GOLD DEPOSITS NEAR VALDEZ.

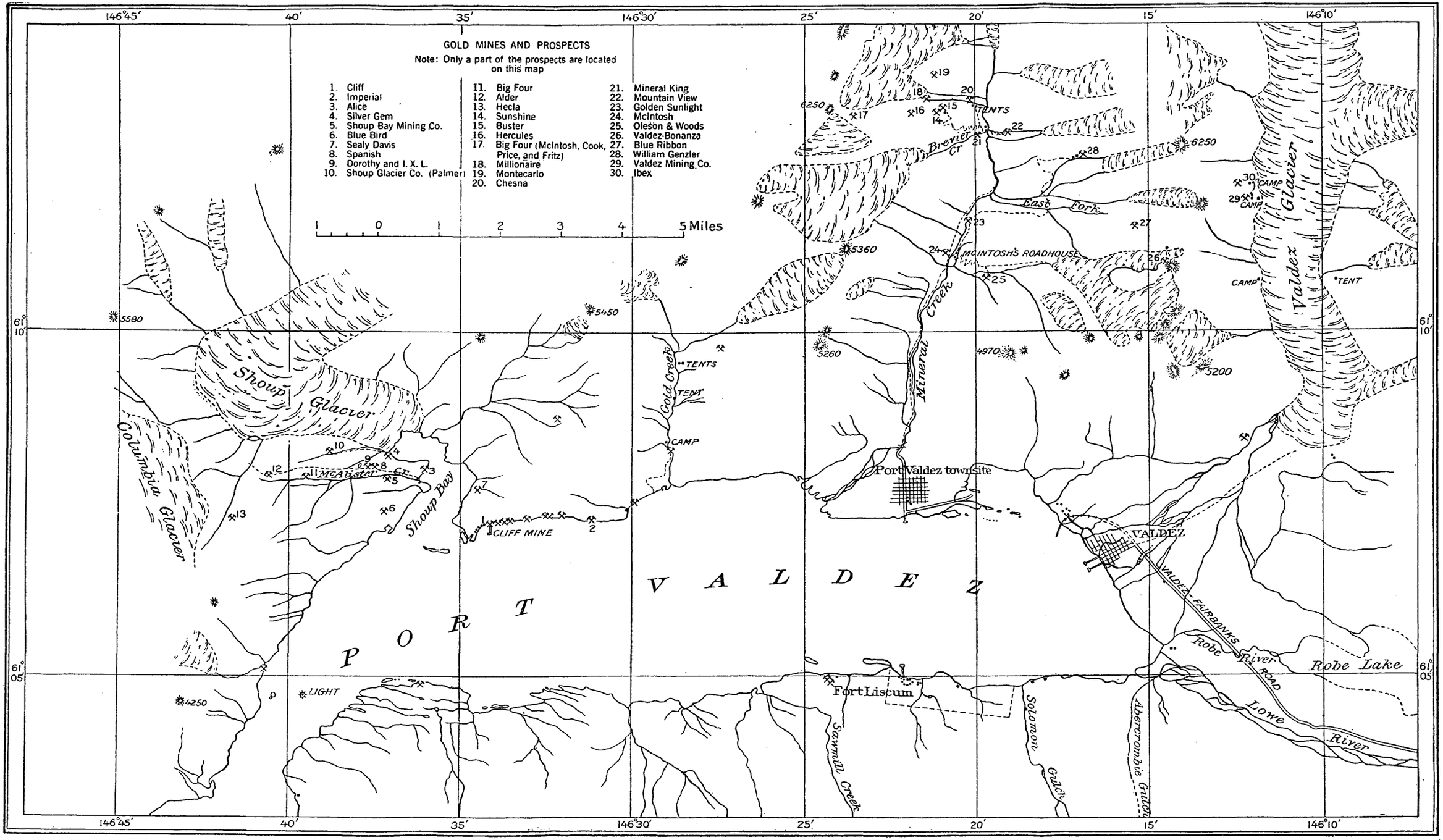
By ALFRED H. BROOKS.

INTRODUCTION.

As early as 1898 some of the streams tributary to Port Valdez were known to contain auriferous gravels, which had been mined in a small way. In spite of this evidence of auriferous mineralization, as well as that suggested by the presence of quartz veins stained with iron, the Valdez district for many years received relatively little attention from the prospector. The thousands who joined in the mad rush over the Valdez Glacier during the Klondike excitement paid no heed to the possibility of finding mineral wealth in the region which they rapidly traversed on their way into the interior. Many of these gold seekers must have passed in sight of the quartz vein outcropping on the north shore of the inlet which 12 years later was developed as the Cliff mine. A few men, however, persistently kept up the search for gold quartz, and some veins were staked as early as 1898, but as they remained undeveloped, definite proof of the presence of workable ore bodies in this region was lacking. The Cliff mine became productive in 1910 and proved a very profitable mining venture. Its success very greatly stimulated prospecting by local miners and also attracted the attention of nonresidents, who quickly recognized the possibility of developing here a new auriferous lode district. As a result, several hundred lode claims were staked and considerable development work was undertaken during 1910 and 1911. These activities first centered in the region immediately adjacent to Port Valdez, but later both the eastern and western extension of what was believed to be an auriferous belt received attention. The search for auriferous lodes was carried westward to Columbia Glacier and later to Port Wells and eastward along the Valdez-Fairbanks road.

In 1910[1] the writer paid a brief visit to the Cliff mine and also obtained sufficient data about the mining advancement at other localities to be convinced that an immediate detailed survey of the district was justified. As an accurate topographic base map is the

[1] Grant, U. S., and Higgins, D. F., Reconnaissance of geology and mineral resources of Prince William Sound, Alaska: Bull. U. S. Geol. Survey No. 443, pp. 72–75, 1910.



MAP OF REGION NEAR VALDEZ.

first requisite to a study of the geology and mineral resources of any region, a topographic survey of what was then believed to be the most important part of the Valdez district was made by J. W. Bagley, assisted by C. E. Giffin, in the summer of 1911. A map based on these surveys is now in preparation. It was impracticable to make the geologic survey during the same season, but in view of the great interest taken in this field by the mining public, it seemed imperative to make at least a preliminary study of the district.

The ten days devoted to this purpose were sufficient only to collect some random notes on the geology and to visit about 25 claims out of the several hundred which had been staked, none of which was exhaustively studied. Therefore those who expect to find a description in this report of all the many properties in this region, or even a comprehensive account of any one property, will be disappointed. Four days were spent on the west side of Shoup Bay and in the adjacent inland region, five days in the Mineral Creek basin, and two days on the west side of Valdez Glacier. This distribution of time made it possible to visit some of the typical occurrences of auriferous lodes as well as most of the best developed properties. Unfortunately, it was possible to see none of the properties in the Columbia Glacier region, on the east side of Shoup Bay, in the Gold Creek basin, or on the shores of Port Valdez (except the Cliff mine), and only a part of those in the Mineral Creek basin.

Much information was obtained from the engineers, miners, and prospectors of the district, to whom the writer hereby expresses his obligations. Among the many who aided the work Eugene Allen, B. F. Millard, Thomas Blakeney, C. M. Nicholson, and M. M. Reese deserve special mention.

This report could not have been prepared if the results of the previous work in this field had not been available. F. C. Schrader studied the geology of Prince William Sound in 1898, and again, in association with A. C. Spencer, in 1900, and in 1905 U. S. Grant and D. F. Higgins traversed the same field in greater detail and in 1908 and 1909 made still other observations. References will be made to the published reports of these investigations. In addition to these reports the unpublished notes of these geologists have been freely drawn upon.

GEOGRAPHY.

SHORE FEATURES.

The town of Valdez, to which the mining district here described is tributary, is located at the head of Port Valdez, a northeastern arm of Prince William Sound. (See Pl. VI.) Port Valdez is one of the many deep fiords that penetrate the mainland of this part of Alaska. It has a lenticular outline, trends about east and west, is about 12½

miles long, and averages about 3 miles in width. It is connected with Prince William Sound by a passage only a mile wide. The fiord averages over 100 fathoms in depth and, except at its head, is deep close to the land. Much of the larger part of the shore line is remarkably even, long stretches being almost unbroken straight lines. Shoup Bay is a small indentation on the northwest shore of the inlet, and several other minor indentations form small coves, notably along the southern shore line.

Throughout most of the inlet the land rises abruptly from the water or from a narrow, rocky beach. An exception is found in the broad gravel floor lowland that sweeps around the east end of Port Valdez. This lowland has been formed by the merging of the deltas of the streams draining Valdez Glacier with the delta of Lowe River. There are also some gravel flats at the mouths of other streams tributary to the bay. Of these the one at the mouth of Mineral Creek, embracing abut 1½ square miles, is the largest.

MOUNTAINS.

Port Valdez occupies a depression in the southern part of the rugged Chugach Mountains, which form a barrier trending east and west between the sea and the Copper River basin. The main range lies north of the inlet, south of which is a less rugged mass, forming a spur, separated from the main range by the bay and by the valley of Lowe River. The mountains north of Port Valdez and adjacent to it include an irregular aggregate of sharp pinnacles connected by narrow, steep-walled ridges and broken by numerous amphitheaters of glacial origin. The summits of these mountains vary in altitude from 4,200 to 6,300 feet. The mountains to the south form a part of a well-defined range, which constitutes the watershed between Port Valdez and Jack Bay. Here the slopes are less abrupt and the summits are more rounded than those in the northern mountains, and the extreme altitudes are only 3,000 to 5,400 feet above the sea.

DRAINAGE.

The region contains many small streams that flow down the mountain slopes in narrow gulches and also some large streams that occupy deep-cut U-shaped valleys. Most of the streams tributary to Port Valdez are less than 3 miles long. Many of the large watercourses head in glacial cirques and some spring directly from ice fronts. The typical valleys have steep walls and narrow floors, which descend with steep gradients to the sea.

Lowe River is the largest stream in the district. It rises on Marshall Pass, 25 miles east of the bay, flows through a steep-walled valley, and discharges into the east end of Port Valdez. Near its mouth a number of streams that flow over a broad flood-plain from

Valdez Glacier, which lies to the northwest, about 5 miles from tidewater, also flow into the bay. Mineral and Gold creeks, Solomon Gulch, and several other streams flow through gravel-filled basins that are connected by stretches of box canyons. Several of the streams, of which Mineral Creek is the best example, are sharply deflected to the west on approaching the sea.

GLACIERS AND GLACIATION.

Valdez Glacier, which is fed by snow fields far back in the Chugach Range and debouches on the gravel plain at the head of Port Valdez, is the largest ice mass of the region. Second in size is Shoup Glacier, which also reaches far back into the mountains and discharges into Shoup Bay. Many other small glaciers, which also lie north of Port Valdez, are drained by streams flowing into the bay. The great Columbia Glacier lies about 4 miles west of Port Valdez and discharges into the sea at Columbia Bay, a northern arm of Prince William Sound.

The present glaciers are but the disappearing remnants of an ice sheet that once filled Port Valdez and the tributary valleys up to an altitude of 3,000 or 4,000 feet. This ice sheet scoured deeply, and eroded many channels and waterways as well as the numerous cirques and U-shaped valleys. The topographic features of the region were well developed before this ice erosion, which, however, deepened and modified them.

VEGETATION.

Timber is rather scant except in part of the flat east of the head of Port Valdez, where there is a growth of spruce, hemlock, and cottonwood, some trees measuring several feet at the butt. Along the shores of the bay there is almost no valuable timber, though a scant growth of spruce and other kinds of trees is found up to an altitude of a few hundred feet above the sea. Good grass grows in the flats, where also some arable lands are found.

CLIMATE.

The climate of Port Valdez is characterized by cool summers with abundant rainfall and by winters which are cold but which have none of the extremes of temperature that are usually associated with Alaska. The records, though meager, indicate an average snowfall of about 12 feet. The total mean annual precipitation is about 75 inches. The data at hand indicate an average temperature of about 51° F. for the three summer months and 20° F. for the three winter months. An average of 176 days of rainy or snowy weather during the year is reported. Records covering two years show a minimum temperature of −14° F. in January and maximum of 79° in June.

GEOLOGY.

GENERAL CONDITIONS.

The Port Valdez region lies within the southern margin of the Chugach Mountains, which, so far as known, are made up of closely folded and faulted sediments, chiefly clay slates and graywackes, both schistose and massive, with some conglomerates. These rocks have been in part altered to phyllites and mica and quartz schists. In the northern part of the range there are also limestones. The axes of folding trend about east and west, and the dips are prevailingly to the north. Some igneous intrusives of various types cut these sediments.

For lack of detailed knowledge of the stratigraphic sequence within this great mass of sediments, which is probably in the aggregate many thousand feet thick, they have all been thrown together as the Valdez group.[1]

The Valdez rocks are believed to be unconformably overlain by another great series of sediments that are of similar lithologic types but that are less altered and include a lower member, made up of ancient volcanic rocks, which has been named the Orca. Intrusive igneous rocks cut the sediments of the Orca group. Grant and Higgins have mapped the boundary between the Orca and Valdez at the entrance to Port Valdez. The Orca group therefore does not occur within the area here under discussion.

The age of the Orca and Valdez rocks has not been determined, but they have been provisionally assigned to the Paleozoic and Mesozoic eras. G. C. Martin and B. L. Johnson in their recent work in the Kenai Peninsula found Mesozoic fossils in a slate-graywacke series that resemble the sediments of Prince William Sound. F. H. Moffit, in 1911, investigated the Bremner River region and there obtained evidence that rocks probably equivalent to the Valdez are of Carboniferous or early Mesozoic age.

Quartz veins are not uncommon in both the Valdez and Orca groups, and some of them are metallized. Some of these veins have long been known to carry gold, but before the Cliff mine was opened none had been exploited on a commercial scale.

SEDIMENTS.

The sediments of the Port Valdez region are chiefly slates and graywackes in proportions that vary greatly from place to place. Local variations from these dominant types include siliceous and carbonaceous slates and feldspathic quartzites.

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[1] Schrader, F. C., Reconnaissance of Prince William Sound and the Copper River district, Alaska, in 1898: Twentieth Ann. Rept. U. S. Geol. Survey, part 7, 1900, pp. 408-410. Schrader, F. C., and Spencer, Arthur C., The geology and mineral resources of a portion of the Copper River district: Special publication U. S. Geol. Survey, 1901.

Grant, U. S., and Higgins, D. F., Reconnaissance of the geology and mineral resources of Prince William Sound Alaska: Bull. U. S. Geol. Survey No. 443, 1910, pp. 22-24.

The weathered surface of the graywacke varies in color from light brown to gray, the brown usually indicating the presence of pyrite. A finely pitted surface is characteristic of the rock where it is exposed to weathering, but the pits are generally so small as to be distinguishable only with a lens. The rock cleaves irregularly and in the fresh fracture is gray or blue. Even the massive graywackes may show on the fresh fracture a minute banding caused by a parallel arrangement of the minerals. The graywackes are composed essentially of minute angular and subangular grains of quartz and feldspar embedded in a cement of quartz, mica, and chlorite. In many specimens, however, these minerals can be definitely recognized only with the microscope.

Many of the graywackes have been wholly or in part recrystallized. Some specimens are difficult to distinguish from igneous rocks except by microscopic analysis. Grant mentions graywackes that have been so altered as to become schists, but none of these was seen by the writer. These graywackes are of sedimentary origin and were probably deposited at a time when a large amount of material was furnished by the erosion of igneous rocks.

A common variation from the above type is a schistose graywacke; that is, one in which secondary cleavage has been developed. In some places this cleavage amounts only to an irregular system of fracturing; in others it is almost slaty cleavage. Another variation is a feldspathic quartzite, in which the percentage of quartz is increased at the expense of the feldspar. With the development of secondary structure the quartzite passes into a quartz slate, and with still greater alteration into a mica schist.

The graywacke occurs most commonly in alternation with beds of slate, but appears locally in masses aggregating in thickness at least several hundred feet. The data at hand indicate that such masses are large lenses in the graywacke and slate series rather than beds or formations that perserve their continuity over considerable areas.

The rocks here classed as slates are fine-grained argillites which have a more or less regular secondary cleavage. The weathered surface of these rocks is in places gray, but where the slate contains pyrite it is more often brown. On the fresh fracture it is gray-blue to black in color. In none of these rocks is the cleavage as perfect as that of roofing slate. In composition the slates are chiefly argillites, which are in places altered to phyllites by the development of muscovite along planes of foliation. Some of the slates are very siliceous, grading into slaty quartzites. These siliceous slates locally contain some feldspar, thus passing into slaty graywackes. At several localities the slates carry a large amount of carbonaceous material and are finely fissile, resembling a carbonaceous shale, but in all these slates the foliation seems to be a secondary structure. Many of the slates carry considerable disseminated pyrite.

Some belts of green chloritic shale found near the head of Mineral Creek seem to form an integral part of the sedimentary series. This rock is made up entirely of secondary minerals, and its original character has not been determined. Grant found similar rocks on the south side of Port Valdez and has suggested that they might be altered volcanic tuffs. Grant also found a belt of greenstone on the northwest side of the entrance to Port Valdez.

IGNEOUS ROCKS.

No outcrops of igneous rocks were examined in the district, but some crosscutting dikes were seen from a distance. One of these, in the Shoup Glacier region, was clearly visible and could be traced up the slope to the crest of the ridge for 200 to 300 feet. A similar dike was seen in the Mineral Creek basin. These dikes are almost white and contrast strongly with the gray sediments which they crosscut. What appeared to be material derived from similar intrusives was found in the débris of both Shoup and Valdez glaciers.

These intrusives are included in those termed by Grant[1] acidic dikes. The specimens collected from the glacial débris are fine-grained crystalline rocks, pale green to white in color. They appear to be altered porphyritic rocks in which the phenocrysts were probably feldspar. The groundmass seems to be chiefly feldspar, but the specimens obtained were so much weathered that no exact determination could be made of the original character of the rock. They can be provisionally termed diorite porphyries. Schrader[2] has noted the presence of dikes of granodiorite or aplite and diorite porphyry cutting the sediments of the Valdez group. He has mapped a large dike of granite near the head of Valdez Glacier and two smaller dikes of aplite on some small islands near Valdez. The latter have been studied by Grant and Higgins,[3] who also found some crosscutting dikes of diabase on the south side of the entrance to Port Valdez.

STRUCTURE.

The general trend of the bedrock structures is about east and west and therefore parallel to the axes of Port Valdez and the bordering mountains. On the south side of the bay strike lines measured by Grant vary from N. 70° W. to N. 70° E., but the average is about east and west. North of the bay the average strike line is about N. 70° E. The observed dips are almost entirely to the north, at angles varying from 45° to 80°. Minor folds observed at several localities indicate that the monoclinal dips are the result of com-

[1] Op. cit., pp. 47–48.

[2] Schrader, F. C., Reconnaissance of part of Prince William Sound and Copper River district, Alaska: Twentieth Ann. Rept. U. S. Geol. Survey, part 7, 1900, pp. 409–410.

[3] Grant, U. S., and Higgins, D. F., Reconnaissance of the geology and mineral resources of Prince William Sound, Alaska: Bull. U. S. Geol. Survey No. 443, 1910, p. 50.

pressed folds overturned to the south. The best indications of faulting observed were the evidences of the movements that formed the fissures in which the quartz veins were deposited. In the Shoup Bay region these fissures fall into at least two well-defined systems, one trending N. 40° to 60° W. and the other N. 20° to 40° E. The data at hand indicate that in the Mineral Creek region the fissuring is not so pronounced, but here also two systems can be recognized, one of them trending from N. 70° W. to east and west, the other from about N. 30° W. to N. 50° W. No measure was obtained of the extent of the movement along these fissures, but the facts that some can be traced for considerable distances and that many show slickensides and much crushed material indicate that it was considerable.

A later period of deformation is shown by faulting of some of the quartz veins which occur in the fissures already described. The only examples of this faulting which could be measured showed displacements not exceeding 3 to 5 feet. There is, however, some evidence of more extensive faults. In the outcrops seen the cleavage of slates and slaty graywackes was mostly parallel to the bedding. Some exceptions to this were noted, and the observations were not sufficient to establish any general law. In some localities there is a well-marked system of jointing, which trends about N. 10° to 30° W. These joint planes, being lines of weakness to erosive agencies, are marked in places by steep-walled gulches on the hill slopes. A second system of jointing, which trends about N. 20° to 30° E., was noted. Quartz stringers were seen along some of these joint planes, and the joints may represent the results of the same epoch of movements as do the fissures.

The facts stated indicate that the bedrock has undergone at least three periods of disturbance. During the first, which was the period of greatest movement, the folding that gave the sediments their present structures took place. At a later date there was a period of deformation during which the fissuring occurred. After the fissures had been filled with quartz there was another and probably minor disturbance, which faulted some of the quartz veins.

AREAL DISTRIBUTION OF ROCKS.

Although the field observations are insufficient for the preparation of a geologic map, they indicate that the sediments of the region occur in more or less well-defined belts, each of which is characterized by the dominance of one kind of rock or association of rocks. Thus, in certain areas the rocks are predominantly graywackes, with subordinate amounts of slate; in others they are chiefly slate, with but little graywacke; and in still others they consist of graywacke and slate in about equal proportions. These lithologically similar areas, as would be expected from the dominant structure, form belts

trending east and west. It is probable that these belts will be the basis for geologic mapping at some future time, when it will be determined which represent distinct formations and which represent duplications brought about by folding and faulting.

In extent of areal distribution the slate-graywacke belts dominate in the region. According to Grant's notes this association of sediments characterizes nearly the entire south shore of Port Valdez, both sides of the entrance, and the west shore as far north as Shoup Bay. Grant has noted that a belt of slates skirts the shore of the bay east of Fort Liscum. The strike of these slates would carry them into the Lowe River Valley, where there is a pronounced development of slate.

On the north shore of Port Valdez slates appear to dominate, but for the most part they have been considerably altered. At the Cliff mine the slates are highly silicified, and near the mouth of Mineral Creek secondary mica has been developed, so that the rocks are properly termed "phyllites." Grant reports that mica schists occur on the small islands lying between Mineral Creek and Valdez. These are to be regarded as a more highly metamorphosed phase of the slate. The slate and phyllite belt at Mineral Creek is about 2 miles wide, but includes some bands of graywacke. It is bordered on the north by a belt of graywacke and slate, which appears to be the same one observed on the west side of the lower part of Valdez Glacier.

The northern boundary of the graywacke-slate belt has not been determined, but considerable slate is found about a mile southeast of McIntosh Road House, and the slates occurring near the Valdez-Bonanza property and near the Valdez and Ibex properties on Valdez Glacier are probably in the same belt. Half a mile north of the Valdez-Bonanza is a series of massive graywackes, which probably bound this slate belt, but have not been traced to the east or west.

The bedrock of the upper part of the Mineral Creek Valley above the mouth of the East Fork is chiefly slate, with some bands of graywacke.

Slates and graywackes in many alternating bands occur on the west side of Shoup Bay. Between McAllister Creek and Shoup Glacier slates dominate. These slates are bordered on the north by massive graywacke, which attains a thickness of several hundred feet. Slates are found again north of this graywacke. Greenstone and chloritic schists were observed by Grant on the south shore of Port Valdez, a mile west of Fort Liscum, where they are in part interbedded with slates. Chloritic schists were also found east of Mineral Creek Road House and 2 miles north of it, along the main stream. The evidence at hand indicates that the greenstone schists are limited to small areas and do not extend for any considerable distance along the strike line.

MINERAL RESOURCES.

OUTLINE.

Up to the close of 1911 one auriferous lode mine, the Cliff, had been developed in the district, and a little gold ore from other properties had been treated at a customs mill erected at Valdez in the fall of 1911. A shipment of copper ore is said to have been made from a chalcopyrite deposit which has been developed on Solomon Gulch since the writer's visit. The only other productive mining in the district consists of the exploitation of some gold placers at various times during the last 10 years. These operations were, however, on only a small scale, and the output was insignificant.

CHARACTER OF ORE DEPOSITS.

The gold-ore deposits of the district that give promise of commercial importance are all fissure veins; that is, they are fillings of fissures or fractures in the country rock. A variation from this type, though of the same genesis, is seen in mineralized zones of fracture that have no well-defined walls. Local pyritization of the country rock is also not uncommon in the district, and it is not impossible that some gold deposition accompanied this action, but even if this is proved there is no evidence that the rock contains commercial ore bodies of this type.

In some parts of the district the fracturing is pronounced, and individual fissures can be traced for long distances. In the region adjacent to the west side of Shoup Bay, for example, two well-defined systems of fissures are recognizable, one striking about N. 10° to 40° E. and the other N. 40° to 60° W. In addition to the veins following these systems, there are veins that are nearly parallel to the bedding striking about N. 70° E., and others whose trend does not fall into any of these systems. The Cliff vein strikes about N. 30° W. and the others nearby are probably about parallel to it, though no definite measurement was obtained on any of them.

The system of fissuring in the upper Mineral Creek basin does not appear to be nearly as well defined as that at Shoup Bay. Observations were made in the upper Mineral Creek basin on eleven veins, five of which trended about east and west, two from N. 70° to 80° E., one N. 50° E., and two N. 20° W. So far as the observations go, they indicate that the prevailing strike of the veins is from N. 70° to 90° E. Too few observations have been made near Valdez Glacier to justify any deductions as to trend of fissures, but those made indicate one system striking about east and west and another striking about N. 30° W.

The fissures are mostly marked by a zone of brecciation and slickensiding. In many of the veins the fragments of country rock form much the larger part of the material included between the walls, the foreign matter brought in being very subordinate in amount. Slick-

ensides are almost everywhere present on one wall, with more or less gouge. In a few fissures slickensides were found on both walls. Some of the fissures are remarkably persistent for long distances. A number have been traced for more than a quarter of a mile, and there is good reason to believe that one or two have been identified at intervals for a mile to a mile and a half. Unfortunately the vein filling by no means shows such persistency. In several fissures which could be traced by slickenside and gouge for a long distance the vein matter practically gives out in a hundred feet or less. In some fissures the vein matter is in places almost entirely absent for considerable distances, and reappears farther along.

Any statement as to the thickness of the workable ore body in a field where only one productive mine has been developed can have little value, for workability is evidently dependent on the cost of mining and the amount of the valuable minerals in the vein. Most of the veins that have been staked are narrow, and though some larger veins have been found, few of them exceed 2 to 3 feet in thickness. The common impression among the miners of the district is that the promise of this field is in small, rich veins rather than in large deposits carrying lower values, and this view is justified by the facts in hand. Some of the lodes in the district, though they occur along lines of more or less well-developed fissures, seem to be very local accumulations of quartz. These masses of quartz are very irregular and seem to have no persistency along either the strike or the dip. As some of these have extensive outcrops and show a large content of gold, thay have given hopes of large workable ore bodies—hopes that were not realized when development was attempted. Some of these quartz masses are local swellings along veins which in their normal thickness may furnish workable ore bodies. Others are simply irregular masses of mineralized quartz whose continuation at depth or along strike is found only in very small stringers.

There is little evidence at hand regarding the continuity of veins at depth. Veins have been found at sea level and at altitudes of over 5,500 feet. This variation in the altitude of the veins and the fact that the rocks stand nearly vertical and the veins are cross-cutting indicate that the ore bodies are not confined to any particular level. At the Cliff mine the vein has been followed to a depth of 400 feet below its outcrop. There is therefore no reason to believe that the ore bodies will exhibit any greater irregularity at depth than they show along the strike line in their surface outcrops. Although many of the veins occur in fissures which are traceable for considerable distances, it is not to be supposed that all or even the larger part of the veins are of this character. Many of those located pinch out or disappear in a short distance along the strike or along the dip. On the other hand, some lodes have been discovered during underground exploration that did not outcrop and yet seemed to be well defined.

DISTRIBUTION OF ORE DEPOSITS.

Considerable prospecting has been done on the south side of Port Valdez, where some promising ore bodies are reported to have been found. None of these were examined, but they are said to be larger and of lower grade than those to the north. Be this as it may, the fact remains that most of the development work has been confined to the region lying north of Port Valdez.

The accompanying map (Pl. VI, p. 108), on which many of the most important prospects are indicated, shows that the area in which the ore bodies have been found lies in a belt paralleling the inlet and extending from Columbia Glacier on the west to and beyond Valdez Glacier on the east, a distance of about 20 miles. It should be added that prospects have been found both east and west of the area thus defined. The most northerly prospects within this area are those on upper Mineral Creek, which are about 8 miles from tidewater. It appears that the inland limit of the occurrence of ores, as above defined, seems to be determined by accessibility. Thus far the prospectors have extended their search only to the headwaters of the streams flowing into Port Valdez, rightfully regarding the region beyond, with its high ranges, as too inaccessible at present to permit the development of any ore bodies that might be found there. The gold-bearing area as thus outlined must in light of present knowledge therefore be regarded as a topographic province in which ores have been found rather than as a geologic province within which the conditions for the occurrence of mineral deposits are more favorable than they are elsewhere. The actual limits of the prospective mineral district will remain to be discovered in the future, when the knowledge of the geology is more nearly complete.

Little is known of the geologic association of the ore bodies thus far discovered. In view of the intimate relation[1] which exists in most of the Alaska metalliferous districts between the occurrence of ores and of igneous intrusives it is natural to look for similar relations in the Valdez district. Here, however, the evidence is largely negative. Intrusive rocks are by no means common in the areas examined, nor does the glacial drift indicate the presence of any large masses of intrusives in the high ranges to the north. The facts in hand do not warrant the conclusion that the mineralization of the district had any connection with igneous intrusion, but a detailed survey may show more intrusive rocks in the district than is now supposed. Gold ores have been found in the areas of slate, of slate and graywacke, and of graywacke. It appears, however, that the country rock adjacent to the ore bodies usually has a more or less well-developed cleavage. In other words, no promising ores have been found in the massive

[1] Brooks, Alfred H., Geologic features of Alaskan metalliferous lodes: Bull. U. S. Geol Survey No. 480, 1911, pp. 57-58.

graywacke. Beyond this fact there is no evidence of any direct relation between the lithology of the country rock and the occurrence of ore. On the other hand, it is to be expected that the various types of sediments found in the district may fracture in different manner and thus affect the continuity of the ore bodies. The data in hand are insufficient, however, to establish any generalizations concerning the character of the fractures in the different rocks.

CHARACTER OF THE ORES.

The mineralogy of the ores, so far as it is known, is simple. In most of the ores pyrite, gold, and argentiferous galena are the only metalliferous minerals recognized. Grant found some pyrrhotite and chalcopyrite in a small vein about three-quarters of a mile west of Fort Liscum. Chalcopyrite has also been found on Solomon Gulch, on the south shore of the bay. Arsenopyrite ores are reported from this part of the district. Pyrrhotite is said to occur on the Blue Bird claim, located near the west entrance to Shoup Bay.

The gangue mineral is almost entirely quartz. Microscopic analysis of many of the ores reveals the presence of some calcite, but in only a few places did this mineral form more than a small proportion of the gangue. Feldspar, chiefly albite, was observed in several of the veins which were studied under the microscope. The typical ore of the district is pyritiferous gold-bearing quartz, in many places carrying a little galena. Pyrite, always the most abundant metalliferous mineral, occurs both in granular aggregates and in small cubical crystals. The galena is present either in small isolated particles or in association with the pyrite.

In the unoxidized vein material visible free gold is relatively rare. When present it occurs in small filaments and particles. Most of the free gold observed was in the weathered portions of the vein, where it is associated with iron-stained quartz.

The quartz varies in color from white to bluish and in places is vitreous. Most of the veins show quartz crystals. In many veins are druses lined with crystals of vitreous quartz. The calcite, which was seen only under the microscope, occurs in small, irregularly outlined masses. The feldspar generally occurs in well-developed crystals. In some of the veins the feldspars constitute a surprisingly large percentage of the gangue material. Masses of country rock form a large proportion of the vein material in many of the lodes. These vary from horses several feet in diameter to small fragments which can be seen only under the microscope. The larger fragments, which show relatively less alteration than the small, are silicified, sericitized, and usually heavily charged with pyrite. Small veinlets of quartz forming networks through the fragments are common. The small fragments of country rock are in many places entirely recrystallized

and are made up of quartz mosaics, calcite, and sericite, with much pyrite.

Many of the veins are banded, dark and light layers alternating. These seem to be made up of bands of country rock consisting of quartz, mica, and pyrite, alternating with bands of quartz carrying pyrite and in many places calcite. Some veins that cut across carbonaceous rocks contain carbonaceous matter, probably graphite.

Most of the specimens of ore collected by prospectors are taken from the surface outcrops and show considerable oxidation, which does not seem to extend to great depth. At the Cliff mine evidence of oxidation was seen to a distance of about 100 feet from surface but was distinctly marked for only about half this distance. Oxidation of about the same depth was noted at the few other localities where observations were possible. In other places the decided decrease in gold at a depth of a few feet indicates that oxidation was in such places very superficial.

The important question of the gold content of the veins does not admit of a categorical answer. There has been relatively little sampling of a kind to yield definite information concerning gold values of the lodes of the district. Current reports indicate that the Cliff vein has averaged about $50 to the ton, mostly in free gold, with very little change in depth. The concentrates are said to run about 7 per cent and carry about $100 worth of gold to the ton. This is probably a fair measure of the gold content of the ores of the district, though many property owners report values ranging from $75 to $200 and even higher. It is needless to state that many veins carry very little gold—only $2 to $3 to the ton. Rich spots in some of these veins have misled prospectors who have not done careful sampling.

GOLD PLACERS.

Some of the streams of the Valdez district were known to carry auriferous gravels long before any workable quartz was discovered, but up to the present time there has been no important placer mining. The surface gravels on Mineral, Gold, and some other streams of the district have been sluiced in a small way, but their gold content was not high enough to warrant profitable exploitation by the simple methods used.

On Mineral Creek, Gold Creek, and in Solomon Gulch, as well as on some of the other streams, there are gravel-filled basins that seem to afford about the only hope for placer mining in the district. These gravels are known to be auriferous on the surface at least, but few, if any, attempts appear to have been made to test them to bedrock. A hydraulic plant which is being installed on Gold Creek affords presumptive evidence that the exploiters have made some tests of the extent and value of the alluvial deposits they propose to mine.

NOTES ON MINES AND PROSPECTS.

Cliff mine.—The following account of the Cliff mine is based on notes taken in 1910, when only the main level and workings above had been opened up, and on one very brief visit to the lower level made in 1911. The mine is on the north side of Port Valdez, about a mile east of the eastern entrance to Shoup Bay (Pl. VI, p. 108). An outcrop of the vein was discovered in 1909 in a cliff close to tidewater. The vein was subsequently found on a hill slope about 100 to 200 feet above, and has been traced probably over 600 feet and reported beyond. Since 1910 it has been systematically developed.

The country rock at the mine appears to be chiefly dark siliceous slate or phyllite, locally carbonaceous and with a blocky cleavage. This slate carries mica and in places is heavily charged with finely divided pyrite, which occurs in veinlets cutting the foliation and is also disseminated along cleavage planes. Slickensided surfaces occur along these veinlets, showing that there has been movement since the pyrite was formed.

The vein follows a well-defined fissure, which strikes from N. 30° to N. 45° W., probably averaging about 35°, and cuts across the foliation of the slate. At the outcrop and in the workings above the main tunnel it dips to the southwest at an angle of 50° to 70°, but exhibits some rolls. Throughout the mine workings, which now reach a depth of about 100 feet below sea level and extend for about 600 feet along the vein, the fissure is plainly recognizable, but in places the vein material is represented by only half an inch of gouge. Where mined the lode probably averages from 14 to 30 inches, but it locally widens to about 4 feet. In some places the lead is made up of a single vein of quartz; in others of a network of quartz stringers separated by masses of country rock.

A smaller vein, which has a course about parallel with the main lead and which is about 45 feet distant from it has been opened up on the lower level. The ore seems to be of about the same character as that of the main vein and is said to be of about the same value. There is some evidence that this may be an offshoot from the main vein.

The ore consists of bluish to white vitreous quartz, with inclusions of country rock. The ore contains pyrite in disseminated grains or crystals and some galena. It is free-milling, but gold visible to the naked eye is comparatively rare. Microscopic analysis shows that it carries some albite and some calcite.

The three-stamp mill which had been installed and successfully operated for about a year was burned in 1911. With characteristic energy the management at once began to erect a new mill of five stamps, which was completed and in operation before the end of the

year. Meanwhile mining was continued and the ore was shipped to Tacoma.

Several properties along the north shore of the bay east of the Cliff mine have been more or less developed. The most work has been done on the Imperial, about 2 miles east of the Cliff, where an adit tunnel has been driven in at sea level and an air compressor installed. The property was idle at the time of the writer's visit in September, 1911, and the underground workings were not examined. Judging by the direction of the adit, the vein appears to be parallel to that of the Cliff.

Shoup Bay and Columbia Glacier regions.—The Alice claim is located on a well-defined fissure on the north shore of Shoup Bay. This fissure trends about N. 62° W. and dips 70° to 80° S., crosscutting a series of interbedded slates and graywackes. It is traceable across a point to the water's edge, a distance of about 1,100 feet. The footwall side is well defined by slickensides and in places the hanging wall also shows similar evidence of movement. Only a little work had been done here at the time of the writer's visit, but the vein seemed to have a thickness of 7 to 22 inches. The vein material, which is heavily iron stained, consists of a mass of brecciated and silicified country rock cemented with pyritiferous quartz and carrying considerable visible free gold.

About half a mile northwest of the Alice claim there is another fissure, which trends about N. 10° W., and dips to the west at an angle of about 70° or 80°. This fissure is traceable from tidewater for over half a mile and its hanging wall side seems to be well defined and slickensided throughout this distance. The vein matter shows a varying composition and thickness, ranging from a few inches of crushed slate with but little quartz or other evidence of mineralization to 12 to 18 inches of quartz and slate fragments carrying pyrite and galena. This vein is said to carry very little gold, but it is reported to contain considerable silver. The Silver Gem claim is staked on the north end of this fissure, where an adit tunnel about 400 feet long has been driven. Some work has also been done by the Shoup Bay Mining Co. at a point more than half a mile to the south.

It is reported that a quartz vein has been found about 500 feet above the sea on the west side of the entrance to Shoup Bay. This vein has been staked as the so-called Blue Bird property. It was not visited by the writer. The vein is said to strike about east and west, parallel to the slate bedrock in which it occurs. It is reported that the lode has been exposed by open cuts for a distance of about 100 feet. The ore is said to carry pyrite, a little pyrrhotite, and free gold. Near at hand also is the Whistler lode, in which the vein material consists of silicified slate fragments and quartz, both carrying pyrite and some free gold.

The Sealy-Davis property, located on the east side of Shoup Bay, was not visited. Here a vein is said to have been opened up by three crosscut tunnels. From the position of these tunnels as seen from a distance, the trend of the vein appears to be northerly, but no measurement was obtained. The Gold Bluff claim, near the east entrance of Shoup Bay, was not visited either.

The Spanish and the I. X. L. claims are located near McAllister Creek, about a mile from tidewater, and lie on the same fissure, which strikes from N. 70° to N. 85° W. Slickensides are found on both walls. The vein so far as exposed is about a foot wide and includes brecciated slate, quartz, and pyrite with, it is said, free gold. The I. X. L. claim joins the Dorothy vein, which strikes about N. 45° W. At their junction a cut shows nearly 3 feet of vein matter, made up chiefly of fragments of country rock, cemented by quartz with much pyrite. Here both walls are well defined.

The Shoup Glacier Co. is developing a vein on what is known as the Palmer claim. It is about a mile from tidewater and is said to be on the same fissure as the I. X. L. A tunnel has been driven for about 100 feet on the vein, which strikes about N. 60° W. and stands nearly vertical. The hanging wall is well defined by a slickenside, but the footwall is not so well marked. The movement has crushed a zone of the country rock from 2½ to about 4½ feet wide. There is a gouge on the hanging wall side. This zone of crushed rock, said to carry free gold, is permeated by quartz stringers that carry pyrite.

The Big Four claim has been staked on a vein outcropping in one of the tributaries of upper McAllister Creek, about 2 miles from the beach. This vein strikes about N. 35° E., dips 70° to the northwest, and crosscuts a slate bedrock. It has clean walls, and in 20 feet varies in width from 1 to 3 feet. The ore is banded, includes pyrite and galena, and is said to carry only a little gold. This vein carries more calcite than is normal for the veins of the district. About 30 feet away there is another vein, striking about east and west, having a width of 1 to 2 feet.

A shear zone in slates, which strikes about N. 40° W., occurs on the divide between the head of McAllister Creek and Shoup Glacier. This zone contains some iron-stained quartz stringers which have been staked as the Alder claim. About a mile to the west are the Hecla No. 1 and Hecla No. 2 claims. They are located on parallel shear zones which trend about N. 40° W. and crosscut a graywacke and slate series. The zone of shattering on Hecla No. 2 is about 7 or 8 feet wide, and includes irregularly distributed masses and stringers of quartz. The quartz carries pyrite, some arsenopyrite, and galena. It is reported that the same shear zone has been recognized on the mountain about half a mile away from the cut, and that it is there 10 to 15 feet wide. The vein material is said to carry some gold and higher values in silver.

The Ford & Thomson Mining Co. is reported to have done work on a group of claims located near the Gold Creek divide about a mile from Shoup Glacier. A quartz vein 18 to 36 inches wide is said to have been traced over 100 feet on the Silver Falls claims. This vein strikes about N. 60° W. and stands about vertical. The quartz is well crystallized and carries pyrite, galena, and free gold.

The Hogan property, belonging to the Mayfield Mining Co., is located near the Columbia Glacier, about 6 miles from Shoup Bay and 8 miles from Columbia Bay. It was not visited, but the vein is said to strike about east and west, to have been traced about 1,000 feet, and to be from 4 to 8 feet wide. An offshoot trending northwest goes out from the main vein. Developments in September, 1911, consisted of a tunnel about 50 feet long, intersecting the vein 55 feet below the outcrop. The ore is an iron-stained, well-crystallized quartz with much pyrite and is said to carry high gold values.

Gold Creek.—Gold Creek was not examined nor was any information obtained about the prospects on it. A trail has been built up to the lower basin of the creek, where a hydraulic plant for placer mining was being installed during the summer of 1911.

Mineral Creek.—The Buster, Sunshine, and Hercules claims are located on the west slope of Mineral Creek valley 2,800 to 3,400 feet above the sea and about 8 miles from tidewater. They can be reached by a horse trail from Mineral Creek. At the Buster claim about 18 inches of quartz which strikes about N. 50° E. is exposed on the surface. The Sunshine vein has been developed by a 25-foot tunnel in which a vein 2 inches to 1 foot in thickness is exposed. This vein varies in trend from about N. 60° E. to east-west. The ore reported to carry some free gold is pyrite and galena, with a white quartz gangue. The Hercules vein outcrops for about 50 to 70 feet, with a width of 18 to 30 inches. It strikes about N. 80° E. and dips 70° N. High free gold values are reported in this vein.

The Big Four claim is located near the divide at the head of Brevier Creek, a western tributary of Mineral Creek. The vein outcrops on a steep talus slope broken by small cliffs at an altitude of over 5,000 feet above the sea and only about 200 feet below the crest line of the ridge. Its trend varies from N. 55° to 80° E., and it dips 70° to 80° N. Its width varies from about 1 to 3 feet, but in places it swells out to 5 feet. The vein can be traced on the surface for about 200 feet, but is offset by several faults whose trend is N. 10° E. In two places the vein is entirely cut out by faulting. It is made up of iron-stained vitreous crystallized quartz and said to carry considerable gold.

The Millionaire claim is also located on upper Mineral Creek, almost a mile north of the Buster. It is an irregular quartz vein from about 4 to 24 inches wide, which is said to carry much gold. It strikes about east and west and dips 70° to 80° N. The country rock is slate and graywacke, striking about N. 70° E. and dipping 60° N.

The Monte Carlo claim is about half a mile north of the Millionaire. It is staked on an irregular body of quartz, which branches in several directions. What seems to be the main lead strikes N. 50° W., but another shoot trends N. 50° E. This lode can be traced only about 50 feet, but in places is 8 to 9 feet wide. The vein matter is iron-stained quartz and includes some druses showing well-developed crystals. Pyrite is disseminated through this ore, which also carries some galena. It is said that specimens taken from surface cropping of the vein carry considerable gold.

A 30-foot tunnel has been driven on the Mineral King claim on the south side of Brevier Creek, about one-quarter of a mile above its mouth. A quartz vein about a foot wide outcrops here. It strikes about N. 40° W., and stands about vertical. About half a mile north of this is the Chesna claim. Here a 3 to 4 foot quartz vein outcrops, which pinches down to a foot in the tunnel and finally, at a distance of 50 feet, can no longer be recognized as a distinct vein. Beyond this point the tunnel penetrates a zone in which a stockwork of quartz stringers occurs in the slate country rock. This stockwork has a well-defined wall on the south but on the north has no definite boundaries. These lodes strike nearly east and west. Just south of the tunnel a network of veins is exposed in the creek bed. Some specimens from the quartz at the entrance of the tunnel and from the network of veins are said to have yielded high values in gold.

The Mountain View claim is on the east slope of the Mineral Creek valley at an altitude of about 2,000 feet and just opposite the mouth of Brevier Creek. Here there is a quartz vein east and west trending and dipping about 70° to 80° N. At its point of discovery it has a width of about 3 feet, of which 1½ feet, next the hanging wall, consists of massive iron-stained quartz with some slate fragments. The balance of the lode is made up of slate fragments with, however, a large amount of vein quartz. A tunnel intersects the vein at a depth of 30 feet, where its widest part is about 30 inches thick. In driving the tunnel the lode was lost, but later a small vein, which may be the main lead or may be a stringer, was found in a crosscut. The vein material is quartz, accompanied by some feldspar and carbonaceous matter and much yellow pyrite. It is reported that the gold content of the vein at the outcrop is much higher than in the vein in the tunnel.

There is a shear zone in the slate graywacke series on the east side of Mineral Creek about a mile above the roadhouse. This zone, which strikes about N. 65° E., is 2 to 2½ feet wide. Within the crushed zone are a number of quartz veins, the largest of which is 3 inches in thickness. These veins, as well as the crushed rock, are iron stained. The Gold Sunlight claim has been staked at this locality. A similar zone was observed on what is known as the Oleson & Woods property

in a series of slates at an altitude of about 2,000 feet above the sea and about a mile southeast of the roadhouse. This zone trends about N. 25° W., and dips 70° E., and has been permeated by iron-stained quartz veins, the largest about 1 foot thick. It is reported that a quartz vein 2 to 3 feet wide has been staked near this locality as the Golden Dollar claim. This claim was not visited by the writer.

A claim, known as the McIntosh property, has been staked on the west side of Mineral Creek, nearly opposite the roadhouse. At this locality there is an irregular shear zone, which traverses some graywacke, trending as near as can be determined about N. 70° W. This zone includes from 1 to 3 feet of shattered rock and some quartz veins. This lode has no well-defined walls.

The Valdez Bonanza claim is located close to the divide between Mineral Creek and the Valdez Glacier. It lies at an altitude of about 4,350 feet, and is about 3¼ miles due east of the Mineral Creek roadhouse, from which point it can be reached by a horse trail. The ore body, which outcrops as an irregularly shaped mass in a cliff, is from 2 to 5 feet thick and is traceable for about 50 feet. Its strike varies from east and west to N. 75° E., and is about parallel to the cleavage of the slate that forms the country rock. A tunnel has been driven for about 100 feet just below the outcrop of the vein. In this tunnel the vein first shows a thickness of 18 to 24 inches, and then narrows down to 2 inches of ribbon quartz, which finally also disappears. The footwall is well defined by a slickenside and continues beyond the point where the quartz has pinched out. A crosscut revealed another large body of quartz, which carries some iron pyrite but is said not to contain much gold.

The Blue Ribbon claim is about a mile northwest of the Bonanza, where an east and west quartz vein, which is parallel to the foliation of the associated slates, has been traced about 1,000 feet. At the west end the quartz filling appears to pinch out, but the fissure is continuous. At the widest place seen it included about 8 inches of ribbon quartz, said to carry considerable free gold, and 4 to 6 inches of white quartz, which carries pyrite but no free gold.

The William Genzler prospect is located on the north slope of the East Fork of Mineral Creek at an altitude of about 4,000 feet. It was not visited, but the vein is said to be from 18 to 24 inches wide, to have good walls, and to carry considerable gold.

Valdez Glacier region.—The Valdez Mining Co. owns a group of claims on the west side of Valdez Glacier about 8 miles from tidewater, at an altitude of about 2,700 feet. It can be reached from Valdez by a horse trail which traverses the glacier for some distance. The country rock consists of interbedded schistose graywacke and slate, which strike about N. 75° E. and dip about 75° N. The vein, which at the outcrop is about 5 to 6 feet wide, strikes about N. 60° W.

and dips 70° S. An adit, which reaches the vein at a depth of about 60 feet, has been driven 110 feet. A winze has been sunk 50 feet below this level, at which depth a drift has been run on the vein for some 40 feet. The vein at this depth is well defined, having good walls and a gouge on the hanging wall. The vein is from 3 to 8 feet wide in the underground workings. It is made up of ribbon quartz, which carries the gold in high values and measures from 2 to 4 feet in thickness, and of massive white quartz. On the lower level the ribbon quartz is from 24 to 50 inches wide. The white quartz also carries some gold. The ribbon quartz includes coarse pyrite masses and crystals. The vein includes druses containing well-developed quartz crystals. Another adit, which has been driven about 115 feet, is intended to crosscut the vein at a depth of 330 feet in a distance of 300 to 325 feet. The Ibex group of claims lies about one-fourth mile northwest of the Valdez tunnel, where a 4-foot vein outcrops at an altitude of about 2,600 feet. Both walls of this vein are well defined. Banded quartz in this vein is said to carry gold in high values. A tunnel has been driven about 200 feet, but the vein was lost at a distance of 100 feet. The Ibex vein is believed to lie on an extension of the Valdez.

A number of other claims have been staked in the region adjacent to Valdez Glacier, some of them east of the glacier. There was no opportunity to examine any of these claims.

COMMERCIAL CONDITIONS.

Valdez, a town of 700 or 800 people, is about 1,230 nautical miles from Seattle. Two steamship lines maintain a service of six trips a month between Valdez and Seattle, the voyage usually taking about five days. Valdez is the coast terminal of the military road to Fairbanks, and until the Copper River Railroad was completed most of the inland travel was by this route. Valdez is connected by cable with other Alaska ports and with Seattle, and by telegraph line with points in the interior. The town is well built, has wharves, banks, a number of hotels, good stores, and telephone and electric-light service. It is the headquarters of the Alaska Road Commission and of the Copper River section of the military telegraphic service. Fort Liscum, an Army post, is on the south side of the bay, where there is also a wharf. The only other wharves on the bay are one near the mouth of Mineral Creek, where there is a small settlement, and one at the Cliff mine. A road and trail lead up Mineral Creek for a distance of about 8 miles. At low tide, wagons can be driven from Valdez to the mouth of Mineral Creek. There is a new trail part way up Gold Creek. Aside from these, there are only a few foot trails in the entire district. Travel along the coast is easy by gasoline launches, of which there are a number at Valdez.

The town affords a good outfitting point for work in the district. Provisions and supplies are not high, except coal, most of which is brought from Vancouver Island and sells at $12 to $16 a ton. The district contains some trees which can be used for mine timber and rough lumber, but most of the good lumber is brought from Seattle.

The strong relief and steep slopes favor the opening of lodes by crosscut tunnels. The heaviest item of expense is usually the transportation of supplies and equipment from tidewater to the place of utilization.

SUMMARY AND CONCLUSIONS.

The bedrock of the region is made up of closely folded and faulted slate and graywacke and a little greenstone schist, with, so far as known, only a few igneous dikes. Auriferous quartz veins constitute the important known mineral deposits of the district. Part of those developed follow well-marked fissures, which can be traced for considerable distances. In parts of the district there are two systems of fissures. There is no reason to suppose that these fissures will exhibit any greater irregularity at depth than they do along the surface. Although many of the fissures are traceable for considerable distances, the vein filling of some of them locally pinches out completely, in some fissures to reappear farther along on the strike.

The principal metallic minerals of the veins are pyrite (locally auriferous), free gold, argentiferous galena, and in a few localities pyrrhotite, chalcopyrite, and arsenopyrite. Quartz is the chief gangue mineral and in many veins appears in more or less crystalline form. Calcite occurs sparingly in most of the lodes, and in a few constitutes a considerable proportion of the vein matter. Feldspar, chiefly albite, was observed in several veins. Where veins cut carbonaceous rocks, graphite is found in the gangue.

Many of the ore bodies that have been opened up are zones of brecciation along fault lines, which have been permeated by quartz and pyrite. In these the fragments of country rock are usually more or less recrystallized. The country rock and ores are similar to those of the Sitka district.[1]

There is no reason to believe that the gold content of the pyritiferous quartz veins will show any greater variation at a considerable depth than it does at a moderate depth, but in many places the weathered outcrop shows marked surface enrichment. Assays of samples of quartz veins from surface outcrops, even if carefully taken, are likely to be very misleading. Many samples taken from outcrops show a gold content of $100 or more to the ton, whereas samples taken 10 or 20 feet below the surface at the same places contain less than $10 in gold to the ton.

[1] Knopf, Adolph, The Sitka mining district: Bull. U. S. Geol. Survey No. 504, 1912.

The most encouraging feature of the district is, of course, the fact that one lode has been profitably mined to a depth of about 400 feet and for about 500 feet along the strike. So far as can be seen there are no geologic conditions at the Cliff mine which are not found elsewhere in the region. Although, as in all mining camps, much the larger number of the claims staked give little promise of developing into mines, yet there a number show results that fully justify further exploitation. The facts at hand indicate that it will be a district of small rich veins rather than of large low-grade deposits. Some larger deposits of low grade, which were not visited, are, however, reported to occur on the south side of the bay.

The geographic limits of auriferous mineralization, as indicated by discovery of gold-bearing veins, seem to be determined by accessibility rather than by geologic conditions, and no evidence in hand indicates that the ore bodies are limited to the particular district in which they have thus far been found. The outlook for further discoveries is therefore good and is made more hopeful by the fact that auriferous quartz has been found on the east, along the Fairbanks road near Beaver Dam, and on the west, near Port Wells.

On the whole, the commercial conditions in the district are favorable to economic development. The prices for most commodities except coal are reasonable. Much of the district is readily accessible from tidewater and most of it could be rendered accessible by roads and trails at no great cost. Economies could be introduced in mining by making available the water powers which are not now being utilized.