LODE MINING IN THE KETCHIKAN REGION.

By PHILIP S. SMITH.

INTRODUCTION.

During the investigation of the stratigraphy of part of the Ketchikan region from May 15 to July 26, 1913, almost all the mines and important prospects of gold and copper were visited. The data then acquired form the basis for this report on the conditions of mining in 1913. Detailed descriptions of many of the mines have been given in previous reports of the Survey and have not been repeated here. For a complete description of the earlier mining activities in the Ketchikan region the reports by the Wrights, Paige, and Knopf should be consulted.[1]

MINING CONDITIONS.

Lode mining in the Ketchikan region was not active in 1913. Three copper and three gold mines were in more or less continuous operation and about a score of prospects, most of which have been known for several years, were further developed. The value of the total production from all the mines and prospects for the year was less than $200,000. This production, though considerable in the aggregate, passes into the hands of a few operators, so that the community as a whole has less interest in mining than in the enterprises associated with the fishing industry, in which the profits are more widely distributed.

[1] Wright, F. E. and C. W., Lode mining in southeastern Alaska: U. S. Geol. Survey Bull. 284, pp. 30–53, 1906.
Wright, C. W., Lode mining in southeastern Alaska: U. S. Geol. Survey Bull. 314, pp. 47–72, 1907.
Wright, C. W., and Paige, Sidney, Copper deposits on Kasaan Peninsula, Prince of Wales Island: U. S. Geol. Survey Bull. 345, pp. 98–115, 1908.
Wright, C. W., Lode mining in southeastern Alaska: U. S. Geol. Survey Bull. 345, pp. 78–97, 1908.
Wright, F. E. and C. W., The Ketchikan and Wrangell mining districts, Alaska: U. S. Geol. Survey Bull. 347, 1908.
Wright, C. W., Mining in southeastern Alaska: U. S. Geol. Survey Bull. 379, pp. 67–86, 1909.
Knopf, Adolph, Mining in southeastern Alaska: U. S. Geol. Survey Bull. 442, pp. 133–143, 1910.
Knopf, Adolph, Mining in southeastern Alaska: U. S. Geol. Survey Bull. 480, pp. 94–102, 1911.
Wright, C. W., Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska: U. S. Geol. Survey Prof. Paper 87 (in press).

The waning interest in mining is due not to the absence of mineralization but rather to the lack of adequate capital and intelligent management for the prosecution of development. To judge from the area examined by the writer last summer there are probably many small lodes of high tenor. The future mining activities in the region, however, depend not so much on these lodes as on large deposits of low-grade material. In this region of strong relief, where water transportation by ocean-going vessels is readily accessible and where labor and supplies are little more costly than in Seattle or San Francisco, the expense of mining can be made very low. The attainment of cheap mining, however, requires careful selection of the area to be mined, considerable original outlay of capital, and a skillful management versed in the most efficient of modern mining practices. Unfortunately the mines that have been opened in the Ketchikan region have seldom if ever had the advantage of this desirable combination. With the failure that has inevitably resulted from the lack of one or more of these requirements, confidence is shaken and the region as a whole receives a setback which makes the development of its mining industry increasingly difficult.

MINES AND PROSPECTS.

DISTRIBUTION.

Most of the mineralization occurs in those regions where sedimentary rocks are intruded by igneous rocks, and almost all the mines and prospects lie in these areas. So widespread are these conditions, however, that few places in the Ketchikan region are more than a short distance from some igneous contact. As a consequence, until further study determines the other factors which are necessary to produce workable ore deposits. almost all the Ketchikan region warrants critical examination.

Although mineralization is widespread and may be found in nearly all the rocks of the region, it seems to be especially abundant in the belts of black graphitic quartzose slates and schists and in the vicinity of certain limestones. On the other hand, it is almost entirely absent from the larger masses of granitic rocks, except in a rather narrow marginal zone. The geologic mapping of the different terranes, therefore, should throw considerable light on the distribution of mineralization and should show the geologic relations of the known mineral deposits and indicate the places where similar conditions may prevail in undeveloped areas. Unfortunately investigations have not yet been carried far enough to give this information, and in this report the different mines and prospects are described by geographic localities. The three main mining areas are Prince of Wales Island, the mainland, and Revillagigedo Island. Mining

work in each of these main areas will be described separately and the scattered prospects which do not fall into one of the above subdivisions will be described under the general heading "Miscellaneous localities."

On Prince of Wales Island the most active mining was done on Karta Bay, Kasaan Peninsula, near Port Johnson, and near the head of Hetta Inlet. At Big Harbor, on the west coast of the island, copper ore was produced, but the property was not visited by the writer. Some prospecting was in progress on these areas and also on Cholmondeley Sound, McLean Arm, Mallard Bay, and Brownson Bay. All these places except the last two were examined. On the mainland development has been in progress at only two places—at the head of Portland Canal near the international boundary (not visited by the writer) and on Cleveland Peninsula north of Ketchikan. On Revillagigedo Island the only active mining was done on George and Thorne arms, fiords a short distance southeast of Ketchikan.

PRINCE OF WALES ISLAND.

KASAAN BAY AND VICINITY.

Kasaan Peninsula, which several years ago was the scene of considerable copper mining, was practically deserted by miners throughout 1913. The only producing property was the Rush-Brown mine, about 2 miles inland from the head of Karta Bay. The development at this place has been rather fully described by Wright,[1] and the description will not be repeated here. Two main ore bodies, known locally as the magnetite and the sulphide bodies, have been extensively opened and another, known as the third ore body, has been slightly prospected. The ore occurs mainly in the form of chimneys whose longer axis is steeply inclined to the surface. It is mined mainly for its copper content, but it also carries considerable gold and so large an amount of iron that the smelters allow a premium for it. Numerous small slips intersect the ore bodies and in one or two localities have displaced the deposit several feet. Late basic dikes here and there cut the ore bodies, but have not been affected by faulting.

Fourteen men were employed on this property more or less continuously throughout the year. A new boiler and hoist were installed in 1913. The working shaft is 177 feet deep and the first level has been driven 187 feet and the second 177 feet. A winze has been sunk to open a third level. The ore is conveyed from the mine to the sea by a narrow-gage railroad about 2 miles long and is there loaded on ocean-going steamers.

[1] Wright, C. W., Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska: U. S. Geol. Survey Prof. Paper 87 (in press).

A report was circulated early in the season that certain copper properties east of the Rush-Brown mine had been examined, with a view to their purchase. No account of the results of this investigation has been received and presumably the terms were not satisfactory. The lack of mining in this region is not evidence that the deposits have been exhausted, for at several places the owners expect an early resumption of work.

Another mining center in the neighborhood of Kasaan Bay that used to be active is in the vicinity of Hollis, a settlement on Twelvemile Arm, the southern prolongation of Kasaan Bay. Only one property was in operation at the time of the writer's visit, the Rogers mine, on the claim formerly known as the Julia, on Harris Creek, about 2¼ miles southwest of Hollis. Five men were employed more or less continuously on the property and in May were mainly engaged in equipping the 5-stamp mill which they expected to have in running order by June 1. The mine and mill are situated close to Harris Creek, a stream large enough to furnish water power to run the necessary machinery. Already part of this power has been utilized by means of a 6 by 8 foot flume, which delivers water to three turbines, of which two are capable of developing 38 horsepower, and the third 25 horsepower.

The lead that has been mined consists of numerous quartz stringers and veins in a black, somewhat graphitic, schistose slate. Both the schist and the vein strike in general N. 35° E. and dip northwest at fairly steep but variable angles. Near the surface the dip is approximately 45°, but lower down it flattens so much that in the length of the inclined shaft—205 feet—a vertical depth of only 95 feet is attained. The average dip from the top to the bottom of the shaft is therefore less than 28°. The width of the material mined ranges from 2 feet to more than 6 feet. This narrowing and swelling of the deposit takes place parallel both to the dip and to the strike.

The ore is mainly valuable for the gold it contains. Although no accurate determination of its value has been made by the writer, it is reported to carry gold in commercial quantities. Sulphides are scattered through both the quartz and the inclosing slates but do not form an appreciable portion of the rock. Pyrite is the most common sulphide, but some sphalerite, chalcopyrite, and galena were also recognized. The gold is said to be mainly native and is especially abundant near the contact of the quartz stringers and the country rock.

Only a small production has been made from this property in the past, but it should be materially increased when the mill is completed. Some ore has already been blocked out underground, but this development should be continued energetically, so that a sufficient reserve may be kept ahead of the mill. Some rock for milling

can be obtained from the old dumps, for they are reported to assay nearly as high as the vein material underground and would therefore pay for reworking. No special difficulties in mining the deposit have so far been met. At the time of the writer's visit the lower part of the shaft and certain drifts were full of water, which had been collecting for several days, but the mine really is not wet. In fact, the operators report that two hours' pumping a day is sufficient to keep the mine dry.

No work has been done for several years at the Puyallup and Crackerjack mines, which lie northwest of Hollis. A small lot of ore was shipped from the Lucky Nell claim, formerly called Flora and Nellie, but no statement of the quality or tenor was obtained. A little prospecting has been done recently on the Commander group of claims, now known as the President 1 and 2, which lies east of the Lucky Nell claim and is about 6 miles northwest of Hollis, but no production has been reported. The old group of claims called the George group, which lies between Hollis and the Julia claim on Harris River, has been renamed the Hendy 1, 2, and 3. No work has been done at this place for several years, but the owners proposed to develop the claims during the later part of 1913, though the work had not been started at the time of the writer's visit. Undoubtedly some work is done annually on other claims in this region, but probably it seldom exceeds that required by law.

CHOLMONDELEY SOUND AND VICINITY.

No productive mining was in progress in the vicinity of Cholmondeley Sound in 1913, and the only places where prospecting was at all active were south of the head of Dora Bay and east of the head of Kitkun Bay. At neither place, however, were more than two or three men employed at a time, and these for only a part of the year.

The claims near Dora Bay are situated between Mineral Lake, which discharges into the north arm of Moira Sound, and Dora Lake, a tributary to Dora Bay. Three claims trending approximately north and one trending northwest have been staked in this region. These claims are, from south to north, the Portland, Seattle, and Portland No. 1; the transverse claim is the Clifton. The Clifton and Portland No. 1 overlap in part. The ore from all these claims is said to contain sphalerite, galena, and copper sulphides, but the last is the main source of value. In addition to these base metals all the ore is said to contain some gold. In certain specimens that were examined a considerable quantity of native gold was intimately associated with the sphalerite. From the relation of the sphalerite and gold to the quartz in which they both occurred the most reasonable explanation of their association is that an earlier series of quartz veins was later

fractured and sulphides with gold from a deep-seated source were introduced.

The prospecting east of the head of Kitkun Bay was on the claims formerly known as the Crœsus group. The work at this place is said to have been mainly to fulfill assessment requirements but is reported to have disclosed some fairly good ore. The country rock is a highly contorted, rather massively laminated dark green schist closely associated with limestones. These claims were not visited by the writer.

PORT JOHNSON AND VICINITY.

Port Johnson is a small indentation on the east coast of Prince of Wales Island, between Moira and Cholmondeley sounds. It is perhaps the best known from the settlement Dolomi, on its north shore. A few years ago in this region considerable gold mining as well as marble quarrying was done, but last summer only one mine was in operation and the settlement was nearly abandoned. The Valparaiso mine was the only mine in operation, but several prospectors, in so far as their slender resources would permit, were actively developing their holdings.

The Valparaiso mine is situated on the north shore of Paul Lake, about 1¼ miles northwest of Dolomi. The lake is connected with the town by a narrow-gage track, from the end of which the mine may be reached by a trail along the shore or by a small gasoline launch. The country rock in the vicinity of the mine consists almost entirely of limestone with here and there silicified zones and quartz-impregnated rock. No other sedimentary rocks and no igneous rocks were recognized in the underground workings. The hanging wall of the ore body is in almost all parts of the mine a strongly marked slip seam, but no sharp plane of division occurs on the foot-wall, and the distinction between ore and waste is determined by assays.

A mill has been built below the mine near the lake shore. It is equipped with a battery of five Hendy stamps, but space has been arranged so that this number can be doubled without much alteration. The ore is crushed to 30 mesh and 90 per cent of the gold it contains is said to be caught either in the mortar box or on the plates of the battery. The pulp from the stamp is led by gravity to a Chilean mill, in which it is ground and from which it passes to classifiers. From the classifiers the fine material flows to slime tables, from which the tailings are discharged into the lake. Little metallic material is caught on the tables. Crushing by means of the Chilean mill after the ore had been reduced to 30 mesh in the stamps is said to increase greatly the capacity of the mill over that obtained by the more usual practice of crushing to 40 mesh in the stamps.

One of the problems confronting the economical development of this property has been to acquire cheap power. At present wood costs about $2.50 a cord, but by the time it is delivered at the boiler it costs nearly $6. A solution of this problem that has been considered is the development of water power from a subterranean stream which debouches on the hillside several hundred feet above the lake. This water evidently comes from a lake that lies to the north. Apparently it flows through a passage in the limestone that forms the country rock, appearing at the surface again where the limestone gives place to schist. The operators of the mine estimate the volume of this stream's discharge at 150 to 600 miner's inches. If as great a volume of water is available throughout the year, it would be a source of considerable cheap power.

East of the Valparaiso and west of the tramroad to James Lake a number of claims have been staked, on many of which considerable work has been done in the past, but at present they are idle. Several veins have been distinguished by the prospectors and given different names. Casual examination of the region seemed to indicate that many of these distinctions are unwarranted by the information now available, and the belief is expressed that practically all represent the same general shattered zone. The character of the mineralization in all the area is essentially the same, although the amount differs considerably in different places. As a rule the gangue minerals are similar throughout the area, but on the Pauline claim, in addition to the common minerals, greenish, slightly translucent, compact muscovite was observed.

East of the tramroad to James Lake a little prospecting has been done on the Beauty claim, about half a mile north of Dolomi, and on the Fortune and Moonshine claims, about a quarter of a mile farther north. The Fortune and Moonshine claims lie near the contact of a dark quartzite and metamorphic limestone. The quartzite is intersected by numerous and irregular quartz veins, which range in width from mere films to 12 inches. Usually the vein quartz is glassy and crystalline. The gold recovered is native and occurs in the quartz veins and also in the graphitic quartzite contiguous to the veins. Some gold is reported to have been found on the surface of the quartz crystals. The vein gold is said to be worth about $16 an ounce. Sulphides are more apparent in the vein material from this deposit than in that found on most of the other prospects examined and are composed mainly of pyrite and gray copper. A small production has been made from this property by a prospector, who has pounded up selected ore in a hand mortar and recovered the gold by panning.

MOIRA SOUND AND VICINITY.

Prospecting in the vicinity of Moira Sound amounted to little more than the annual assessment work required by law. Between the head of North Arm and Mineral Lake the copper mines, once active, were idle throughout the year and the only person in the region was a man who looked after the various properties and as opportunity offered did a little prospecting. Efforts have been made to prospect further the Navaho claim, formerly called the Hope claim, which lies between Cannery Cove and North Arm. No important new discoveries, however, have been made at this place.

No productive work was done during last year on any of the properties adjacent to Niblack. Only one person now lives in this region, and although part of his time is spent in prospecting little new work has been accomplished. Reports were current that plans were under way to reopen the Niblack mine, but they were not verified. The strongly faulted and deformed structures in this region undoubtedly will increase the difficulty and expense of mining.

A small prospect hitherto not reported lies in the small bight north of Black Point, at the entrance of Niblack Anchorage. The lead had been opened by means of a vertical shaft, now full of water, and by a short adit. The country rock is an agglomeratic or pyroclastic igneous rock trending east and dipping south. Not far away an infaulted mass of black shales and slates was exposed. Work at this place had been abandoned only a relatively short time, but the exposures did not seem to be sufficiently encouraging to warrant further development at present.

M'LEAN ARM AND MALLARD BAY REGION.

Seven miles north of Cape Chacon, the extreme southern point of Prince of Wales Island, is McLean Arm, a fiord about 5 miles long. A slight indentation immediately south of this arm is called on the charts of the Coast and Geodetic Survey Mallard Bay, but according to local usage this name correctly applies to the next bay south, which is called on the charts Stone Rock Bay. Without presuming to decide which of these names is correct, the writer has accepted the nomenclature adopted for the charts, and in the following notes the name Mallard Bay is used for the first bay south of McLean Arm.

The country rock in the neighborhood of McLean Arm is composed chiefly of a medium coarse-grained granodiorite, similar in physical aspects to the intrusive rocks of the Coast Range farther east. South of Mallard Bay the country rock is also igneous in origin, but differs from that to the north in that it is much more porphyritic. It may be of the same age as the granodiorite and may possess a different appearance because of having cooled under different conditions. Between these two areas of deep-seated igneous rocks is a narrow

belt of greenstones and greenstone schists. The relation of the greenstone to the granitic rocks was not apparent in the exposures examined, but the impression gained was that the greenstone had been brought into its present position by faulting. The greenstone outcrops along the south shore of Mallard Bay and its trend is slightly north of west, so that it is again exposed near the head of McLean Arm.

Along the belt of greenstone claims have been located. These are, from east to west, the Veda group, the Apex-Adit group, the Hillside, and the Wano. Although the claims have been located a number of years, none had been brought to a producing stage and none is being developed continuously. Copper is said to be the main metal of value in the ore and occurs as chalcopyrite. This sulphide is most abundant in the greenstone and schist, but in places it is also found in the granitic rocks.

A little prospecting has also been done farther south in the vicinity of Stone Rock Bay. This place was not visited, but from reports of prospectors the country rock is dominantly the same porphyritic granitic rock that occurs south of the belt of greenstone. A short distance northwest of the head of the bay claims are being prospected by Decker and West, and about 2 miles from the head of the bay on the north shore of a small lake are claims locally known as the Hanson prospect. The main metal of value recovered from the ore is reported to be copper, but no reliable information as to the tenor or extent of the deposits was obtained.

HETTA INLET AND VICINITY.

The region near the head of Hetta Inlet has long been the greatest producer of copper ore in the Ketchikan region. Although it still produces the greatest quantity of copper ore, mining activities have dwindled, until in 1913 it contained only one producing mine. This mine, the Jumbo, owned by the Alaska Industrial Co., is located about 3 miles south of the town of Sulzer. About 50 men are employed more or less continuously throughout the year. The ore is delivered by an aerial tram from the mine to bunkers at the wharf, from which it is loaded onto ocean-going steamers and transported to the Tacoma smelter. No notable developments occurred during the year, and mining was carried on at the same places and with the same general results as in the past. The facts regarding the geology and mining developments in the neighborhood of this mine have been given in considerable detail by Wright[1] in a recent report and will not be repeated here.

[1] Wright, C. W., Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska: U. S. Geol. Survey Prof. Paper 87 (in press).

The Copper Mountain group of claims, formerly an important copper producer, lying south of the Jumbo claims, was not visited by the writer. To judge from reports, none of these claims were productive in 1913. Prospecting, however, was carried on at several places on this property, and some ore that seemed to promise well is reported to have been found. No indications that work will be resumed on this property in the near future were seen. The geology and mineral resources of this group of claims have also been fully described in the report by Wright mentioned above.

Near Lime Point, at the extreme southern entrance to Hetta Inlet, a little prospecting has been carried on. As yet, however, not enough has been accomplished at this place to show the character and extent of mineralization.

BIG HARBOR MINE.

On the west coast of Prince of Wales Island, near the head of the bay locally called Big Harbor but on the Coast and Geodetic Survey charts called Trocadero Bay, lies the Big Harbor mine. This place was not visited, but the following notes, gathered from a number of sources, afford what is believed to be a fairly accurate description of the general developments.

Big Harbor mine may be reached directly by ocean-going vessels, as deep water extends all the way up to the company's wharf. No ships except those under special charter, however, call at this place, so that it is rather inaccessible. The air-line distance from salt water at Trocadero Bay, on the west side of Prince of Wales Island, to salt water on Twelvemile Arm, on the east side of the island, is less than 10 miles. A trail over a relatively low divide connects these two bays.

The main underground developments consist of two shafts, each of which is about 50 feet deep. These shafts are situated about one-third of a mile from the beach, at an elevation of about 250 feet above the sea, and about 190 feet of crosscuts and 180 feet of drifts have been driven from them. Stopes have been blocked out and during the year some ore was shipped from this property to the Tacoma smelter. The ore is mainly valuable for its copper content, but it also contains accessory values in gold. According to Knopf,[1] "the ore was reported to consist of chalcopyrite in a lime gangue, but the samples shown to the writer proved to be a highly siliceous, sericitic schist, carrying disseminated chalcopyrite and pyrite. Some ore rich in black zinc blende was seen that came from the same locality." The ore as shipped is reported to contain normally less than 20 per cent silica and slightly more than that amount of iron. No

[1] Knopf, Adolph, Mining in southeastern Alaska: U. S. Geol. Survey Bull. 480, p. 102, 1911.

reliable information as to the character of the country rock has been obtained. At Soda Springs Bay, 10 miles to the south, carboniferous limestone outcrops; less than 10 miles to the north Upper Devonian limestones, argillites, and quartz are exposed on Klawak Inlet, and less than 10 miles west of Big Harbor Upper Devonian limestone is exposed on San Juan Bautista Island. In other parts of Prince of Wales Island rocks of approximately the same age are strongly mineralized. The conclusion that the rocks occurring in the vicinity of the Big Harbor mine are of this same general age, namely, late Paleozoic, seems justified.

MAINLAND.

SMUGGLERS COVE PROSPECTS.

On Cleveland Peninsula the two main places at which mining has been active in the past are at the head of Smugglers Cove and on the west side of Helm Bay. These bays indent the southeastern coast of Cleveland Peninsula and are 25 to 30 miles northwest of Ketchikan. At the time of the writer's visit no mining was in progress in the vicinity of Smugglers Cove, but later in the season several of the claims were reported to have been purchased by a company that proposed to actively develop them. Exact information regarding this enterprise is not yet at hand, and consequently the operations are not discussed in this report.

On the Old Glory claim, which lies about 1¼ miles northwest of the head of Smugglers Cove, several openings have been made. The new camp is built at an elevation of about 900 feet, and near it is a crosscut 110 feet long, from the inner end of which a 70-foot drift has been turned off to the south. The lead trends about N. 20° W. and dips steeply west. The vein consists almost entirely of quartz and contains only a small quantity of sulphides. Free gold was observed in several of the specimens and is said to be sufficiently abundant to warrant mining. Southeast of the new crosscut and drift is an old adit, now somewhat caved, 75 feet long. To the left and slightly lower is another adit on the same vein. The presence of the vein between the two adits has been proved by means of several prospect pits. The country rock throughout this group of claims is greenstone schist, with numerous quartz stringers. Samples of the disintegrated material on the surface near the vein disclosed many small particles of gold. Facilities were not at hand for determining whether this gold was entirely derived from free gold in the vein or had been originally carried in the sulphides and separated from them by oxidation.

West of the Old Glory claim is the American Eagle claim. On this property a short crosscut has been driven and drifts, each 100

feet long, have been turned off to the northwest and southeast. The vein trends about N. 35° W. and dips south. The country rock appears to be the same as that on the Old Glory claim.

About half a mile west of the American Eagle claim is a property formerly called the Keystone, later known as the Bradley, and now named the London claim. The underground developments at this place consist of a crosscut 150 feet long, trending N. 30° E., from which drifts have been run 120 feet N. 60° W. and 105 feet S. 60° E. An old raise connects the inner end of the crosscut with the surface. The dip of the vein is in general very steep toward the northeast, but in places it is vertical. The vein is split into numerous quartz stringers, which show considerable slickensiding. Calcite and siderite are associated with the quartz in the gangue. The main value of the ore is reported to be its free gold content. A fine water-power site is located near the coast about 1¼ miles from the mine. Two falls, the upper one 25 feet and the lower one nearly 75 feet, not more than 500 feet distant from each other, discharge sufficient water into the head of Smugglers Cove to furnish a very economical means of supplying power for mining and milling.

HELM BAY AND VICINITY.

The Gold Standard group of claims on Helm Bay was at one time the scene of considerable mining activity, but no work has been done there for six years. Many of the buildings and a large part of the tram line that was built on trestles have collapsed, though the mill still seems to be in fairly good condition. The ownership of the claims is said to be in dispute, and this is given as one of the reasons why the property is lying idle. A little prospecting was done in 1913 at a place about a quarter of a mile from the shore by one man, who was stripping a series of quartz stringers that trend N. 10° E. and dip 60° W. Considerable pyrite occurred in the veins. The stripping had exposed a width of about 15 feet, and through this distance small quartz stringers formed an irregular network.

Some placer gold has been obtained from the hillside detritus near the main shaft of the Gold Standard group by a placer miner, who worked on the ground a considerable part of the summer. The gold occurs in rather angular semicrystalline aggregates, and many of the pieces have quartz and chlorite schist adhering. These characteristics point to the conclusion that the gold has been little transported and probably is a residual placer below the outcrop of the vein rather than a normal creek placer. The gold is said to be 920 fine. Only a small production was made, as much of the promising area had been covered by the waste dumped from the lode mine above.

West of the head of Helm Bay and three-fourths of a mile inland occurs the contact of black slates with the greenstone that forms much of the country rock to the west. A lake half a mile long lies near this contact, and the hills rise steeply to the northeast and southwest. West of the lake one group of claims has been staked but has not been prospected. East of the lake occur numerous small gold-bearing quartz stringers, several of which have been sampled and are reported to carry gold in commercial quantities, but none of them has been opened up. On the Quartzite Ledge claim an adit had been driven a few feet on a greenstone which contained a small amount of calcite and disseminated sulphides. The leads, however, have not come up to expectations, and one by one the claims have been relinquished until now practically the whole region is open for location.

PORTLAND CANAL AND VICINITY.

The mining developments on Portland Canal were not visited by the writer owing to lack of time. Mr. W. S. Polsen, of Ketchikan, however, who is familiar with that region, furnished much of the following information. No production has been made from this district, but prospecting has received an impetus from the recent building by the Dominion Government of a road up Salmon River, through United States territory, to reach claims on the Canadian side of the line. This road has made the region accessible and has materially reduced the cost of transporting supplies into the mineralized area.

Most of the prospecting has been done in a belt of schists and metamorphic rocks that lies along the inner or eastern margin of the great area of intrusives which form the country rock westward along Portland Canal. The belt of schists is wedge-shaped, being bounded on the east by a smaller granitic mass which lies 1 to 5 miles east of the main mass of the western intrusive. Numerous smaller intrusives also cut the schists. The schists apparently form the continuation of the rocks which in British Columbia have been called by McConnell[1] the Bear River formation and described by him as comprising "porphyrite, tuff, breccia, agglomerate, etc."

Mineralization is reported to be widespread and occurs both in distinct veins and in mineralized zones. Pyrite is the most common metallic mineral and is even more abundant in the schists than in the veins. Gold is the main valuable mineral for which this type of deposit has been exploited. Certain of the prospects have been developed on deposits whose main metallic mineral is galena. This type is principally valuable for the silver contained in the ore.

[1] McConnell, R. G., Salmon River district: Canada Geol. Survey, Dept. Mines, Summary Rept. for 1911, pp. 50–56, 1913.

As only a small amount of work has been done on any of these prospects little has been definitely determined about the ore—its commercial tenor, its persistence in depth, its mining or milling qualities are still unknown. In regard to the persistence of the ore in depth it should be remembered that although most of the mineralization is in the schists some occurs also in the granite. This condition indicates that the ore bodies are not necessarily limited in depth by the granite but extend into it. To what depth this penetration goes should be carefully determined. In a region like that at the head of Portland Canal, where the granitic rock nowhere lies very deep below the surface, the determination whether or not the mineralization cuts certain of the batholithic masses is important.

REVILLAGIGEDO ISLAND.

LONDEVAN MINE.

The only mining on Revillagigedo Island during 1913 was done on George and Thorne arms. On George Arm some mining was done at the Londevan property, on the west side of the bay, about 10 miles from the head, and work was continued at the Peterson prospect, 3 miles farther south, and at the Mahoney prospect, which was formerly known as the Ash prospect, about the same distance to the north.

At the Londevan mine six men were employed until the later part of May. The mine was then closed and, according to report, has not been reopened. No ore was shipped from this property but has been dumped in a stock pile near the water's edge. In the early development of the property numerous surface excavations disclosed ore that seemed to promise well. Difficulty in developing the deposits by shafts led to the driving of a long crosscut from a point near sea level to intersect the vein in depth. The crosscut was started about 185 feet above the sea on the Portal claim and was driven about S. 75° W. more than 2,000 feet to the vein and drifts turned off to the north and south. Several small veins were intersected in the crosscut; one at 850 feet from the entrance was about 18 inches thick, one at 1,000 feet was about 2 feet thick, and one at 1,200 feet beveled the crosscut at an angle, so that its thickness was indeterminate but considerably greater than that of the preceding veins. Between these last two veins are two fault zones, one tending approximately east and the other more nearly north. These faults have afforded planes along which water penetrates freely. In consequence this part of the crosscut is wet, but the water is readily carried off by the slope of the crosscut.

About 800 feet beyond the vein last noted is the main vein. At the place where it was first cut it was 3 to 4 feet wide and dipped westward. Drifts were turned off on it, the one to the north being over

500 feet long and the one to the south about 1,800 feet long. The vein in the northern drift consists of a number of small stringers, which separate and unite in an intricate fashion. A strongly marked plane of movement appears to form the footwall of the vein throughout the northern drift. At the north end of the drift the vein gradually narrows until it almost entirely disappears, but the footwall fault plane continues. At the north end of this drift a crosscut has been driven west and a large mass of white, glassy, little-mineralized quartz disclosed. In the southern drift the hanging wall is remarkably smooth and appears to be a fault plane, dipping about 65° W. At the face the vein is much broken, and considerable water comes into the mine along the fracture planes. At the face the quality of the ore is said to improve, and the width of the vein is fully as great as at any other place in the mine.

The country rock throughout the mine is dark schist with a greasy graphitic luster. The cleavage planes are not strongly contorted and appear to dip in a uniform direction, except in those places where later faulting has interrupted the normal inclination. No granite or limestone was recognized in the underground workings. All the schist is more or less mineralized with iron pyrite. In fact, it is difficult to obtain even a hand specimen that does not show cubes of this mineral. This condition is rather surprising, for the veins do not show a large amount of pyrite. Sulphides, it is true, occur in the veins, but at a rough estimate they form less than 5 per cent of the volume. Pyrite is the most abundant of the sulphides, but some sphalerite, galena, and a very little copper pyrite were also recognized. Much of the gold reported to occur in the vein is said to be native, but no careful test of the quantity carried in the sulphides has been made. The gold tenor is said to increase markedly in those places in the vein where galena is abundant, as at the end of the southern drift.

The average tenor of the ore was not disclosed, but it is regarded by the owners as rather low. The estimated back of ore above the crosscut level of over 1,000 feet, the convenient shipping facilities, and the good surfaces to break to in mining should permit development at a rather low cost. Much money has been spent on the property, but even more will be required to develop the mine to a producing stage. The need for additional outlay probably has caused the temporary shutting down of the property.

MAHONEY PROSPECT.

The Mahoney prospect is on the small bay on the west side of George Arm, about 3 miles north of the Londevan mine. A drift about 25 feet long has been driven N. 15° W. on some mineralized

stringers that can be traced underground for nearly 175 feet. The last 75 to 100 feet of this drift lies in barren rock, with no signs of mineralization. At the northern end of the drift a strongly marked fault trends N. 75° E. This fault has been followed for a short distance east and west of the drift as though in an attempt to find the vein. The search apparently was not successful and was abandoned. The country rock in the drifts and crosscuts is mainly rather heavy, dark-colored blocky schist, but near the shore a nearly black ottrelite schist and farther to the northeast a schistose conglomerate are exposed. A small amount of limestone also outcrops in this neighborhood.

On the hillside above the prospect is a narrow stringer carrying some galena, which occurs both in well-formed crystals and in compact fine-grained masses. The vein is narrow, in few places being more than about 8 inches wide. It has been traced by numerous shallow pits and trenches for several hundred feet. The ore thus exposed is much superior to any seen in the underground workings. In general the dip of the vein is rather low. Not far away is a small mass of granite, which from its nearness suggests a genetic relation to the vein.

PETERSON PROSPECT.

The Peterson prospect, formerly called the Surprise group of claims, is situated on the west side of George Arm, about 2 miles south of the Londevan mine. Only a little work has been done there lately. Practically the only mining has been the opening near the shore of two drifts north and south of the creek. The northern drift is about 35 feet long and trends N. 25° W.; the vein exposed in it dips about 70° E. Considerable shattered quartz appears on the footwall, but the drift is driven on a much-brecciated black mineralized schist similar to that forming the country rock at the Londevan mine. As at the Londevan mine, the quartz appears to carry rather smaller amounts of sulphides than the schists. The sulphides in the country rock are almost exclusively pyrite, but in the vein they are pyrite, galena, sphalerite, and copper pyrite. The relative abundance of these minerals is approximately in the order named, pyrite being by far the most abundant.

THORNE ARM PROSPECTS.

About two-thirds of a mile northeast of the head of Moth Cove, a small bay on the west side of Thorne Arm near the entrance, are claims of the Gold Standard Mining Co. These claims are located on the belt of calcareous schists that lie northeast of the mile-wide granitic intrusion which outcrops along the shores of Moth Cove. The dominant structure of the schists is their cleavage, which strikes

in general N. 68° W. and dips at rather low angles to the south. The vein on which most development work has been done trends parallel to the schist but dips at a much higher angle. Mining developments at this place consist of a 75-foot drift, from a point near the center of which a 100-foot winze has been sunk at an angle of about 45°. The winze is driven at a flatter inclination than that of the vein and consequently the lower part lies in barren country rock which the operators believe is a few feet above the vein.

The vein in places is said to have been 5 feet wide, but in the breast of the drift the width was about 18 inches. The gangue is mainly quartz with subordinate quantities of calcite. Pyrite is the most abundant metallic mineral, but the ore is reported to carry about 5 per cent copper in the form of sulphide. The ore is mined both for its copper and gold content. The gold in the ore is said to be equal in value to the copper.

Work at this place has been in progress more or less intermittently for three years, but no ore has been shipped and seldom have more than three or four men been employed. A small 6-horsepower gasoline hoist is the only machinery as yet installed. So far only a little water has been encountered and the walls stand well without timbering, so that mining expenses are not heavy.

On the Sealevel group of claims at the head of Thorne Arm no work has been in progress for about nine years, and at the time of the writer's visit only a caretaker was living in the region. The buildings are fast falling into ruins and many have already collapsed, burying and still further wrecking the machinery that they contained. The only recent prospecting was done on some claims about three-eighths of a mile from the beach. This work was done during the winter of 1912–13 and accomplished little more than exposing some mineralized vein material. The vein was similar to most of the gold quartz veins of southeastern Alaska in that it was not strongly mineralized with metallic sulphides. It was considerably fractured, but so far as exposed was not much dislocated. Between this claim and the beach were numerous large bowlders of glassy white unmineralized quartz that undoubtedly have not been transported far.

MISCELLANEOUS LOCALITIES.

In the past prospecting has been carried on at some places on Dall Island, on Annette Island, and on Gravina Island, but in 1913 practically no work was in progress at any of these places.

DALL ISLAND.

Dall Island lies off the southwestern coast of Prince of Wales Island. Copper and gold have been discovered at several places on its eastern coast and in the past have been most extensively

developed on the Mount Vesta group of chains. This property was idle in 1913, but a little prospecting was done on a group of 12 claims on Baldy Mountain that are situated near the contact of a granite and limestone northwest of the Mount Vesta group. Near the head of Sea Otter Harbor, a bay on the west coast of Dall Island between Juel Point and Cape Lookout, prospecting on the Moonshine claim has disclosed galena ore that is said to carry a considerable amount of silver. Developments at this place, however, have as yet not been sufficient to demonstrate the extent or quality of the ore.

ANNETTE ISLAND.

Many years ago Annette Island was given to the natives and prospecting or mining by whites forbidden. This prohibition has led to considerable dissatisfaction, owing to the circulation of tales of fabulously rich mineral deposits. Before the prospectors were ordered off some work had been done at several places on the eastern side of this island, notably about 1½ to 2 miles inland from the head of Crab Bay and along the western shore of Cascade Inlet. At all these places mineralization was seen, but its amount as disclosed in the pits and excavations, which presumably had been made on the most promising leads, was not great enough to warrant much further exploitation even if the island were open for mining location. At scores of places in other parts of southeastern Alaska fully as extensively mineralized areas are lying unstaked.

In the mineralized area on the west shore of Cascade Inlet gold is the main valuable mineral. It occurs both native and associated with sulphides in quartz veins in the contact zone between dark graphitic schists and nearly black, less deformed slaty shales. The native gold is said to have been particularly abundant near the contact of the veins and the country rock. Pyrite and gray copper are the most abundant of the sulphides. They form, however, probably less than 1 per cent of the vein material and are distributed mainly in narrow stringers, apparently along fracture planes in the quartz.

The mineralized area west of Crab Bay lies near the contact of limestone and quartzose schist. Gray copper is the principal metallic mineral. It occurs in disseminated particles and in narrow stringers, of which the largest seen was less than half an inch wide and a foot long. Associated with the gray copper is a small amount of galena and pyrite. At most of the openings no distinct quartz veins are recognized. On the old Tyee claim, however, there was a shattered zone in which some quartz and sulphides had been introduced. At this claim some barite, a mineral nowhere else noted in the region, was recognized in stringers several inches wide, but its relation to the quartz and sulphides was not determinable. The

drainage at this place is noteworthy, for two lakes, each a quarter of a mile or more long, discharge eastward by means of a subterranean river whose course is determined by a belt of soluble limestone. After flowing nearly half a mile underground this water again appears at the surface east of the hills that apparently form a barrier to the eastward discharge of the lakes.

GRAVINA ISLAND.

Gravina Island lies northwest of Annette Island and west of Revillagigedo Island. Formerly some mining was done near Vallenar Bay at the north end of the island, near Gravina Point on the east coast, near Seal Cove on the southeast coast, and at a small bay on the west coast a short distance north of Dall Head, but at none of these places was mining in progress in 1913. The old prospect on the south shore of Vallenar Bay has been long deserted. The Goldstream mine, north of Gravina Point, was reopened a short time ago, but inadequate capital and other difficulties caused an early abandonment of the venture. A few shallow pits, which disclosed somewhat mineralized rock, were noted south of the Goldstream mine, but these represented little more than the annual work required by law.

When Seal Cove was visited in May no work was in progress, and not even a caretaker was living on any of the properties. The buildings and equipment, however, were in a good state of preservation, and a resumption of activities was anticipated in the near future. The main development at this place consists of a crosscut tunnel over 2,000 feet long, driven westward from a point near the shore. Four or five leads were intersected in the tunnel, and each of them has been somewhat explored by short drifts or raises. Sulphides are common not only in the veins, but also in disseminated particles throughout the country rock. The sulphides in the veins are mainly chalcopyrite and pyrite, but those in the country rock are dominantly pyrite. Subordinate quantities of gold are also reported to occur in the more mineralized areas. The rocks traversed by the crosscut are mainly igneous and have diverse compositions, trends, and inclinations. All of them are considerably jointed, and many of them are strongly slickensided. They stand well, however, and in the crosscut require little or no support by timber.

In the small bay on the west side of Gravina Island, about 2 miles north of Dall Head, some prospecting for copper has been done in the past, but the finds apparently were not satisfactory, for no work was in progress last year. The place, however, is interesting to the geologist, for in 1913 in certain of the rocks near the prospect holes Triassic fossils were found. The presence of these fossils determines

the lower age limit of the mineralization of this part of Gravina Island and corroborates the previously theoretically deduced conclusion that the age of part at least of the mineralization in the Ketchikan precinct is Mesozoic. Similar rocks containing specifically identical fossils extend several miles north of this bay and include the previously reported but now abandoned prospects about 6 miles north of Dall Head.