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 ft., and one mine only, the Surprise, has been proved to a depth of 360 ft. 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 Co. 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

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 were run, but it was not until the 260-ft. level was reached that the ore body assumed a definite character.

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

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

From the data collected this deposit may be described as an ore shoot occurring in a zone of brecciation in the crystalline limestone, this zone being approximately parallel to the strike. Divided into subordinate shoots above the 360-ft. 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 it 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 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 ft. with ore on both sides. This dyke dipped to the south, and in its downward extension became much reduced in size. On the 760-ft. level it is only 7 in. 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 movements 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 redeposited 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 all 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 enor-

*"Genesis of Ore Deposits"—Prof. J. H. L. Vogt, p. 648 *et seq.*; Waldemar Lindgren, p. 725 *et seq.*

"Trans. Amer. Inst. Min. Eng."—W. H. Weed, Ore Deposits near Igneous Contacts, Vol. XXXIII, p. 720.