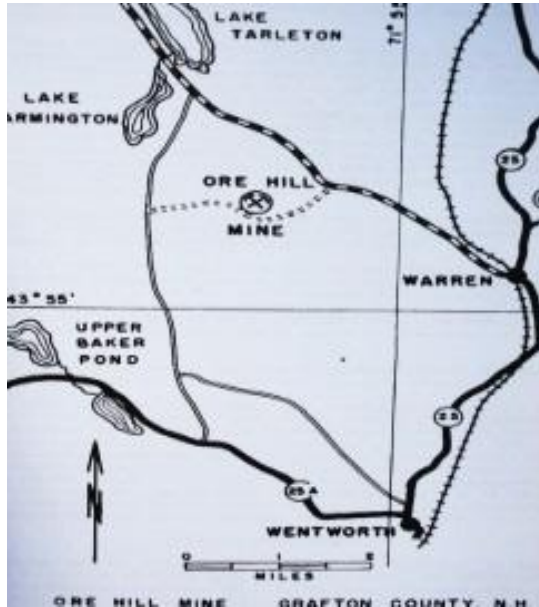


The Story of Ore Hill Zinc-Lead Mine, Warren, Grafton County, NH

By Anna Wilken

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Through the 80 years the mine has been worked it has had different names: The Copper Mine, The Warren Silver-Lead Mine, The Warren Zinc Mine, The Ore Hill Zinc-Lead Mine or just Ore Hill Mine.



Ore Hill is located in west-central New Hampshire at the western edge of the White Mountains.

It was the second largest known base metal sulfide deposit in New Hampshire, with total zinc, lead, copper production estimates ranging from 50,000 - 100,000 tons. The deposit was exceeded in size only by the one half million ton Cu-Zn deposit at the Milan Mine in New Hampshire.

Ore Hill's geological setting is Middle Ordovician Ammonoosuc Volcanics. It is situated in a northeasterly trending belt of early Paleozoic metavolcanics and metasediment. The belt extends from Massachusetts through part of Vermont, New Hampshire to Maine.

Minerals found in the mine are: Pyrite, galena, rutile, chlorite, biotite, cordierite, hematite, epidote, spessartine garnet, tremolite, quartz, talc, pyrrhotite, sillimanite, anthophyllite, muscovite, phlogopite, silver (as a byproduct of galena), chalcopyrite (copper ore), kyanite and sphalerite.



Galena



Pyrite



Rutile

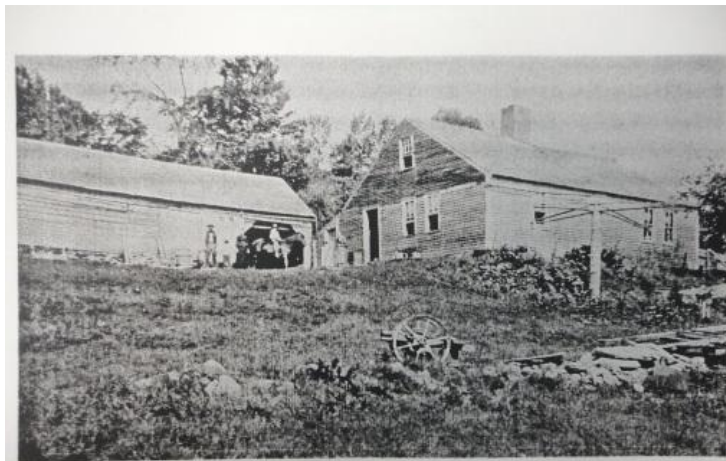


Sphalerite



Tremolite

In 1826 True Merrill bought “the westerly half of lot number five in the sixth range” in Warren NH for \$230 from Stevens Merrill. He built his farm there and in 1834 he discovered copper ore on his land. The stone foundations of the Merrill Farm are still there today to the northeast of the mine site.



TRUE MERRILL FARM, LATER JESSE MERRILL HOMESTEAD, LOCATED IN THE AREA OF THE MINE

Second-hand accounts say that a company known as “The Copper Mine” was formed early-on. The mine soon closed due to a lack of capital as well as to a lack of knowledge of ore processing techniques. In November of 1838 True Merrill sold the mine to Luke Brooks for \$300 and its name was changed to “The Warren Mine”. It was worked for a short period as Luke Brooks died in 1840.

In 1842 the mine was transferred to Horace Brooks as the administrator of the Luke Brooks estate. The same year he leased the mine to Hezekiah Bradford of New York. It is interesting to note that control of the Bristol (Connecticut) Mining Company passed into Bradford’s hands in 1845. This may have been the reason he terminated his efforts at Ore Hill.



IN THE EARLY DAYS AT ORE HILL MINE



The mine was active for only two years under his management.

1857 was the year when the Warren Silver, Lead and Copper Mining Company leased the mine but the company only worked it for two years, when in 1859, Aaron Charles Baldwin from Boston took over the mine. Baldwin, had been engaged in accounting and “mercantile pursuits” in Boston from which he reportedly retired by 1860. Mr. Baldwin built a mill and dwelling houses, put in stamps for crushing ore, installed a steam engine and secured a large number of separators. A whim house was built to hold the vertical drum used for hauling materials up from the shaft. A 100 foot deep shaft was sunk in the ore bearing rock. A drift was then bored north from the base of the shaft 150 feet further into the sphalerite and galena bearing rock. Many tons of ore were raised, crushed, separated and sent to market.



WARREN

RAILS TO ORE HILL SMELTING PLANT, WARREN, NH

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Back in the 1850s and 1860s miners from Cornwall, England were working in the US mines. Many worked at the Ely Copper Mine in Vermont and at Ore Hill. The superintendent working for Mr. Baldwin was also a Cornish miner named Samuel Truscott. In 1861 William Hooper – also from Cornwall - came to help his brother-in-law, Sam Truscott. They both worked at the mine for two years. But then they moved on to Bath, NH to erect a concentrating mill for a copper mine there.

Baldwin and Superintendent S. S. Sheldon convinced the selectmen of Warren that the town should finance a new road up the mountain thereby lowering the transportation costs. The road, Ore Hill Road, began at what is now Route 25C near the fork in Ore Brook and extended west up the hill. It made a substantial saving in distance and time. Nevertheless, whatever the benefits of the new road, they were not enough to overcome the operating expenses of the mine, so it closed. A map of Grafton County (Walling 1860) shows a substantial community in the vicinity of Ore Hill with a network of roads radiating out from the mineshaft. There were ten farmsteads, a

school, and a blacksmith's shop. Also present were facilities associated with mining. There was an area marked "dressing works" (for ore processing) and what might have been three separate mining operations: a copper mine, a silver mine, and "the shaft". The map is not completely clear about known mining operations.

In 1868 Captain James Edgar leased the mine. C. H. Hitchcock commented in his 1869 *First Annual Report upon The Geology and Mineralogy of the State of New Hampshire* that "the Warren Zinc Mine is now under the skillful management of Capt. Edgar." Hitchcock went on to explain changing geological conditions at the Ore Hill mine. It originally had been known for its copper. But as the vein went deeper, the proportion of zinc greatly increased while the proportion of copper diminished. The principal vein was quartz, which was intersected by a mass of tremolite. To a depth of twenty five feet, copper ore and galena predominated. Below that point, to the bottom of the 150 foot excavation, zinc was the most abundant ore. Once at the bottom, the vein was twenty feet wide and fifteen feet thick and there was a drift 180 feet long. Accounts indicate that there was a "pipe" or "chimney" of pure zinc ore in the vein. This was the most valuable part of the ore lode. It is for the zinc that the mine is now mostly remembered.

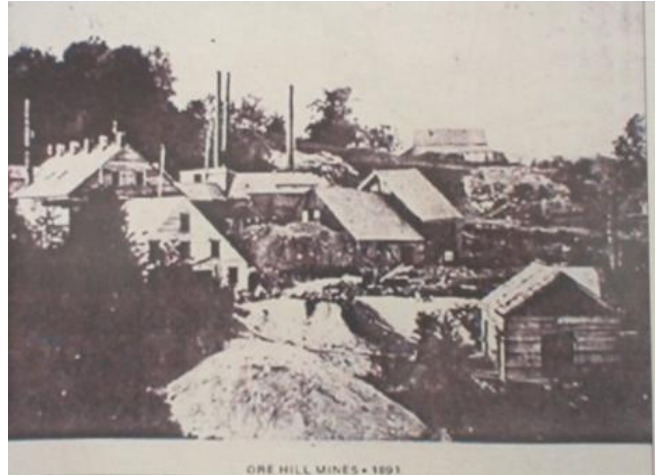
When Edgar took over the mine, the mill and steam engine had been auctioned off and water had filled the shaft. He set up a small stationary engine to pump the water out of the mine and to raise the ore. During this time period there are conflicting reports concerning the manner in which the ore was processed. It is plausible that a variety of methods were tried. One account says that the ore was put into a kiln and fired on site by burning large piles of wood underneath it to expel the sulfur. This was done to save weight in freight. Ten tons of sulphur were expelled from every thirty tons of ore. Each burning could take several months. This process had previously been tried at the Ely copper mines in Vershire, Vermont (Blaisdell 1982). After cooling, the ore was put in bags and sent to Pennsylvania to be smelted into metallic zinc.

Hitchcock reported that the ore was sent to Lowell Bleaching Company to remove sulphur and make acid. Then the residue went to Bethlehem, Pennsylvania where it was smelted into "spelter" (crude metallic zinc). Yet another account records that Edgar shipped 100 tons of ore to England but the operation proved to be too costly. In his history of Warren William Little attributes this to Edgar but at a time some five years prior to 1869. There is no available corroborating evidence to say it did or did not happen then. Captain Edgar eventually suspended operations and the mine again went silent and deserted not long after 1871.

Two decades later in the fall of 1889, the mine was taken over by the Warren Zinc Company. James Edgar had returned and worked in management. The company made substantial investments in new equipment including a large boiler. The Ore Hill community grew into a small village with two dozen houses, a boarding house, a school and several stores. Up to thirty-five men were said to have worked at the mine. When fire consumed the Ore Hill Mine complex in the winter of 1890 inflicting major losses, the company rebuilt even more extensively.



FIRE AT THE MINE (1890'S)



ORE HILL MINES - 1891

A Warren town map was made in 1892 by D.H. Hurd. It is not clear precisely when the data for the map was gathered. Several differences between the 1860 and the 1892 maps are apparent. But many things changed in 32 years.

The arrangement of roads changed and several homes were added. Other homes were omitted. Still, the scale of the community appears to have remained about the same. The new map also indicates an apparent shift in emphasis from settlement on the hill to settlement in the adjacent valley. The road that formerly extended northeast from the Merrill farmstead is shown on the 1892 map as only a trail, perhaps now only little traveled. The school and farmsteads that had been located northeast of the Merrill property along that road were gone. The school was relocated to what is now Route 25C. On the Warren 1892 map, the mine location is indicated only by the term "the shaft." The blacksmith's shop of 1860 was gone and a new store was present at the intersection of Ore Hill Road and the valley road.

In a report dated August 19, 1893 made out to the Warren Zinc Co., mining engineer Arthur Benjamin Browne wrote:

"The property is developed to a considerable extent. The inclined shaft is 8x12 feet and has a depth of 100 feet. A drift 8x7 feet has been pushed to the south to a distance of 63 feet 6 inches. Another drift has been made to the north that is 76 feet 7 inches. Below the 167 foot level the shaft has been sunk a distance of slightly over ten feet."

(Note: An apparent discrepancy exists regarding the matter of a northerly drift. In 1842 the records refer to a 150 foot drift to the north at the 100 foot level. In this 1893 report it cites a 76' 7" long drift was made to the north at the 100 foot level. It's possible that they were two separate drifts roughly in a northerly direction. The author is at a loss to clarify the matter.)

The vein itself lies between a hanging wall of gneiss, quartz and a footwall of slate (schist), and varies in thickness from 2 feet to about 10 feet. The ore is a mixed ore with sulphide of zinc predominating. Sulphides of lead and iron are also present with a few ounces of silver to the ton." (In analyzing the ore Mr. Browne came to the conclusion the ore had a value of \$ 35.33 per ton.)

Mr. Browne described the assets on the site: “Underground the mine is supplied with four steam drills, pump etc. A trolley track extends to the 167 foot level, while the 100 foot level also has an iron tram-road laid through it. Above ground the hoisting works are suitable to the requirements of the mine for some time to come. The blacksmith shop is well equipped. Power is furnished for the mill by a 100 HP boiler and Exeter engine, both of which appear in excellent condition. Two supplementary 50 HP boilers are also in the mill.”

Arthur Browne went on: “The ore is dumped from the skip on to the deck-head, from whence, after cobbing, is dried in a rotary dryer and broken in a Blake crusher, then crushed by two pair of rolls, sized and delivered into six bins. The crushing plant is well arranged and has been the source of much expense and delay. Four Harz jigs, a Golden Gate concentrator, two Ticonderoga dry jigs, a Gates end-bump table and various minor appliances constitute the machinery on the mill floor, a roasting furnace of questionable efficiency stands in a separate building, while just outside is a partly constructed slime table.” (Slime is a portion of the ore which, after crushing, is of such a small size that it makes it unfit for treatment. The “slime table” consists of different sizes of mesh.)

Despite the good report, financial difficulties forced The Warren Zinc Co. to close in 1896 and the miners were left without work.

In 1900 John Dwight paid all the back taxes that the Warren Zinc Company owed to the Town of Warren. The whole Ore Hill mining complex was evaluated by three appraisers at a total value of \$3,100. So, in December of that year, Dwight formed the Warren Separating Company in which he owned 140 shares valued at \$25 each.

Ore Hill and John Dwight’s efforts there were well known to the mining and metallurgical community Dwight was doing his best to incorporate cutting-edge technology at the mine. The same year the mine was bought, he was already grappling with the problem of separating the zinc sulfide (sphalerite) ore from the iron sulfide (pyrite). He knew that by “roasting” the ore the iron sulphide would become magnetic thereby allowing it to be separated. Early-on the company installed a Wetherhill cross-belt ore separator. This was what Dwight referred to as a “magnetic machine”. In October 1902 Elly wrote to Emma and Ruth “had a long session with Mr. Keedy and think I can make a good arrangement with them if I am willing to make the experiment”. So in order to make the roasting separation process more efficient, Dwight installed a Keedy ore-sizer and “jig” (drier).

Snippets of correspondence among Dwight himself, his wife Emma, and the woman called Elly illustrate and give a sense of typical mining problems at Ore Hill. Elly speaks with some degree of authority and clearly shows management skills.

November 5, 1901 (John to Emma)

“Ore Hill is a busy place just now. Nine carpenters at work beside our regular fire building, engine house, boarding house, house for Elly and one or more cottages for miners besides flooring and sealing the buildings to make them warm this winter.”

August 4, 1902 (John to Emma)

“Spent the day at the mine and had an interesting time, but not a very satisfactory one. The main trouble was in the drier, it just would not do much work. So I had to study up the reason why and of course the trouble was in the fact that the ore to be dried was twice as wet as it was when I was trying it last week. Have however ordered some new contrivances for it. I mean they were ordered last week and perhaps may come today and there will be the fun of trying that and perhaps it will make our drier complete.”

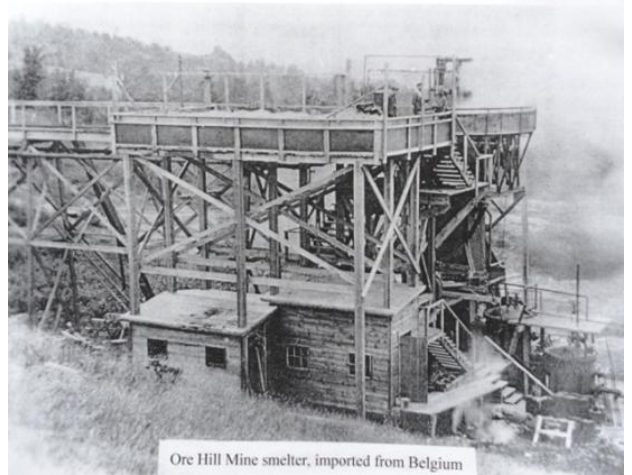
January 28 and 29, 1903, (Elly to Emma)

“Got a new roaster. Affaires at the mine are what you might call slow. We are waiting till our new roaster is finished and we can start up once more and then wait and see if it can stand the racket (heat). Letting all carpenters, brick layers and miners go and keeping only the loose men and enough to finish roaster and settling tank. When we try the new roaster (we) shall so continue till we have tried the capacity of our plant. Then if the roaster or anything don't work all right I shall shut down altogether, look for a roaster that is doing our kind of work and that we know will do it, buy it and when ready to ship it- employ only men to set it up and when ready try it again. Of course with all the work stopped there will not be any material to buy – and I shall be relieved from a burden.”

In the autumn of 1902 a small blast furnace employing the “Lungwitz process” was put into service. This was a process whereby zinc was separated from ore in a furnace under heat and pressure. Many years later in a detailed report, W. McA. Johnson describes how John E. Dwight had “fathered the scheme.” He also gave a long account of the futile attempts to make the 25 foot tall furnace work. After three weeks of problems it “finally froze”. He cited “inherent metallurgical difficulties” and flawed and “faulty theory” in the furnace design and function.

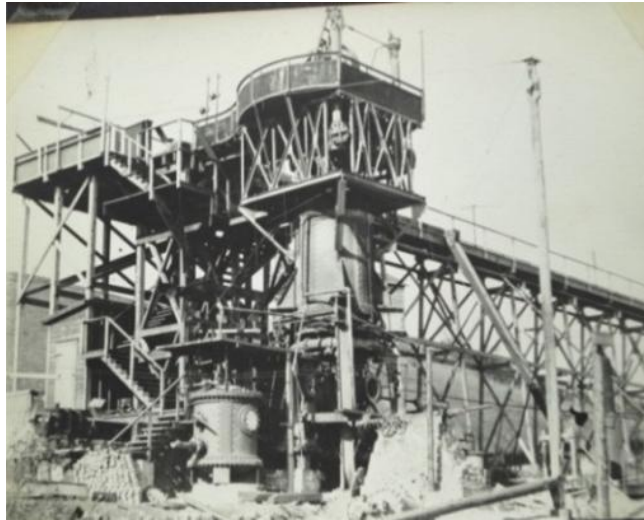
At some point during Dwight's management of Ore Hill it is reported (Blaisdell in *The Opinion Journal* 1981) the company invested \$250,000 in new equipment. This included a new 80 foot smelter imported from Belgium intended for the smelting of zinc ore. The cost of securing and erecting the smelter alone was said to be around \$146,000.

Secondary sources indicate that the smelter was transported to Warren in pieces and hauled up the two mile grade to Ore Hill over the snow in April of 1904 by a team of forty horses and oxen. It then was to take nearly two years to assemble and erect. This smelter is clearly documented in photographs, however, once it arrived, there is no further mention of its operation or its success, that is, until its final demise in 1934. This is clearly documented in photographs, however, once it arrived, there is no further mention of its operation or its success, that is, until its final demise in 1934.



Ore Hill Mine smelter, imported from Belgium

If the dates are to be believed the smelter should have been under or near completion shortly after the fire.



When fire struck the mining community in February 1905 it consumed the mill. The losses were estimated at about \$50,000. Warren Separating Company rebuilt once more



ORE HILL MINE REMAINS AFTER FIRE OF 1905, WARREN, NH



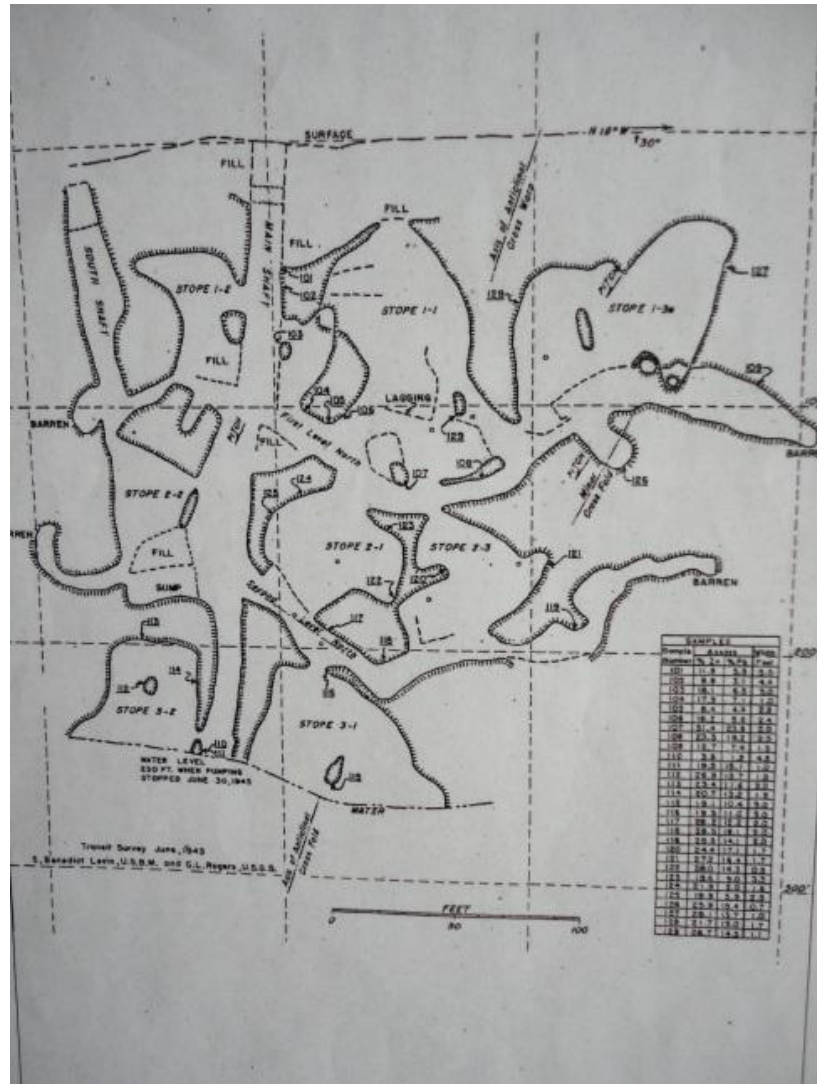
During the post 1905 fire period the Ore Hill shaft was deepened to over 400 feet and considerable lateral work was done underground. The exact number of men employed was said to have been in the hundreds. Problems processing the complex material continued to plague the mining efforts and led to the closing of the mine in 1907. The Warren Separating Company continued to exist on paper and John E. Dwight was still listed as its President and Director in the 1911-12 *Directory of Directors in New York City*.

In 1914, John E. Dwight's son John Dwight, Jr and (his sister) Ruth Dwight McVitty reopened the mine again as the Warren Separating Company. They sank the shaft to a depth said to be between 475 and 600 feet.

They attempted to separate the ore by gravity concentration, a method based on differences in specific gravity. Ore smelting must have continued to be a problem and the mine closed for the last time that same year. Before closing they sent a small shipment of concentrates produced at the mine in 1906 to Johnson experimental electrothermic zinc smelter in Hartford, Connecticut in 1913 and 1914 but they could not overcome the smelting problems.

The Dwight family continued to own the mine until 1926 when the mine and land were sold to Archer E. Wheeler from New York City for one dollar. A year later the mine was pumped out but there is no known existing report.

In 1934 Archer Wheeler sold the mine and property to Otto F. Mertsch. At the time a portion of the huge smelter was still standing. One report states that it was taken down and shipped to Bethel, PA as scrap. Another says that the remaining steel structures were stolen piece by piece, dismantled and secreted away down the back side of Ore Hill without the knowledge of Mertsch.



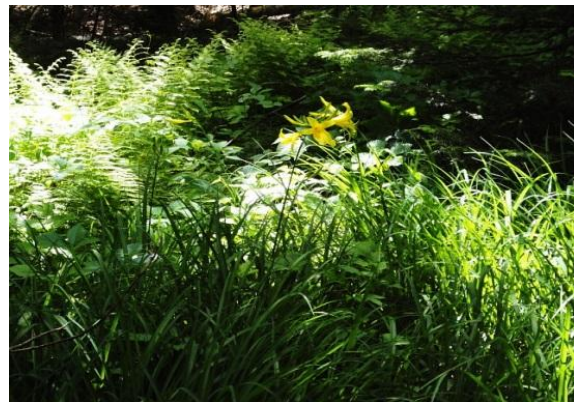
The U.S. Government acquired one half of the Ore Hill Mine site in 1937 to be part of the White Mountain National Forest. In 1943 and 1944 during a wartime shortage of metals, the mine was investigated by the U.S. Bureau of Mines. They drained the old shafts to a depth of 250 feet. They made core drillings and sampled the old tailings. This map is a cross section of the mine (Hermance and Mozier 1948).

There were further explorations and more test drillings in 1957 by the New Jersey Zinc Company, but they did not find enough of sufficient economic value. In the early 1980's the mineral deposit was evaluated by the Canadian mining concern Naranda Explorations Inc., but they did not reopen the mine. None of these efforts resulted in mining activity.

In 1984 the Forest Service, in coordination with the National Park Service (which had acquired a portion of the site for the Appalachian Trail corridor) recontoured the tailings piles. They capped the area with a thin layer of limestone, several inches of topsoil, and seeded the area to prevent the acidic drainage from the tailings into Ore Brook.

In 1988 additional work was done. Some on-site surface water flow was diverted, and channels were lined with limestone. These actions improved the visual quality of the area and downstream water quality reportedly improved.

By 2000 when the Forest Service conducted a "Preliminary Assessment", several acidic seeps had appeared on site. The grassed soil cap on the tailings area was also failing. Further studies were made and in 2004 it was determined that a phosphate-based treatments could significantly reduce the metals leaching from the tailings and waste rock. So in 2009 several town meetings were held and the project moved forward.



Ore Hill is now quiet and deserted. Grass, shrubs, trees and even daylilies are taking over where the old farms were and mineral collecting on the hill has come to an end.

Thanks to my husband Bob, my proof reader and the one to keep me on my toes, and not letting me cut corners.

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