sparingly disseminated minute crystals of pyrite and some carbonate material and weathers brown and greenish. The rocks are also traversed by several cleavages which cause the shale in weathering to break up into small thin shingles or pencils.4/

4/ Mallery, Willard, op. cit.

As exposed to the northwest and 80 to 100 feet above the mill and farther up the slope the Star Peak rocks are overlain unconformably by horizontally bedded green volcanic tuff 100 feet or more in thickness, locally known as basaltic ash, and which higher up is capped with brownish andesite.

As exposed on the slope at about half way between the mill and the Bernice mine, the rocks are also cut by dikes of fresh black basalt or basic aguite andesite ranging up to 20 feet or more in width. These dikes, the flow capping the green tuff and the adjoining andesite area on the west, may all be the same rock.

Silver-gold deposits

The deposits occur mainly in quartz veins in the Star Peak formation. They are opened principally at 5 localities, as follows: the Bernice mine, the Antimony King mine, the Williams-Hoyt mine, the I.H.X. mine, and the Lofthouse mine.

Mines

Bernice mine

The Bernice mine is located about a mile north of Bernice in the trunk of the ridge separating Antimony Canyon from Hoyt Canyon on the north at an elevation of about 6,300 feet, figure 102. It is on the Bernice vein which strikes a few degrees east of north following in part a fault, and dips mostly steeply about 70° to the west in the dark slate-sandstone rocks of the Star Peak formation. The dip, however, varies from 40° to nearly 90° and locally in the middle tunnel it is steep to the east.

The vein varies from 1 to 6 feet or more in width and averages about 4 feet in width. It consists of quartz and crushed, altered, and mineralized rock or fault breccia and is in part banded and some drusy, much of the quartz being hard. It is a silver-gold deposit and contains in the sulphide zone associated with pyrite also some antimony or stibnite. The values are mostly in silver with much of the ore running also $5 to $6 in gold to the ton. The ore was mostly free milling especially in the oxidized zone which extends to the depth of about 100 feet, and contained much rich silver chloride. The sulphide zone begins more or less abruptly. Its upper limit probably marks an ancient water table, for the mine is said to have been always dry. The sulphide ore has an arsenical base. Banded specimens of it having a quartz-feldspar gangue

collected by the writer from the 2nd tunnel level contain much arsenopyrite, with considerable associated stibnite and a polished section shows jamesonite replacing sphalerite. But the ore on being treated for 2 1/2 hours with 12 to 20 percent of salt is said to liberate 85 percent of its metallic values. Most of the ore was milled at the mine and it was mostly of relatively high grade. The vein has a known length of more than 1,200 feet and a vertical range of more than 500 feet. It has been opened to the depth of more than 400 feet, principally on 3 levels by 3 adit drifts or tunnels, upper, middle, and lower, which are spaced respectively about 130 feet and 190 feet apart vertically, and contain extensive stopes and raises.

The upper tunnel is at an altitude of about 6,300 feet and is about 200 feet below the highest openings on the vein and 300 feet below the top of the ridge.

The lower tunnel is about 1,100 feet in length and ends in the dark slate. The others are probably each about 700 feet in length; the upper tunnel for the distance of 500 feet from the portal is stoped to the surface.

From the other levels are projected extensive upraises and stopes in some of which ore is still in sight. Men who worked in the mine believe it to contain much ore below its present workings.

The deposits are believed to be pre-Tertiary and genetically connected with Mesozoic intrusive rocks.

Hoyt mine

The Hoyt mine, not visited in this work, is in Hoyt Canyon about 3 miles northwest of Bernice and 2 miles northwest of the Bernice mine. It is reached by a road ascending the canyon from the west. It is owned by Hoyt and John Williams of Fallon. It is said to have produced more than $60,000 in chiefly silver ore, which was treated in the Bernice mill. It is said to have produced also considerable antimony.

The country rock throughout the canyon has been mapped as rhyolite by the Fortieth Parallel Survey. But the deposits probably occur in the underlying black slate, the same as those at Bernice to which they are said to be similar. They are opened to the depth of more than 200 feet and have been worked mainly by means of adit drift or tunnel.

Antimony deposits

At the three mines or prospects remaining to be described, the deposits are antimony deposits. According to Mallery who examined the antimony deposits throughout the district, they all occur in quartz fissure veins in the lower slate member of the Star Peak formation, and they are associated with the intercallated siliceous limestone strata which, in general, are persistent with their course across the country marked by prominent croppings. The ore mineral is stibnite, the sulphide of antimony on which the yellow oxide cervantite, whose occurrence is of mineralogical interest only, forms coatings in the croppings and ore at or near the surface.

Antimony King mine-- The Antimony King mine, owned by J. P. Williams and which has been the principal producer of antimony in the district, is nearly opposite Bernice on the southerly side of Antimony Canyon and approximately on the southerly trend of the Bernice vein. It is mainly on the Antimony King vein, which has been described by Mallery5/

5/ Mallery, Willard, op. cit.

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as having a known extent of more than 900 feet, and is regarded as remarkably persistent for an antimony deposit. It dips 50° westward in the lower dark slate member of the Star Peak formation, which it cuts at nearly right angles. The slate wall rock is altered and contains a little cubical pyrite. The vein traverses also two intercallated siliceous limestone strata each about 8 feet in thickness and spaced about 300 feet apart. It is a quartz fissure vein with a parting of dark slate gouge on either wall and the quartz ranging up to 4 feet in width, all of which width in places is solid ore or stibnite. Sphalerite is very sparingly present in the ore.

The deposits are best developed in association with the limestone strata which consist of a fine-grained massive bluish gray rock. It contains small disseminated cubes of pyrite and specks of stibnite and on the joint and cleavage planes films of stibnite, by reason of which latter mineral its croppings for long distances are stained yellowish with antimony oxide. But the stibnite is not present in sufficient quantity in the rock to constitute ore.

> "The best ore-shoots occur south of the intersection of the vein with the southern limestone stratum. Here the lower drift has opened up the vein continuously for a distance of 200 feet to a depth of 100 feet. A faulted segment of the limestone strikes nearly parallel with the vein at this intersection, and for a distance of 70 feet this segment has become incorporated into the lode, forming a 'lime spur' lying next the hanging wall. The best orebodies occur in the quartz under this lime spur, where solid stibnite in widths up to 2 feet and a mixture of massive stibnite and quartz in widths up to 4 feet have been discovered. This 'spur' feathers out on the south strike of the vein and the ore becomes less massive in character, showing a banded structure of alternate stibnite and quartz. Northward through the slate the vein though small, continues with occasional good shoots of ore until it intersects the northern limestone stratum, beyond which it is apparently barren." 6/

6/ Mallery, Willard, op. cit.

1916?

I. H. X. mine--The I. H. X. mine, known also as the Solomon mine, is in Antimony Canyon, about a mile and a half downstream from the Antimony King mine and a mile from the mill, at an elevation of about 5,100 feet.

The Chapman Smelting Co., of San Francisco, is said to have produced 50 tons of 50 percent antimony ore here in 1915, and that it was expecting to produce 200 tons in 1916.

The country rock is the brown indurated calcareous shale or slate of the Star Peak formation which here and in the vicinity is intruded by dikes of light-gray nearly dense sodic (plagioclase) aplite, with which the ore is associated.

The vein dips 60° to the west. As seen by the writer in 1920, it consists chiefly of alternately banded quartz and stibnite. It ranges up to 3½ feet in maximum width and contains good shoots of relatively pure stibnite.

The principal workings are in the bluff standing about 40 feet above the floor of the canyon. They comprise several hundred feet of drift and stopes extending mostly from the face of a lower adit crosscut tunnel. The upper part of the workings show that an 8-foot wide dike of the aplite in part at least forms the hanging wall. They also show a gouge parting of crushed country rock, aplite, and quartz on the vein walls. The dike contains sparingly disseminated minute cubes of primary pyrite and specks of stibnite. Many prospect openings have been made along the dike on the opposite side of the canyon.

Lofthouse mine--The Lofthouse antimony mine, owned by Ralph Lofthouse, of Fallon, is about 5 miles south of Bernice, in Dyer Canyon, the second large canyon south of Antimony Canyon. It is credited with a small production of antimony during the World War. The deposit occurs in the same black slate section of the Star Peak rocks as the Bernice deposits afore described. The vein is a fissure with quartz filling and dips 50° to the west like the Antimony King vein. The limestone stratum associated with it is the only one in great thickness of enclosing slate, and is another good example of the genetic relation of the limestone and the ore bodies characteristic in the district. The ore is less massive than that in the Antimony King mine. It occurs mostly in fibrous and acicular forms.7/

7/ Waller, Willard, op. cit.

Alpine district

Location and topography

The Alpine district is near Alpine in the eastern part of Churchill County in the lower east slope of the Augusta Range, at an altitude of about 6,000 feet. It is on the opposite side of the range from the