native silver nuggets are found in the placers, while in the Baker Creek group, where the placer gold contains about 20 per cent of combined silver, there are no silver nuggets. The only other minerals known in the concentrates with the gold are hematite, a small amount of magnetite on Thanksgiving Creek, pyrite, garnets on Ruby Creek, barite on a few other creeks, and copper on Hunter, Little Minook, and Slate creeks.

In all cases the matrix of the gold has probably been in the immediate neighborhood of the placers, though it may be the result of the concentration of many hun-

[a] Burlingame, E. E., & Co., Denver, Colo.

dreds of feet of bed rock. There seems to be no indication that the gold has been derived from any great "mother lode," and it has probably come from comparatively small veins distributed through the country rock.

All of the creeks at present known to be gold bearing to a paying extent, except Slate and Ruby creeks, take their rise in the Minook-Baker-Troublesome divide. Along this divide are dikes of monzonitic, dioritic, and acid igneous rocks, and it may be that these were associated with causes that introduced gold-bearing solutions into the rocks. The large mass of diabasic rocks in the Minook group may have been related in some way with the mineralization of that area.

As to the origin of the silver and copper nuggets with the gold in the creeks of the Minook group, little can be said. On all the creeks in which they are found, except Slate Creek, both limestones and diabases occur. On Slate Creek diabase was not seen, although there is much of it on Ruby Creek. It is likely that the silver and copper nuggets come from the oxidation of contact minerals resulting from the diabasic intrusions.

The average depth of gravel worked is probably between 10 and 20 feet. The gravels are mostly frozen, but much trouble in working them is sometimes had on account of live water. Hydraulicking has been introduced and apparently works well in the frozen gravels. This form of mining will probably become of considerable importance in the Minook Creek group wherever plenty of water and head are obtainable. In the Baker Creek group the expense of obtaining water for hydraulicking seems to be very much greater, though data are lacking. There is much gravel in this group, which can probably be worked at a profit only by this method. In the Troublesome country there is plenty of water, with sufficient fall for hydraulicking in that valley.

The following tables give the most important statistical data of the Rampart region and include the total gold production, so far as ascertainable, up to the fall of 1904:

Distances, men employed, and freight rates of Rampart region, 1904.

Name of diggings.	Distance from Rampart.	Number of men employed.	Freight rates.	
			Winter.	Summer.
	Miles.		*Cents per pound.*	*Cents per pound.*
Minook Creek				
Hunter Creek	3	15	2	4
Little Minook Creek	4½	30	2	4
Little Minook Junior Creek	5	10	2	4
Hoosier Creek	6	7	2	4
Florida Creek	8			
Ruby Creek	9	10	3	6
Slate Creek	11	5	4	8
Eureka Creek	28	40	6	15
Bench bars	30		6	15
Doric Creek	30		6	15
Glenn Creek	30	24	6	15
Gold Run	31	10	6	15
Seattle Creek	31		6	15
Omega Creek	32	3	6	15
Thanksgiving Creek	34	10	6	15
Quail Creek	20	5	6	15-20
Total		169		

Gold production of Rampart region to fall of 1904.

Name of diggings.	Winter of 1903–4.	Summer of 1904.	Total, 1904.	Previous to 1904.	Total to fall, 1904.
Minook Creek	.....	.....	.....	$10,000	$10,000
Hunter Creek	$3,000	$3,000	$6,000	18,000	24,000
Little Minook Creek	40,000	2,900	42,900	443,200	486,100
Little Minook Junior Creek	17,000	.....	17,000	133,000	150,000
Hoosier Creek	500	.....	500	1,500	2,000
Florida Creek	.....	.....	.....	2,000	2,000
Ruby Creek	3,000	2,000	5,000	8,500	13,500
Slate Creek	12,000	3,000	15,000	.....	15,000
Eureka Creek, Bench bars, Doric Creek	45,500	16,500	62,000	23,300	85,300
Glenn Creek	11,000	39,500	50,500	227,000	277,500
Gold Run	16,000	.....	16,000	9,000	25,000
Seattle Creek	100	.....	100	.....	100
Omega Creek, Thanksgiving Creek	12,100	5,300	17,400	800	18,200
Quail Creek	.....	500	500	2,800	3,300
Total	160,200	72,700	232,900	879,100	1,112,000

INDEX.