LEAD AND ZINC.

THE TRES HERMANAS MINING DISTRICT, NEW MEXICO.

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GENERAL FEATURES AND GEOLOGY.

About 25 miles south of Deming, N. Mex., and 10 miles north of the Mexican boundary the small group of mountains known as Tres Hermanas rises from the general level of the high plateau. The lead and zinc mining district is in the northern part of the group, the three peaks of which are in plain view from Deming. The road from Deming is almost level and has an elevation of 4,300 to 4,000 feet; on the east the crags of the Florida Mountains form a picturesque background to the plain, which is dotted by luxuriantly growing yuccas. According to Wheeler the highest peak of the Tres Hermanas attains an elevation of 7,151 feet. The railroad from Deming to Hermanas station is at the nearest point 10 miles from the mines, which as yet are most easily accessible from Deming.

The mines have been known for many years and have yielded a moderate production, possibly $200,000, principally from the Cincinnati vein and from the lead deposits in limestone near the present zinc mines. In 1904 zinc ores were discovered in the district, and in 1905 shipments were made to smelters in the Mississippi Valley, but in 1906 and 1907 there was little activity.

The geologic examination on which this paper is based was confined to the northern end of the district. It appears, however, that the predominating rock in the mountain group is a granite porphyry, which forms the central peaks and is intruded in Carboniferous limestones, which occupy the foothills. Specimens collected near the zinc mines show a coarse light brownish-gray porphyry with phenocrysts of feldspar up to 15 millimeters in length, small foils of biotite, and small crystals of dark-green hornblende. The

microscope shows that the phenocrysts consist of orthoclase with some oligoclase and that the crystals are embedded in a coarse micropegmatitic groundmass of quartz and orthoclase. Possibly the rock is more correctly to be classified as a quartz syenite porphyry.

The northern foothills at the zinc mines consist of bluish-gray fossiliferous limestones of lower Carboniferous age dipping northwest at low angles. At the junction with the granite porphyry strong contact metamorphism is noted.

MINERAL DEPOSITS.

The mineral deposits consist of normal fissure veins in granite porphyry and typical contact-metamorphic deposits of lead and zinc in limestone near the contact with porphyry. Little work has lately been done on the veins, which are situated about 1 mile south of the zinc mines, but some information in regard to them was obtained from reliable sources.

The Cincinnati vein, owned by the Golden Cross and Eagle Company, is the largest producer, and is said to have yielded $100,000. It is stated to be a narrow vein in porphyry, very rich in lead and gold. The ore was found within 100 feet from the surface. Some ore has also been shipped from the Yellow Jacket vein, which is reported to be an extension of the Cincinnati. The Hancock vein, owned by C. E. Burdick, of Deming, is also said to be a narrow vein in porphyry, up to 8 inches wide. The shaft on this vein is 400 feet deep and some work was in progress in 1905. About 1,000 tons of rich lead ore, with some gold, is said to have been shipped.

The zinc mines are situated at the northern base of the first porphyry hills. Old surface workings indicate the places where formerly galena ores were mined. Even now pieces containing this mineral are occasionally found. In 1904 attention was attracted to a heavy white massive or crystallized material occurring plentifully in the old workings and it was found to consist of carbonates and silicates of zinc. The property, which consists of five claims forming a compact group, was worked by Thurman & Lindauer, of Deming, in 1905, and a considerable number of carloads of ore were shipped to Mississippi Valley smelters. Some difficulty was experienced in obtaining ore of the requisite high percentage, and the systematic and careful development that the property seemed to deserve was not undertaken and it was practically idle in 1906 and 1907. Another group of claims adjoining the property on the northwest is owned by Doctor Swope and associates, of Deming, and some ore containing zinc and lead was shipped in 1906. The railroad freight from Deming to the smelters is $5 a ton, and the hauling to the station costs $2 a ton. Ore containing 29 per cent of zinc was paid for

by the smelters at about $11 a ton, and 37 per cent ore yielded approximately $16.50; obviously the lower grade left but little profit. The developments are slight, consisting of a few shallow inclines and surface cuts.

The traveler approaching Tres Hermanas from the north first encounters a low, broad limestone ridge, separated from the higher and more abrupt hills of porphyry on the south by a low gap. The principal zinc mines lie on the west side of this gap; the road leading up to it follows a broad gully, at first with a southeasterly direction, which close to the mines changes to due east. From the gap the plains are in full view, east and west. The main contact between limestone and porphyry runs east and west about a quarter of a mile to the south of the gap. The office of the Thurman & Lindauer property is situated in the gulch just west of the gap. The summit of the flat-topped limestone hill about 1,000 feet north-northwest of the office shows a moderately thick bed of bluish-gray limestone of lower Carboniferous age, highly fossiliferous in places. The strike is N. 80° E., the dip about 10° N. This series of limestones continues north-northwestward to the edge of the plains. In the little escarpment toward the gap the thin bed of fossiliferous rock is underlain by 5 feet of quartzitic limestone and below this lies a coarsely crystalline limestone. The gap is occupied by a similar coarse crystalline limestone with various dips and strikes; in one place, at some zinc prospects, a strike of N. 70° W. and a dip of 30° NNE. were noted. Nearer the porphyry hill the dip increases to 60°. About 1,000 feet west-southwest of the office at the principal workings there is a small hill with limestone which lies flat on the top, but bends to dips of 20° on the north, west, and south. The actual contact with the porphyry south of the gap is not very well exposed, but near it the limestone contains several well-defined dikes, and in one place a projecting broad tongue of porphyry distinctly cuts across the strata.

Contact metamorphism is clearly manifest, the affected zone being in places over 1,000 feet wide. The principal complex of limestone northwest of the gap is, on the whole, not metamorphosed, but even here, more than half a mile north of the contact, a few thin beds of garnet rock and coarsely crystalline limestone are noted. In the little bluff facing southward from the highest point where the fossiliferous limestone outcrops the beds underneath this member are distinctly altered to calcareous hornfels and coarsely crystalline limestone. In the gap the crystalline limestone prevails, with intercalated beds of pure garnet rock and hornfels, the latter evidently representing a contact-metamorphosed lime shale. Some of the strata exposed here contain well-preserved specimens of *Spirifer* and

Fenestella and look like limestone, but, in fact, the rock consists very largely of garnet. The principal zinc workings, about 2,000 feet west of the gap, are in limestone, in which the only sign of alteration consists of bunches of wollastonite.

The deposits contain oxidized zinc minerals and some galena; they lie in part parallel with the stratification, but in part they follow short and ill-defined nearly perpendicular fissures and veins cutting across the beds and varying in strike from northwest to southwest. The ores also in places form irregular bunches in the limestone. Several small deposits of the two latter classes are present on the main limestone hill, in many of the prospect holes sunk there, but have not yet been proved to be of value. A short distance north of the principal gap oxidized zinc ores occur in kidneys and bunches between beds of coarsely crystalline limestone and garnet rock. A veinlike deposit striking N. 60° E. and standing nearly vertical also contains zinc ores at this place. Many of the prospect holes in the area of most intense contact metamorphism in the gap or immediately east of it have also given assays high in zinc. The principal developments, about 2,000 feet west of the gap, consist of surface pits and small shafts with irregular workings. Here the oxidized zinc ores occur in the greatest abundance, in part parallel to the strata, in part along a vein with west-northwest strike. Little intelligent propecting had been undertaken in 1905, the deepest hole having attained only 35 feet from the surface. The ore grades into limestone, and great care must be exercised to avoid mixing with barren material.

About 1,000 feet north of this place, on the Contention claim, Doctor Swope and his associates sunk an incline 150 feet long following the dip of the strata, which here was 30°. Some lead and zinc ores were shipped from this claim in 1906.

Systematic prospecting with drills would be necessary to develop these deposits. The principal ore bodies will no doubt be found intercalated between the flat-dipping strata.

As noted above, the galena was discovered at an early date, but the zinc ores escaped detection until recently. A few green stains are the only indications of copper minerals found. Possibly exploration may develop more of this metal in beds at greater depth. The galena was seen at the principal workings accompanied by a little pyrite and intimately intergrown with wollastonite in a manner indicating simultaneous deposition. The zinc ores occur as dark-gray cellular masses and consist largely of the unusual mineral willemite, the pure anhydrous silicate of zinc. Smithsonite, the zinc carbonate, is also present in its usual mammillary form and light-gray or bluish color. Hydrozincite was shown to be present by Doctor Hillebrand as an earthy incrustation. Tabular crystals of calamine, the hydrous silicate of zinc, were noted in crevices of the ore. Willemite appears to

make up the bulk of the specimens collected. It is accompanied by a little black pyrolusite, which gives a dark tinge to the ore, and it forms small radial aggregates of slender hexagonal prisms, terminated by flat rhombohedra. It also forms loose crystalline aggregates and crusts of needle-like crystals. This habit is unusual, the more common form being a short, stout, hexagonal prism. The occurrence at Tres Hermanas seems to be paralleled only by that at Moresnet, in Belgium, where the willemite is also accompanied by galena. The only other occurrences noted in this country are at Franklin Furnace, N. J., and as rareties at Clifton, Ariz.,[a] and at the Merritt mine, in Socorro County, N. Mex. The zinc minerals of Tres Hermanas are beyond doubt derived from zinc blende by oxidation.

The principal zinc minerals of Tres Hermanas and their tenor are as follows:

Willemite (Zn_2SiO_4), zinc silicate, 58.6 per cent zinc.
Calamine ($H_2Zn_2SiO_5$), hydrous zinc silicate, 54.7 per cent zinc.
Smithsonite ($ZnCO_3$), zinc carbonate, 52.1 per cent zinc.
Hydrozincite ($ZnCO_3.2Zn(OH)_2$), basic zinc carbonate, 59.9 per cent zinc.

The zinc ores shipped from Tres Hermanas probably contained about 30 per cent of zinc. The shipments of lead-zinc ores made by Doctor Swope are stated to have contained from 11 to 40 per cent of lead and 2 ounces of silver to the ton. They also contained up to 19 per cent of zinc, 4 per cent of lime, 4.2 per cent of iron, and 7.40 per cent of silica.

An analysis of picked material from a loose aggregate of yellowish-white minute crystals gave the result recorded in column 1 below. Under 2 is given an analysis of a specimen fairly illustrating the average ore, but probably of lower grade than the material shipped.

Analyses of zinc ores from Tres Hermanas.

[Analyst, George Steiger.]

	1.	2.
SiO_2	23.52	9.12
$(FeAl)_2O_3$	.26	.22
ZnO	65.18	24.00
CaO	5.78	37.44
CO_2	4.59	29.05
H_2O-	None.	None.
H_2O+	.57	.71
MnO	None.	None.
	99.90	100.54

The first analysis gives willemite (Zn_2SiO_4), 82.75 per cent; calamine ($H_2Zn_2SiO_5$), 6.93 per cent; calcite ($CaCO_3$), 10.32 per cent;

[a] Lindgren, Waldemar, The copper deposits of the Clifton-Morenci district, Arizona; Prof. Paper U. S. Geol. Survey No. 43, 1905, p. 111.
[b] Genth, F. A., Contributions to minerology; Proc. Am. Philos. Soc., vol. 24, p. 37.

smithsonite ($ZnCO_3$), 0.14 per cent; limonite, 0.31 per cent. The second analysis, the water being disregarded, gives rather closely 66.05 per cent of calcite and 32.77 per cent of willemite. As in the first analysis, the water above 110° C. indicates the presence of a small percentage of calamine. However, as in that analysis, the calamine must be calculated from the small quantity of water contained, which makes the exact amount uncertain.

SURVEY PUBLICATIONS ON LEAD AND ZINC.

The following list includes the more important publications on lead and zinc published by the United States Geological Survey. In addition to the publications cited below certain of the geologic folios, especially the Joplin district folio (No. 148), the Lancaster-Mineral Point folio (No. 145), and the Franklin Furnace folio (No. 161), contain discussions of the lead and zinc resources of the districts of which they treat.

These publications, except those to which a price is affixed, can be obtained free by applying to the Director, United States Geological Survey, Washington, D. C. The priced publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.

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[a] Earlier volumes of the Mineral Resources of the United States contain discussions relating to the lead and zinc industries of the United States.

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IRVING, J. D. (See Emmons, S. F., and Irving, J. D.)

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