The Palomas Gap vanadium mines

Robert W. Eveleth, 1986, pp. 297-300

in:

Truth or Consequences Region, Clemons, R. E.; King, W. E.; Mack, G. H.; Zidek, J.; [eds.], New Mexico Geological Society 37th Annual Fall Field Conference Guidebook, 317 p.

This page is intentionally left blank to maintain order of facing pages.

THE PALOMAS GAP VANADIUM MINES

ROBERT W. EVELETH
New Mexico Bureau of Mines & Mineral Resources, Socorro, NM 87801

Abstract—The White Swan and Dewey vanadium mines at Palomas Gap, Sierra County, were the focus of a great deal of excitement among geologists and engineers alike during the first decade of the 20th century. Vanadium was a newcomer to the marketplace, after having been little more than a scientific curiosity for a century. The rush to develop domestic deposits of the metal without sufficient metallurgical research and expertise led to some interesting investment failures, one of which was the Vanadium Mines Company of Cutter, New Mexico.

INTRODUCTION

Today it is difficult to believe that Engle and Cutter on the Atchison Topeka and Santa Fe Railroad in Sierra County were ever bustling communities of several hundred souls. Engle, for example, was the shipping and receiving point for virtually all the mining activity in the Black Range from the early 1880's until truck haulage became practical around WWI. Cutter, on the other hand, was the site of a curious "experiment" during 1910–1911: an unsuccessful attempt by the Vanadium Mines Company of Pittsburgh, Pennsylvania, to develop the vanadinite ores discovered near Palomas Gap and convert them into vanadium pentoxide (V_2O_5) at their leaching plant at Cutter. The story of the failure of Vanadium Mines Company is an interesting part of the mining history of Sierra County.

A SUDDEN DEMAND FOR VANADIUM

Vanadium was discovered in 1801 by Andres Manuel del Rio while analyzing a sample of lead ore from Zimapan, Hidalgo, Mexico (del Rio named his discovery erythronium), but technology had little use for the metal until ca 1900 when Professor Arnold of the University of Sheffield, England, discovered its toughening and hardening effect on steel. Demand exploded when auto manufacturers like Henry Ford pioneered its use in 1908 (Morgan 1980).

Vanadinite (endlichite) was first collected in New Mexico at Lake Valley during 1884 and named in honor of Dr. F.M. Endlich who was superintendent of the Sierra Mines (Northrop 1959: 226). Some ten years later, William F. Hall, perhaps familiar with the Lake Valley find, discovered endlichite on his property about 3 mi northeast of Hillsboro. But vanadium had yet to achieve any commercial value and the best of Hall's material (1,250 lb) was sold to the Foote Mineral Company of Philadelphia and marketed as rare mineral specimens (Leatherbee 1911).

WHITE SWAN TRADED FOR A JERSEY COW

The area around Palomas Gap was the scene of much prospecting activity soon after the turn of the century. Several claims were located and prospected primarily for lead. These included, from south to north, the Rosa Lee, Napoleon, Red Top, White Swan, and Dewey lodes.

Among the prospectors were Ralph Widener and his father who located the Dewey lode early on the morning of 1 April 1906. An attempt by the pair to locate the adjoining ground to the south revealed the fact it had been located as the White Swan the previous midnight by another prospector, R.T. Ward! Ward apparently had little interest in proving up the claim and ultimately offered the Wideners one-half interest if they would do the validation work. Later, when the bonanza discovery did not materialize, Ward traded his remaining one-half interest to the Wideners for a jersey cow (Allen 1911: 376). The Wideners concentrated their efforts on the White Swan and, to a lesser degree, the Red Top properties, developing the former deposit through an adit and a small shaft, and the latter through a shaft (Fig. 1).

In the White Swan adit was a streak of galena associated with about six inches of a brown mineral called lead carbonate (cerrusite). The elder Widener, however, was always suspicious of the mineral's identity "and spent much time studying the long, brown, hexagonal crystals which separated so beautifully in his pan" (Allen 1911: 376). The true identity of the mineral would remain hidden for several more years.

THE SOUTHWESTERN LEAD AND COAL COMPANY

Meanwhile, the Southwestern Lead and Coal Company (originally "land" instead of "coal") arrived in the area during 1905 and purchased the Napoleon and Rosa Lee claims, possibly from W.H. Byerts of Socorro (Jones 1902: 1). A 50 tpd concentrator was constructed on a site about 1.5 mi east of the mines to process the low-grade galena ores produced primarily in the Rosa Lee (Fig. 2). Additionally, a small coal seam was developed 5 mi north of the lead mines to fuel an on-site power plant erected ca 1905 (Lindgren et al. 1910: 285). This plant supplied power to the mines, mill, and pumping plant to the north on the Rio Grande and would later provide the same to the leaching plant at Cutter as well as an additional pumping plant at a well cluster on the Jornada between Cutter and the mines. Thus, the Southwestern Lead and Coal Company was the only company in the immediate area

FIGURE 1—Panoramic view to southwest of White Swan (left) and Dewey (right) vanadium mines and tent camp at Palomas Gap. Photo Frank Hess, 20 August 1911, courtesy U.S. Geological Survey.

FIGURE 2—Southwestern Lead and Coal Company's 50 ton mill ca 1907. The ore, originally from the Rosa Lee and later from the White Swan, was freighted by team and wagon to the dump point (left center) and then hoisted to the mill over the rail tramway. Originally designed to reduce lead sulfide, the mill was not particularly successful in concentrating vanadinite ores even when redesigned. Photo courtesy Mrs. Lydia Key, Black Range Museum, Hillsboro.

FIGURE 3—Single-jack drilling in a stope at Palomas Gap, probably in the White Swan, ca 1910. The White Swan was ultimately developed down to the 500 ft level, the Dewey to 400 ft. Photo courtesy Mrs. Lydia Key, Black Range Museum, Hillsboro.

with milling facilities and was doubtless constantly seeking additional mill feed. Toward this end, the White Swan and Dewey claim group (and probably the Red Top group) was purchased from the Wideners during the fall of 1907 for $3,000 (Allen 1911: 376).

THE VANADINITE DISCOVERY

While conducting an examination of the Red Top property in early 1909, J.O. Clifford properly identified the brown hexagonal prisms as vanadinite. According to Clifford (1911: 857) "a trial shipment of the mineral was made to the General Vanadium Company of America" who subsequently leased the property. Additional shipments were made to their affiliate, George Blackwell Sons and Company of Liverpool, England, but the low grade of the crude ore and the lack of efficient local milling facilities resulted in the company giving up their lease. (General Vanadium was at that time developing a higher-grade deposit in the Paradox Valley, Colorado [Clifford 1911: 857, Hess 1913: 1007].)

VANADIUM MINES COMPANY

The Southwestern Lead and Coal Company observed this activity with interest and doubtless deduced that the six-inch vein of brown material in the White Swan must also be vanadinite, hopefully somewhat higher grade than that in the Red Top. Immediately after General Vanadium vacated the area, a stockholder named A.B. Bement of Terre Haute, Indiana, reorganized Southwestern Lead into the Vanadium Mines Company (Harley 1934: 202).

The Vanadium Mines Company moved into the Cutter–Palomas Gap area in a big way. In the reorganization, the new company acquired all Southwestern's assets including the mines, pumping plants, power plant, coal mine and the 50 ton concentrator near the lead mines. In addition, the company announced plans to re-fit the concentrator to be used "as a testing plant to determine the most efficient equipment for a modern mill near the mines" and to erect a leaching plant at Cutter (Allen 1911: 378). Unfortunately, detailed operational data are scant since the company appears to have considered each phase of their venture proprietary.

MINE DEVELOPMENT

The White Swan and Dewey mines appear to have been substantially developed and adequately equipped for their day. The White Swan was opened by a two-compartment shaft equipped with an electric hoist to about 500 ft, while the Dewey had a similar shaft down about 400 ft. Development ultimately included about 6,500 ft of drifts and tunnels and 2,000 ft of raises (McDonald 1931: 2) (Fig. 3). Frank Hess of the U.S. Geological Survey attempted to visit the mines, but tells us that "permission was absolutely refused by Mr. Poillon (superintendent?) on the grounds that it was against the company's rules" (Hess 1911). Paul Larsh, a well-known mining engineer of those days, was much more successful, probably because he had allowed Vanadium Mines Company to investigate his Lucky Bill property near Bayard from which he had shipped 15 tons of high-grade vanadium ore to Germany in 1911 (Larsh 1911: 5, Lasky 1936: 101).

Larsh estimated the White Swan and Dewey might produce 20,000 tons of ore grading 1% vanadium and 4% lead, with additional tonnages possible from extensions of the White Swan and Red Top veins (Larsh 1911: 118). It is unlikely, however, that ore reserves sufficient to justify rebuilding of the mill and construction of the leaching plant had been blocked out. Regardless, worse problems were yet to be encountered on the metallurgical end of the operation in both the mill and leach plant.

MILL AND LEACH PLANT POORLY DESIGNED

Initially, the old Southwestern mill was to be used only for testing, but the unfortunate decision was made to simply modify it to process the vanadinite ores. Crushing was presumably done with stamps and, since early-day mills relied almost entirely upon gravity to transport ore and concentrate streams, the operators experienced immediate difficulty because of inadequate fall (i.e. elevation difference). Shaking tables (possibly Wilfley's) were used to concentrate the ore, but serious difficulties were encountered in separating the barite gangue (waste) from the galena and vanadinite even though the latter two minerals are about 50% denser.

Efficient liberation of the ore minerals required crushing to minus 20 mesh which resulted in a significant portion of the vanadinite being reduced to slimes (Allen 1911: 378). In an attempt to recover the slime fraction, the company installed four new Akens and Evans slime concentrating tables, but these machines had just recently been introduced on the market (Richards 1909: 1500) and may have been an additional source of trouble (Fig. 4). The net result of all the above was that the vanadinite concentrate shipped to the leach plant was considered "crude" (Harley 1934: 202). Milling problems were insignificant, however, compared to those encountered at Cutter.

The leach plant at Cutter, on the railroad, was equipped with 10 acid-leach tanks, two evaporating furnaces, and one calcining furnace and was said to have cost at least $100,000 (Engineering and Mining Journal 1910: 903, 1911a: 438, 1911b: 516) (Fig. 5). Plant design called for mixing the vanadinite concentrate with sulfuric acid, perhaps with agitation, in the 10 wood tanks. Following leaching the lead would, in theory, precipitate out as lead sulfate, while the vanadium sulfate, now in solution, would be decanted off, evaporated to dryness in the fur-

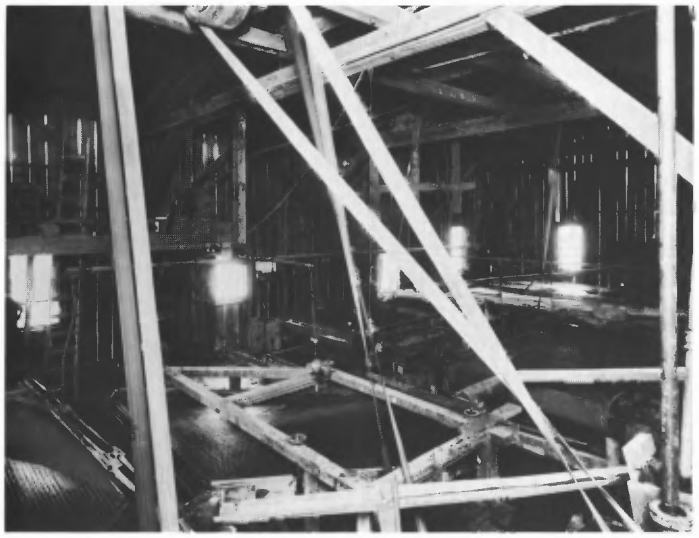

FIGURE 4—Shaking tables (left foreground) and slime concentrating tables (right) in Vanadium Mines Company remodeled mill. The slime tables were a recent development and may have been the source of considerable concentrate loss. Photo courtesy Mrs. Lydia Key, Black Range Museum, Hillsboro.

naces, and finally converted to V_2O_5 in the calcining furnace. Photos of the operation reveal that much hand labor was necessary and working conditions were hazardous—only natural ventilation was available to remove the toxic fumes and the leaching and holding tanks were open and easy to fall into (Fig. 6).

The plant was a resounding failure primarily because of inefficient leaching. According to Allen (1911: 378) "the acid [had] the tendency to form a coating of lead sulphate on the outside of the grain of the minerals which protect(ed) the inside from further action." Larsh (1911: 118) further noted that "leaching with sulfuric acid was not practicable unless the concentrates are high grade" (which they were not). After a short run in 1911, during which a total of about 1,500 lb V_2O_5 was produced, the plant was shut down. The Vanadium Mines Company knew it was in trouble (Engineering and Mining Journal 1911c: 735) and frantically experimented with other extraction and concentrating techniques including special smelting–leaching combinations and even went so far as to let a $75,000 contract for the construction of a new concentrator (Engineering and Mining Journal 1911d: 516), but the stockholders had had enough. One Helen F. Bennet appears to have

FIGURE 5—Vanadium Mines Company leach plant at Cutter, New Mexico, on the Atchison Topeka & Santa Fe Railroad. The two products of this plant, lead sulfate and vanadium pentoxide, were to be shipped to paint manufacturers and to the company's Rankin, Pennsylvania, ferro-vanadium plant, respectively. The company went to great efforts to exclude the view of curious passersby—note the high wooden fence surrounding the entire plant. Photo courtesy Mrs. Lydia Key, Black Range Museum, Hillsboro.

FIGURE 6—Vanadinite concentrates were leached with sulfuric acid in the upper tanks; the vanadium-sulfate solution was then decanted, probably to the holding tanks, foreground, from where it was taken, apparently by hand, to an evaporating furnace followed by calcining to V_2O_5. Photo courtesy Mrs. Lydia Key, Black Range Museum, Hillsboro.

petitioned for bankruptcy, alleging the company was $203,000 in debt (Engineering and Mining Journal 1912: 238), and this action signaled the end.

VENTURE SUFFERED A SERIES OF ERRORS

With the possible exception of development at the mines, the Vanadium Mines Company appears to have made serious errors in design and judgment in each phase of the operation. Even the market was against them because of the (un)timely discovery and development of a remarkably high-grade vanadium deposit at Mina Ragra, Peru, during 1905–1907, which continued to produce into the 1950's (Kuck 1985: 1).

According to reports, "they shut down, sold off and/(or) wrecked the machinery and buildings and left the country in 1912 (McDonald 1931: 1, Engineering and Mining Journal 1913b: 543). But they maintained the veil of secrecy beyond the grave: the Engineering and Mining Journal noted as late as 1913 that "the result of this company's operations is a matter of conjecture as all information in regards to its properties is withheld" (1913a: 124).

REFERENCES

Allen C.A. 1911. Vanadium deposits in the Caballo Mountains, New Mexico.—Mining and Scientific Press, 23 September 1911: 376–378.

Clifford J.O. 1911. Vanadium in New Mexico; Caballos Mountains deposits.—Mining and Engineering World, 28 October 1911: 857–858.

Engineering and Mining Journal 1910. Vanadium in New Mexico (special correspondence).—5 November 1910: 903.

Engineering and Mining Journal 1911a. [Lead ores at the Cutter mines].—2 February 1911: 438.

Engineering and Mining Journal 1911b. [Caballos district, Sierra County, New Mexico].—11 March 1911: 516.

Engineering and Mining Journal 1911c. [Reduction plant at Cutter closes after short run].—8 April 1911: 735.

Engineering and Mining Journal 1911d. [Contract let for new concentrator].—9 September 1911: 516.

Engineering and Mining Journal 1912. [Company goes into receivership].—27 January 1912: 238.

Engineering and Mining Journal 1913a. Mining in New Mexico in 1912.—11 January 1913: 124.

Engineering and Mining Journal 1913b. [Vanadium Mines Co. sale of property].—8 March 1913: 543.

Harley G.T. 1934. The geology and ore deposits of Sierra County, New Mexico.—New Mexico Bureau of Mines & Mineral Resources, Bulletin 10: 220 pp.

Hess F.C. 1911. Field notes regarding Vanadium Mines Company Plant 15–20 mi. SW of Engle, NM, August 20, 1911, pages not numbered.—U.S. Geological Survey Field Records, Denver, 5 pp. (copy on file at New Mexico Bureau of Mines & Mineral Resources).

Hess F.C. 1913. Uranium and vanadium. *In* Mineral Resources of the United States, Calendar Year 1912, Part I—Metals.—U.S. Government Printing Office, Washington, DC, pp. 1003–1037.

Jones F.A. 1902. Report concerning the Napoleon and Rosa Lee Lead Mines. *In* Letter to Henry Rolf Brown, April 25, 1902.—New Mexico Records Center and Archives, Santa Fe, Fayette A. Jones papers, 3 pp.

Keyes C.R. 1905. Ore deposits of the Sierra de los Caballos.—Engineering and Mining Journal, 29 July 1905: 149–151.

Kuck P.H. 1985. Vanadium. *In* Mineral facts and petroleum.—U.S. Bureau of Mines, preprint from Bulletin 675: 21 pp.

Larsh P.A. 1911. Caballo Mountain vanadium mines.—Engineering and Mining Journal, 15 July 1911: 118.

Lasky S.G. 1936. Geology and ore deposits of the Bayard area, Central mining district, New Mexico.—U.S. Geological Survey, Bulletin 870: 144 pp.

Leatherbee B. 1911. Vanadium in Sierra County, New Mexico.—Engineering and Mining Journal, 25 February 1911: 426.

Lindgren W., Graton L.C. & Gordon C.H. 1910. The ore deposits of New Mexico.—U.S. Geological Survey, Professional Paper 68: 361 pp.

McDonald J.D. 1931. Report on vanadium mines, Cutter, New Mexico.—Private report on file at New Mexico Bureau of Mines & Mineral Resources, 2 pp.

Morgan, G.A. 1980. Vanadium. *In* Mineral facts and problems.—U.S. Bureau of Mines, Bulletin 671: 1005–1014.

Northrop S.A. 1959. Minerals of New Mexico.—University of New Mexico Press, Albuquerque, 665 pp.

Richards R.H. 1909. Ore dressing, vol. 3.—McGraw–Hill Book Co., New York, p. 1500.