there are scattered, irregular bodies of galena. The largest body of ore was mined from a tunnel at a barometric elevation of 8,100 feet, on the north side of the hill across which the fissure runs. This body, averaging about 2 feet wide, was 75 feet long on the drift and about 25 feet high on the dip of the vein and pitched northeast in the fissure. At both ends of the ore shoot the barren calcite filling of the fissure continues. About one-half mile south of this body, in the bottom of a gulch, at a barometric elevation of 7,600 feet, tunnels on the fissure open some smaller bodies of ore. There is very little oxidation on this vein. Nearly pure galena outcrops all along its strike, but occasionally small amounts of anglesite and cerusite are seen as thin crusts coating the galena directly at the surface. The sorted galena is said to carry about 2.75 ounces of silver a ton.

Nubagah prospect.—The Nubagah prospect is 4½ miles northwest of Steptoe post office, in the middle part of the east slope of the Egan Range, where the massive limestones are the country rock. A 10-foot shaft is sunk on a tight fissure with north strike and steep east dip. A little galena and cerusite replace the limestone for a short distance on both sides of the fissure. The largest body of ore was found directly at the surface and east of the fissure.

WARD DISTRICT.

LOCATION AND GENERAL FEATURES.

The Ward district (No. 29, fig. 1, p. 18) includes a few square miles of the east front of Egan Range, about 16 miles south of Ely, its shipping and supply point. A good road in Steptoe Valley leads to the camp (barometric elevation, 8,025 feet) at the base of the range, which rises abruptly from the valley floor at least 1,500 feet in about 2 miles. The principal mines are in secs. 14 and 15, though some claims are in secs. 9, 10, and 16, of T. 14 N., R. 63 E. (See fig. 17.) Small springs occur in the vicinity of the mines, and a good stream of water flows in Willow Canyon about 4 miles south of the camp.

GEOLOGY.

This part of the Egan Range seems to consist entirely of a series of thin-bedded, light and dark blue-gray Carboniferous limestones that have been intruded by an intricate system of quartz monzonite dikes. In the surface exposures the igneous rocks are not conspicuous, but in the various mine workings large amounts of them may be seen

SEDIMENTARY ROCKS.

The limestones, which form the greater part of the surface exposures in the Ward district, are in beds 10 inches to 2 feet thick. They are usually of a light blue-gray color, though some beds are dark gray and some contain a large amount of brown chert. Between the Paymaster and the Mammoth tunnels (Nos. 6 and 8, fig. 17), lime shales are interstratified with the true limestones. Among a few fossils collected by the writer on the trail halfway between the Paymaster and Martin White tunnels (Nos. 6 and 9, fig. 17), G. H. Girty identified the Pennsylvanian forms *Rhombopora* sp., *Productus* sp., and *Spirifer* aff. *S. cameratus*. Spurr[1] reports that a large collection of Permian fossils was obtained from limestones on the southeastern slope of Hamels Peak, whose summit is about 6 miles northwest of Ward. (See Pl. I.)

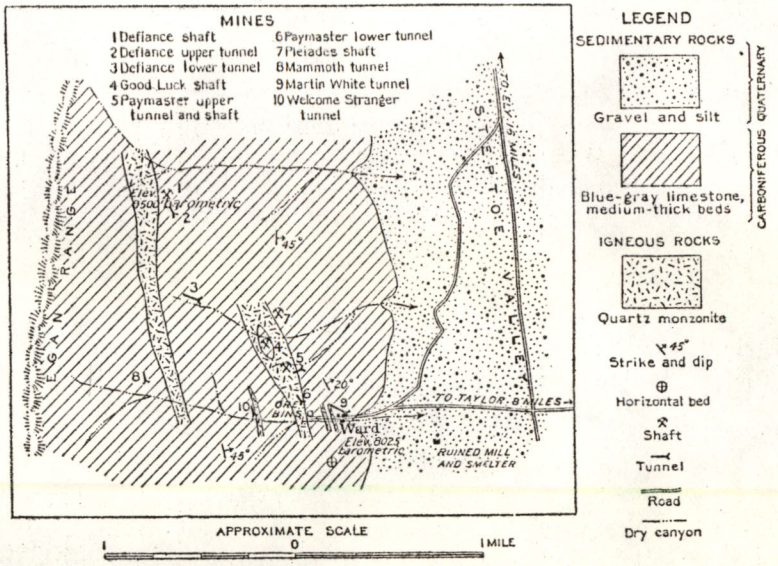

FIGURE 17.—Sketch map of the Ward district, White Pine County, Nev.

In the vicinity of Ward the sedimentary rocks have a north or north-northwest strike and a low east dip. South of the mouth of Ward Canyon the limestones are horizontal. A rather strong fault seems to strike north-northwest across Ward Canyon a mile west of the Ore Bins and east of the upper Defiance workings (Nos. 1 and 2, fig. 17). This fault appears to dip east and is thought to have dropped the beds on the east relatively to those on the west.

IGNEOUS ROCKS.

All of the dike rocks of this district are much altered and most of them have been mineralized to some extent. A specimen of fairly

[1] Spurr, J. E., Descriptive geology of Nevada south of the fortieth parallel and adjacent portions of California: U. S. Geol. Survey Bull. 208, p. 52, 1903.

fresh rock from the dump of the lower Paymaster tunnel seems to be a quartz monzonite porphyry, though it may be a granite porphyry. Phenocrysts of a plagioclase feldspar too much altered for definite determination, with some quartz, biotite, and possibly orthoclase are the phenocrystic minerals. The feldspars are altered to masses of calcite and sericite and the biotite is chloritized. The groundmass consists of a microgranular intergrowth of quartz and feldspar, the latter being sericitized. Apatite is an abundant accessory mineral. In most places where seen the highly altered porphyritic rocks retain their texture, though in many places all the minerals, except quartz and apatite, are changed to sericite and calcite. Crystals of pyrite and galena are widely disseminated in the highly altered igneous rocks.

The limestones near the dikes are comparatively free from lime silicate minerals, though in some places they have been silicified and in other places altered to soft iron-stained masses of sericite or calcite. Near the Welcome Stranger tunnel (No. 10, fig. 17) a small mass of dark lime silicate rock lies along the contact between limestone and a porphyry dike, and near the face of the lower Defiance tunnel (No. 3, fig. 17) the limestones are silicified and contain some narrow bands of lime silicate. The most abundant contact-metamorphic mineral in the district is a brownish-gray garnet, though a little light-colored pyroxene, calcite, and quartz are usually present in the zones of lime silicate rocks.

ORE DEPOSITS.

HISTORY AND PRODUCTION.

The ore bodies of the Ward district are said to have been discovered about 1869. The district was organized in 1872, at which time Raymond[1] says that the Martin White Silver Mining Co. of San Francisco owned most of the mines in the district. This company started development in October, 1874, and during the year sank the Paymaster shaft 190 feet. Raymond says that all the mines show considerable quantities of ore, principally sulphurets, assaying from $40 to $300 a ton. Whitehill[2] reports that Ward had a population of 1,000 in 1876, and that a 20-stamp mill and two furnaces of 35 tons' capacity each were in operation. The Austin chloridizing process was used for a time on the rich carbonate ores from the Paymaster and Defiance mines. Whitehill[3] reported that the total

[1] Raymond, R. W., Statistics of mines and mining in the States and Territories west of the Rocky Mountains for 1874, p. 272, 1875.

[2] Whitehill, H. R., Nevada State Mineralogist Sixth Biennial Rept., for 1875–76, pp. 167–168, 1877.

[3] Whitehill, H. R., Nevada State Mineralogist Seventh Biennial Rept., for 1877–78, pp. 160–175, 1879.

production of the district was $550,000 to the year 1878. It is said that the mines were actively worked until about 1882. Plate[1] says that the Martin White Silver Mining Co. did not mine any ore of less than $50 grade, as a consequence of which many tons of fair-grade ore are yet in the mines.

In 1906 practically all of the claims in the Ward district were acquired by the Nevada United Mines Co., which now owns 12,000 acres of patented mining ground and 1,000 acres of ranch land at the mouth of Willow Creek, whose waters they own. According to the estimates of the present owners, $7,000,000 has been taken from these ore bodies. The mines have been idle for several years, but some ore has been shipped from the old dumps. In 1913 a small force of men was reopening the Good Luck shaft and the lower Paymaster tunnel with a view to working the large body of low-grade ore left by the early operators.

OCCURRENCE AND CHARACTER OF THE ORES.

The ore bodies of the Ward district are closely associated with the intrusive quartz monzonite porphyry. They usually occur along the contacts of the igneous rocks as replacements and veins both in the intrusive and limestone. The mineralization took place after the consolidation of the quartz monzonite porphyry, and that rock is everywhere sericitized and calcitized and contains finely disseminated pyrite and galena. The large ore body at the Good Luck appears to be a block of altered limestone included in the porphyry. The Defiance body at the surface is a mass of brown limonite cut by fissures in which rich lead carbonate was found. As seen in the lower tunnel 500 feet below the croppings, it is a mass of silicified limestone about 300 feet wide impregnated with sulphides.

The rich ore mined in the early days was largely argentiferous lead carbonate that carried the silver in part as chloride. The old workings were apparently above the water level. The sulphide zone was cut at a depth of 160 to 180 feet, and the sulphide ores were found to consist largely of sphalerite, pyrite, and galena, with chalcopyrite in some places. As a rule, however, there does not seem to have been a large amount of copper in any of the primary ore bodies.

THE MINES.

Defiance mine.—The Defiance ore body, at an elevation of about 9,500 feet 1½ miles northwest of Ward, is developed by a shaft, now inaccessible, a drift tunnel aggregating 800 feet near the top of the hill (Nos. 1 and 2, fig. 17), and a crosscut tunnel 1,300 feet long, 500 feet below the croppings (No. 3, fig. 17). The croppings are about

[1] Plate, H. R., The old camp of Ward, Nev.: Min. and Sci. Press, vol. 94, p. 281, 1907.

200 feet wide and at least 600 feet long along the east side of a quartz monzonite dike that strikes north. They consist of cellular dark-brown hydrous iron oxide that in places shows a little copper stain and in places is cut by northeastward-trending fissures filled with yellow lead carbonate. These streaks of sand carbonate constituted the rich silver ore mined in the early days. It is said that similar ore continued to the bottom of a winze 140 feet below the tunnel level, at which depth a wall that dipped 40° W. cut off the ore. The lower crosscut tunnel runs N. 70° W. for 1,300 feet. Near the end of the tunnel a belt of silicified limestone containing abundant pyrite and some chalcopyrite and galena lies east of a strong fault that strikes N. 40° E. and dips 50° E. Near the fault some narrow bands of gray garnet carry galena and pyrite. Farther east the limestones are silicified and show bands of sulphides as well as the bands containing disseminated minerals. The bands of sulphides, some of which are 20 feet wide, consist almost entirely of pyrite but show a little chalcopyrite. In the bands of silicified limestone, pyrite is more abundant than galena, and both minerals are apt to be segregated to some extent in bands and nodular masses. This whole zone of mineralized rock has been fractured, and little veinlets of calcite carrying secondary galena or a little pyrite permeate it everywhere.

It seems probable that the face of this tunnel is not far from the eastern edge of the quartz monzonite dike exposed on the hill above the tunnel mouth. There is little question that the body of sulphide ore exposed at the end of this crosscut is the extension of the oxidized iron croppings of the Old Defiance workings.

Good Luck shaft.—The Good Luck shaft (No. 4, fig. 17), about half a mile northwest of Ward, is vertical and is said to connect with 3,500 feet of workings. The 280-foot level of this shaft connects with the lower Paymaster tunnel (No. 6, fig. 17). The Good Luck ore body seems to be a replacement of the southern part of a block of limestone included in the large quartz monzonite dike. At the 260-foot level the limestone in an area 60 feet by 150 feet is altered to a soft ocherous mass containing irregular streaks and bunches of hard dark-brown iron oxide and pockets of yellow sand carbonate, which is the high-grade ore. The east, south, and west boundaries of the ore body at this level are porphyry that is bleached and mineralized at the contacts. The north boundary is not definitely marked, the ocher grading through iron-stained rock into unaltered limestone. The ore at this level is said to average less than $10 a ton. On the 160-foot level the ore body is at least 150 feet by 250 feet in area, as shown by a large number of crosscuts and drifts. The east boundary only is definitely marked by the porphyry, which dips 55° W. At this level the bodies of sand carbonate seem to be larger than in the lower level, and some irregular bodies of hard lead carbonate occur.

The ore body at the 135-foot level is about 300 feet long and about 200 feet wide, and is said to average $17 a ton in lead and silver. The ore is redder than in the lower levels and carries some manganese oxide, particularly in the zone between the good ore and barren limestone at the north end of the body.

Paymaster mine.—The Paymaster mine is developed by abandoned shafts and tunnels about a quarter of a mile northwest of Ward and by the Paymaster lower tunnel (No. 6, fig. 17) a few hundred feet west of the camp. This tunnel runs north-northwest for 1,200 feet under the old Paymaster workings to the Good Luck ore body. In the tunnel the northeast-dipping limestones are intruded by a number of small and large dikes of quartz monzonite porphyry. The limestones are somewhat silicified along the contacts but do not appear to be so highly altered as the intrusive rock, which is in many places changed to a mass of sericite and calcite that is thoroughly impregnated with sulphides. The alteration and mineralization of the intrusive rock is particularly strong near a series of fractures that strike N. 20°–40° W. and have a flat northeast dip. The Paymaster ore body is not well shown in this tunnel and the old workings can not be entered. The material on the dump of the upper tunnel (No. 5, fig. 17) indicates that part of the rich ore obtained was an ocherous sand carbonate. Specimens of both limestone and porphyry from this dump carry galena, sphalerite, and pyrite, and one of them carries a small amount of what seems to be argentite and a lead-copper-silver antimony-bearing mineral. A joint in a specimen of the sulphide ore contains a soft greenish-drab carbonate mineral that contains zinc and copper and shows light-purplish and green stains that denote silver and copper and are called silver chloride by the miners. The dumps have been sorted many times and practically all the ore has been shipped.

The dump of the lower tunnel consists of bleached quartz monzonite porphyry and limestone that shows little contact metamorphism. In the ore bins there are several tons of sulphide ore. Black sphalerite, galena, pyrite, and chalcopyrite (named in the order of decreasing abundance) occur in veinlets and irregular replacement veins in both altered igneous rock and limestone but appear to be more abundant in the quartz monzonite. From the poor exposures of the Paymaster ore body in this tunnel it would seem that the original ore minerals will probably be found in the immediate vicinity of the contacts of limestone and porphyry and that the larger bodies will be found in the porphyry, particularly near fissures that strike northwest. Blowpipe and rough chemical tests indicate that the original sulphide minerals do not contain large quantities of silver, and it seems probable that the chief metals found at depth will be zinc and lead.

The Martin White crosscut (No. 9, fig. 17), which starts at the camp, is said to be 3,200 feet long and to undercut both the Paymaster and Good Luck ore bodies. It was caved near the mouth in October, 1913, and could not be entered.

Pleiades shaft.—The Pleiades shaft (No. 7, fig. 17) is about 500 feet north of the Good Luck shaft across a shallow gulch. It is 250 feet deep with three short levels. The small ore bodies are irregularly scattered in a zone of crushed limestone and quartz monzonite porphyry along the footwall of a dike of the intrusive rock which strikes N. 40° W. and dips 50° SW. Oxidation extends to about the 100-foot level, below which the ore is comparatively low grade, consisting of sphalerite and galena, with minor amounts of pyrite and chalcopyrite.

Mammoth tunnel.—The Mammoth ore body (No. 8, fig. 17) is developed by open cuts and a short tunnel. The croppings, which are much like the Defiance croppings, consist of cellular brown limonite. They are 60 feet wide and 300 feet long on the surface a few feet west of a quartz monzonite porphyry dike.

Welcome Stranger tunnel.—The Welcome Stranger tunnel (No. 10, fig. 17) is about half a mile west of Ward on the north side of the canyon. The tunnel is about 500 feet long and trends N. 20° W. It starts 50 feet west of a 50-foot dike of quartz monzonite, which it cuts 200 feet from the mouth. The dike is altered and contains small cubes of pyrite and some galena. The limestone for 30 feet west of the dike is silicified and contains some disseminated pyrite and galena and also narrow bands of lime silicate rock with sulphides. The faulted contacts of the dike in several crosscuts expose gouge and crushed rock that contains sphalerite, pyrite, and galena. A number of east-west veins cutting both the limestone and porphyry carry sulphides and quartz.

faulting pre-ore

AURUM DISTRICT.

LOCATION AND ACCESSIBILITY.

The Aurum district (No. 21, fig. 1, p. 18), as described in this report, includes the north end of the Schell Creek Range, lying in Tps. 20, 21, and 22 N., Rs. 65 and 66 E., and comprises the Muncy Creek, Silver Canyon, Siegel Canyon, and Schellbourne subdistricts. (See Pl. VI.) The Schell Creek Range is long and is relatively narrow in its northern portion. Spring Valley lies east of the mountains and Steptoe west of them. Both of these valleys have typical broad flat bottoms with several playa basins along their axes. The mines and prospects on the east side of the range were visited during the reconnaissance on which this report is based. Aurum post office, at the mouth of Muncy Creek, in Spring Valley, is 42 miles by road

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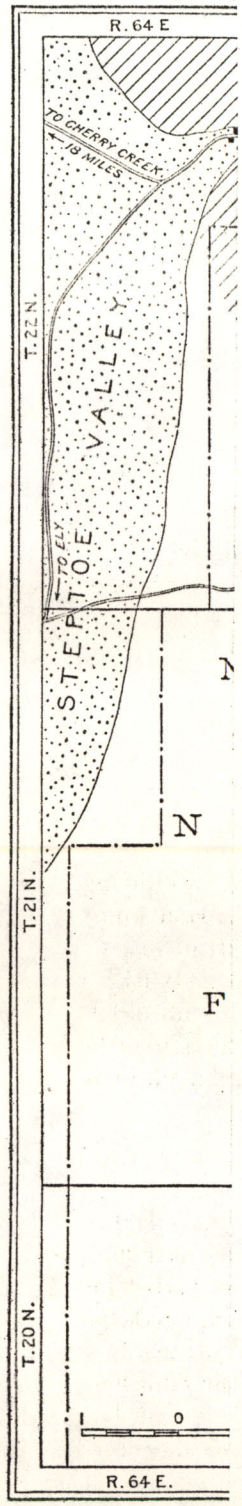

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