Much movement is shown by the slickensided walls, and later cross fractures are filled with calcite. The ores are galena, zinc blende, copper and iron pyrites carrying as a rule low values in gold and silver. The ore is also very pockety, and solid ore alternates with barren zones. The width of the veins varies from 2 to 4 feet, and one mine only, the Surprise, has been proved to a depth of 360 feet. Other veins contain pyrite chiefly and have been noted for the rich showings of free gold in quartz. These, unfortunately, were only surface enrichments and had no depth, the pyrite immediately below being practically barren.

Contact deposits between the various igneous rocks and the limestone, include the large and important bodies of magnetite situated on the south side of the island and owned by the Puget Sound Iron Company. On this property there is also a series of copper deposits—chalcopyrite and carbonates—along the contact of the limestone with the altered porphyrites or the magnetite. The ore occurs in rudely lenticular bodies lying at various angles from vertical to horizontal, the limestone being almost invariably the hanging wall or roof.

The important deposits of bornite and chalcopyrite, to which particular reference will be made, are found wholly in the limestone. At present two mines are being worked—the Marble Bay and Cornell. The Copper Queen, which was the pioneer mine of the district, is lying idle. (Fig. 1).

THE MARBLE BAY MINE.

In 1897, an insignificant outcrop of copper and iron pyrites with some bornite was found a quarter of a mile east of Sturt Bay, on a Crown-granted lot, owned by Messrs. Christie and Palmer, of Toronto. A shaft was sunk on the ore and drifts run, but it was not until the 260-foot level was reached that the ore body assumed a definite character.

In 1902 the property was purchased by the Tacoma Steel Company for $150,000, and it was extremely gratifying to the company to have been able to pay the whole of the purchase price in three years out of the profits earned by the mine. The mine is now 760 feet deep and 715 feet below high tide. The ore body from the 260-foot level to the present workings has varied in length from 75 to 115 feet, and in width from a few inches to 45 feet. On the first floor of the 760 level, it is 87 feet long with a maximum width of 32 feet.

From the 140 to the 560 level the ore body pitched north at a high angle, but from there to the 760 it is practically vertical.

From the data collected this deposit may be described as an ore chute, occurring in a zone of brecciation in the crystalline limestone, this zone being approximately parallel to the strike. Divided into subordinate chutes above the 360 level, it has, below that, been continuous. The borders are broadly irregular, and small stringers are given off which run a few inches into the country rock. In the upper levels the walls were brecciated and weak, but in the lower they are firm, and very little work is necessary in the way of lagging. The ore is bornite with subordinate chalcopyrite, and a little pyrite, pyrrhotite and molybdenite. These occur in a gangue made up largely of pale green pyroxene—"green-felsite,"—and reddish brown garnet—"bull-felsite,"—with calcite. The ore is either finely disseminated through the pyroxene, or occurs in large rather pure masses between the pyroxene and the limestone. Very little is found in the garnet. A considerable proportion of the pyroxene gangue is partially altered, and disintegrates rapidly on exposure to the air. There are also large areas of the pyroxene which are practically barren. A microscopic examination of a few prepared sections of the gangue shows that the pyroxene (variety omphacite) occurs in mosaics of clear individuals with turbid borders. The garnet, which shows zonary structure, and optical anomalies, is traversed by numerous cracks which are filled with turbid material, in part calcite. Towards the calcite, the garnet has a tendency to develop crystal outline. Bornite and chalcopyrite occur in small grains, solitary, or connected in groups by narrow stringers between the pyroxene individuals, inter-grown with them, or along cracks in them and the garnet. Calcite with the larger grains of the sulphides, well formed garnets-andradite—and vesuvianite, were the last to crystallize out, and filled all the interstitial spaces.

Subsequent to the formation of the ore body, it was cut by one of the later dykes of basic porphyrite. Between the seventh and eighth levels it varied in width from 4 to 6 feet, with ore on both sides. This dyke dipped to the south, and in its downward extension became much reduced in size. On the 760 level it is only 7 inches wide, and crosses the drift some distance south of the ore body. It is highly altered with a development of numerous fissures now filled with epidote, and pyrite. This intrusion caused considerable movement in parts of the ore body, and many small fissures were formed and subsequently filled with chlorite, pyrite and calcite. Some beautiful examples of slickensided surfaces are seen, especially where molybdenite occurs. The pyroxene and garnet have both been fractured, and under microscopic examination the former showed strain shadows, incipient and complete granulation, with considerable alteration. Bornite has been re-deposited along these lines of fracture, between individual grains, and along cleavage planes. It occurs in solitary and connected grains and parallel bands. Calcite of the first generation shows strain shadows, and the last phase in the formation of the deposit was the filling up of the small interstitial spaces with calcite. The order of crystallization was pyroxene and garnet, simultaneously, along with the greater part of the bornite, then the remainder of the bornite in larger masses associated with well-formed garnets, vesuvianite and calcite.

ORIGIN.

This deposit is closely connected with the intrusion of the coast granite, and is clearly of pneumatolytic origin, being an example of the Kristania type.

It is well known that molten magmas give off enormous quantities of aqueous vapors which in this case would have a profound effect on the limestone through which they would pass along zones of brecciation or bedding planes. The limestone has here been replaced by silicates rich in lime, and by sulphide ores with the consequent liberation of carbonic acid gas. With the exception of the lime and a small amount of magnesia, all the other constituents are foreign to the limestone, and must have been brought up from below with the aqueous vapors.

An approximate analysis of the pyroxene gangue resulted as follows: SiO_2 55.25, Fe_2O_3 and Al_2O_3 6.50, CaO 25.00, MgO 14.50.

Garnet (andradite) averages about 31%, and vesuvianite about 35% of lime oxide.

The deposition of ore and gangue went on simultaneously with the cooling of the granite magma, and the ore body was formed before the intrusion of the aplite dykes. These dykes have not been found as yet in the