

Vanadium in New Mexico; Caballos Mts. Deposits

By James O. Clifford.

Since the introduction of vanadium as a purifying agent in the manufacture of steel, great interest has been evidenced in prospecting for and location of deposits of vanadiferous ores of commercial value.

While vanadium is comparatively widely distributed in nature, but few deposits of economic importance have thus far been discovered. The most important producing districts are Spain, Peru, Colorado and New Mexico. Of these, Spain produces vanadinite—a vanadate of lead with an inferior portion of lead chloride; Peru produces patronite (a vanadium sulphide), its oxidation products, and a vanadiferous asphaltite; Colorado produces carnotite (a uranyl-potassium vanadate contaminated with calcium and barium compounds) and roscoelite—a vanadium-aluminum silicate. The New Mexico product is mainly vanadinite.

The discovery of vanadium in New Mexico was made by Dr. F. M. Endlich in 1884, during his examination of the Lake Valley silver-lead mines. There the mineral occurs as long, slender, needle-like crystals and as flat crusts along the walls of the ore deposits. In chemical composition it varies from true vanadinite by its lesser percentage in vanadium pentoxide, and the higher content of arsenic pentoxide. Being intermediate in composition between vanadinite and mimetite it was named endlichite, in honor of the discoverer, and so listed by Dana. The mineral does not occur in commercial quantities in the Lake Valley district.

Vanadinite occurs near Hillsboro, Cook's Peak, Chloride, Georgetown and in the Caballos mountains, New Mexico. Roscoelite and descloizite have been found in the northwestern part of the state. Of the several districts above mentioned the Caballos Mountains' deposits, in view of their more extensive development, are the most important; therefore particular reference will be made to that district.

CABALLOS MOUNTAINS' DISTRICT.

History.—The presence of vanadinite in the mines of the Caballos mountains was first noticed by the writer during his examination of the Red Top property in the spring of 1909. A trial shipment of the mineral was made to the General Vanadium Co. of America. Subsequently the property was leased by representatives of that company, and other shipments forwarded to the reduction works at Liverpool, England. In view of the low vanadic acid content of the crude ore, and the absence of efficient milling facilities in the immediate vicinity of the mining properties, the General Vanadium Co. withdrew from the field.

Immediately following the abandonment of the district by the General Vanadium Co., the Vanadium Mines Co. (a re-organization of the Southwestern Coal & Lead Co., owning properties adjoining the Red Top mine) was incorporated and

has developed a fairly large tonnage of low-grade vanadinite ores in the White Swan and Dewey mines.

Geography, Mineralogy and Geology.—The Caballos mountains are situated in Sierra county, New Mexico, 100 miles north of El Paso, Texas, and 14 miles west from Cutter station on the Atchison, Topeka & Santa Fé railway. The range lies parallel to, and 6 miles east of the Rio Grande. The Elephant Butte dam-site (one of the large government reclamation projects) is near the extreme northern point of the range.

The range trends nearly north and south over a distance of 25 miles, with an average width of 3 miles. The elevation of the highest point, Timber peak, is about 9500 ft. On the west, overlooking the Rio Grande, is a great north-south fault-scarp having an average elevation of 6500 ft. along its crest in the vicinity of Palomas gap. Palomas gap divides the range into the North and South Caballos. A foot-hill belt several miles wide extends from the range east and north toward Cutter and Engle, respectively.

There have been at least three distinct earth movements at widely separated periods of time. The first movement formed the monocline bounded on the west by the fault-scarp mentioned in the preceding paragraph, with consequent fissuring of the eastern slope. These parallel fissures cut the thick sedimentaries, and low-grade lead ores have been found in several places along the veins. The cross-cutting of the range by a system of steep, southward-dipping, east-west fissures (which is particularly noticeable in the North Caballos where the limestone series are folded and warped, and in some cases turned on edge) resulted from the second movement. East of the main range are evidences of other minor disturbances, extending far to the north and northwest. These last mentioned movements occasioned tremendous fissuring a few miles east and north of the range, followed by extensive basic lava flows which form the western mesa boundary of the Jornada del Muerto.

The prominent geological feature of the range is the great limestone and quartzite series 1000 to 1500 ft. thick. The base of the range consists of massive red and black Cambrian quartzite, about 200 ft. thick, resting upon granite. Heavy-bedded Silurian and Carboniferous limestones, intercalated with shales, rest upon the Cambrian quartzite; the quantity of the shale series is, however, small. About one-half mile east of the mines on the eastern slope are the Red Beds, above which the Cretaceous sandstones, cut by basic dikes, occur.

The minerals of the district comprise vanadinite, wulfenite, cerussite, anglesite and galena; the predominating minerals are vanadinite and galena.

The vanadinite occurs in well-formed

hexagonal prisms in colors ranging from red and yellow to brown and brownish-black in the vug-holes, and at flat crusts along the walls of the small caves. Small seams of almost pure massive vanadinite of a reddish-yellow color are also found, usually along the foot walls of the veins. Galena occurs in coarse cubes, in many instances accompanied by well-formed crystals of wulfenite.

Development.—The mining properties thus far developed in the range comprise coal, copper, lead and vanadium deposits. The coal area is negligible, as but little development has been done. The copper deposits are confined to the steep westward-facing slope of the range. Greatest development of the lead and vanadium deposits has been done in the vicinity of Palomas gap within an area of less than 2 sq. miles.

The three most important veins in the Palomas Gap section are the White Swan, Dewey and Red Top. These veins belong to the system of parallel fissures above referred to. The two first mentioned lie about 700 ft. apart; the Red Top is five-eighths of a mile farther eastward.

The ores of these properties occur in shoots ranging from 1 to 15 ft. in width. The vein-filling is a porous, friable calcite (an altered limestone) with some barite, fluorite and quartz from which the original mineral (lead sulphide) has been dissolved and partially replaced by the vanadinite. In point of ore occurrence the properties are analogous; therefore I will describe the White Swan only in detail.

Of the three properties mentioned the White Swan is the most developed. Development consists of a vertical shaft about 200 ft. deep with drifts from the 75 and 150-ft. levels. So far as developed the ore body is continuous and averages from 3 to 15 ft. in width. The gangue is an altered limestone containing numerous vug-holes and small caves. The vug-holes are usually filled with vanadinite crystals of a brownish-black color. The larger cavities contain wall incrustations of the same material, or are filled with disintegrated masses of almost pure vanadinite. Seams of pure massive vanadinite are found, usually along the foot wall of the vein or not very far removed therefrom. In some instances, as in the Dewey mine, fine crystallized vanadinite occurs in a manganese oxide gangue. A remarkable feature of all three veins is the transition from the soft, porous gangue containing the vanadinite, to a firm, silicified limestone (in some cases barite) containing galena in coarse crystals accompanied by small quantities of molybdate. The ores cannot be satisfactorily hand-sorted, consequently the entire vein-filling is milled as mined.

The next important property is the Dewey. Although not so well developed as the White Swan the mineralogical and structural conditions appear identical.

The Red Top property and extensions

MINING AND ENGINEERING WORLD

Published every Saturday by
MINING WORLD COMPANY
 Monadnock Block, CHICAGO
 Phone Harrison 2893

NEW YORK: 35 Nassau St. Phone Cortland 7331
 SALT LAKE CITY, Utah: 423 Judge Bldg.
 DENVER: 307 First Nat'l Bank Bldg.
 MEXICO CITY, Mexico

Registered as Second-Class Mail Matter at the Post
 Office at Chicago, Illinois

WINCHESTER HOLMAN President
 GEORGE S. SCOTT Vice-President
 EDWARD A. SISLEY Sec'y and Treas.

SUBSCRIPTION PER YEAR:
 United States and Mexico, \$3.00; Canada, \$5.00;
 Foreign, \$6.00 in Advance
 by Check, Draft, Post Office or Express Order.

ADVERTISING COPY
 to be at Chicago Office by 10 A. M. Monday to
 insure publication same week

18. VOL. XXXV. OCTOBER 28, 1911

P 858

are not so well developed as the two others mentioned, but in view of the higher general average of the ores produced and the better surface indications, give promise of becoming important producers. The vein on this property can be traced on the surface over a distance of 1000 ft. Development consists of a vertical shaft 100 ft. deep with drifts at the 40 and 80-ft. levels, respectively. The ore-shoot varies from a few inches at the surface to 6 and 8 ft. in width below the first level, and is similar in structure and composition to the White Swan and Dewey properties. The vein-filling in this property is more uniform in grade, due to the more extensive surficial impregnation of the brecciated limestone.

There has not been sufficient prospecting work performed to determine the absolute extent of the deposits, but the district is worthy more extensive development.

CONCLUSION.

The average vanadic acid content of the vanadinite ores mined is from 1 to 3%, which necessitates preliminary treatment at the properties. A small concentrator erected several years since by the Southwestern Coal & Lead Co. is being used by the Vanadium Mines Co. as a testing plant to determine the most efficient equipment for a modern mill to be constructed near the White Swan and Dewey mines.

An oxide plant was built at Cutter station to handle the vanadinite concentrates produced by the old concentrator at the mines, but it proved unsuccessful, and will therefore be dismantled and shipped to Pennsylvania. The sulphuric acid treatment employed to leach the vanadium from the concentrates did not effect a high percentage recovery of that metal; one of the other metallurgical processes would, no doubt, have proved more satisfactory.

Water supply is a very serious problem in the district. The Vanadium Mines Co. has a power and pumping plant several miles north of the mines near the Rio Grande, from which electrical power is transmitted to the several mines and the mill, and water piped in a 4-in., spiral-riveted pipe under a 350-ft. head.

The gross value of the crude ore containing 1% or a unit of vanadic acid is \$8 per short ton. Eastern and foreign market quotations for vanadiferous ores are: 40 cts. per lb. vanadic acid contained f. o. b. New York, minimum content 10% per short ton. The commercial product is ferro-vanadium alloy, for which there is a price of \$4 to \$5 per lb. of metallic vanadium. The annual production of metallic vanadium is about 200 tons.