

A REVIEW OF MERCURY MINING IN THE PHOENIX MOUNTAINS, MARICOPA COUNTY

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by Diane Bain

In response to numerous requests for information on the historic mining of mercury in the Phoenix Mountains, the Department has prepared this brief review. An article (see Appendix) on elemental mercury and mercury sulfide by Samuel Rector, Aquatic Contaminant Specialist for the Arizona Department of Environmental Quality, is included.

History

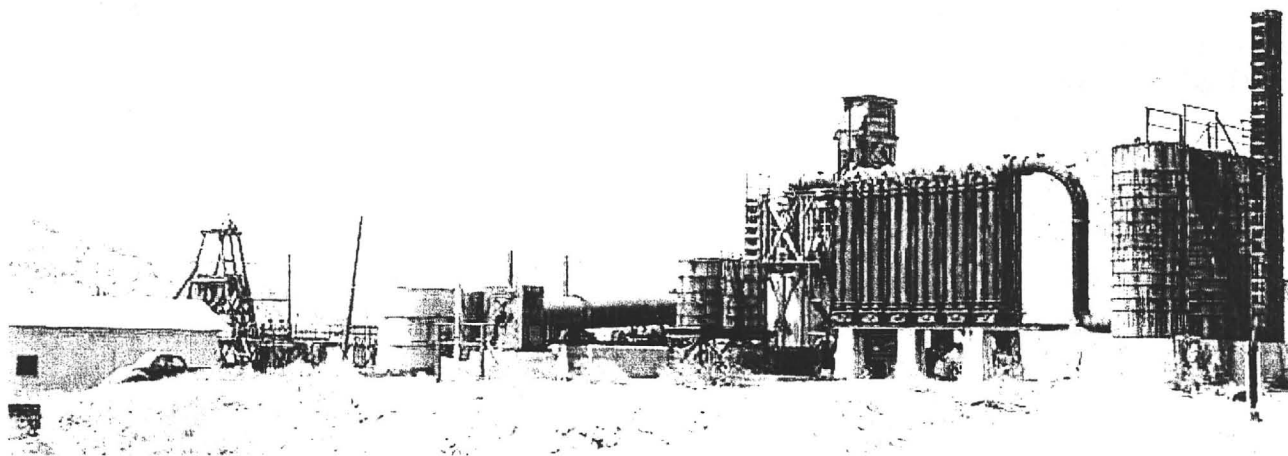
In December of 1916, Sam Hughes, a Phoenix resident, discovered cinnabar deposits in the area now known as Dreamy Draw. Cinnabar, a mercury sulfide, had been discovered earlier that year in the area. Near his largest deposit, the Rico Mine, Sam Hughes erected a retort furnace, built a cabin, and sunk a main shaft and water well. Hughes, working alone, would fill an ore bucket, climb 100 feet of ladder to the surface and then hoist the ore bucket using a hand windless. In 1925 the U.S. Bureau of Mines reported that, "the bottom of the mine is damp, the temperature in the face of the drift is high, and the ventilation is poor."

These conditions, along with narrow mineralized widths, kept production small. It is not known if Hughes ever profited from his labors.

The U. S. Bureau of Mines reports total production of mercury from the Phoenix Mountains at 65 flasks. A flask of mercury is 76.5 pounds. The US currently uses about 800 metric tons per year.

In 1917 the United States Geological Survey sent a geologist, Frank C. Schrader, to Arizona to examine the mercury deposits in the Phoenix Mountains. The geologist reported that he reached Squaw Peak, since renamed Piestawa Peak, by way of the Phoenix-Glendale Electric Railway plus a walk of 5 miles! He found only three deposits to have workable ore.

The mine near the Mercury Mine School site was probably the Victoria Quicksilver Mine that included the Crown Prince, Victoria, Duchess, Duke, and Royal claims. A Department mine



Rico Mercury Mine, circa 1930, Northern Avenue at Dreamy Draw. State Route 51 now covers the mine remains. This view is of the furnace plant and machine shop, with the headframe in the distance.

owner's report from 1940 shows the owner to have been Nellie DeVere. Nellie reported that she planned to clear the 120-foot shaft that was then holding about 40 feet of water and mine for mercury, gold, silver, and copper. She was optimistic because the area now had electric power. She added that the former names of her claims were the Little Scout 1, 2, 3.

Production from the Victoria, if any, was probably quite small. The Post-World War II era spelled the end for a great many mines in Arizona. Plummeting prices made it difficult to continue mining after the war.

The piers of the Rico retort furnace, the foundations of the cabin and the cinnabar-red dump could be visited until 1991 when they were buried by freeway construction. The Northern Avenue overpass of the Squaw Peak Freeway was built over the old Rico mine and millsite. Mercury Mine School located at Dreamy Draw and 28th Street is named for the prospects in the area. A shaft of one of the old mercury mines lies deeply buried under the softball backstop at the school. Few surface outcrops of cinnabar remain in the Phoenix Mountain area.

Mercury Characteristics

(see Appendix for detailed description)

Mercury, also known as quicksilver, is the only metal that is liquid at ordinary temperatures. Its chief uses are in drugs and chemicals. It is also used in mercury-vapor lamps, power-control switches, thermometers, barometers, and in dental preparations. Mercury is found in only a few minerals; most commonly, cinnabar, a mercuric sulfide (HgS). The color of cinnabar generally is vermilion-red. Mercury in the Phoenix Mountains was in the form of cinnabar.

Conclusion

Dreamy Draw, which lies along the western end of Squaw Peak, was named for the effects of intense exposure to mercury. It is not named for any such effects occurring in that area.

Reconnaissance field sampling in Dreamy Draw, including the Mercury Mine School area, by the Arizona Department of Environmental Quality in the summer of 2003, revealed no detectable mercury in the soil samples. The lone exception was a "background" level at one collection area below the historic plant site.

Samuel Rector, Aquatic Contaminant Specialist with the Arizona Department of Environmental Quality concludes that, "Overall, what mercury that may be found at the old Dreamy Draw mine sites is most likely at a concentration and/or in a form that would render it unavailable to human uptake."

References

Arizona Department of Mines & Mineral Resources, file data, including Victoria Quicksilver, Mercury Group, Eureka Group, Rico Mercury, and Cram Quicksilver

Lausen, Carl, and Gardner, E. D., *Phoenix Mountains Deposit. Quicksilver (Mercury) Resources of Arizona*, Arizona Bureau of Mines Bulletin No. 122. Mineral Technology Series No. 29. University of Arizona, Tucson, 1927

Schrader, F. C., *Quicksilver Deposits of the Phoenix Mountains Arizona*, USGS Bulletin 690-D. Washington, D.C., 1918

Appendix

A Discussion of Mercury in the Environment, Pertinent to its Occurrence in Dreamy Draw, Maricopa County

by Samuel Rector
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The two types of mercury most likely to be found in the Dreamy Draw area are elemental mercury, (the "quicksilver" most of us have seen in thermometers and thermostats), and mercuric sulfide, also known as cinnabar. Elemental mercury may have been deposited in the Dreamy Draw area as a result of the refining and transport process during the early part of the 20th century. These deposits were probably short lived due to elemental mercury's propensity to evaporate at temperatures greater than 77 degrees Fahrenheit¹. Elemental mercury also readily forms alloys (amalgamates) with most metals except for iron and readily combines with sulfur at room temperature². Elemental mercury combined in this manner forms a tight bond and is

essentially immobile in the landscape³ and biologically unavailable. If ingested in the unamalgamated, elemental form, mercury is poorly absorbed (<0.01%)⁴ in the stomach and intestinal tract⁵. Once ingested, elemental mercury also has a relatively short half life of 60 days and is eliminated in the urine, feces and by exhalation.

Cinnabar is even less biologically available and environmentally mobile than elemental mercury, due largely to it's low solubility in water. In tests, tissue concentrations of mercury in mice administered mercuric sulfide (cinnabar) for five and 55 days did not differ significantly

¹ Much of the mercury deposited on land, appears to revaporize within a day or two, at least in areas substantially heated by sunlight. National Research Council Canada; *Effects of Mercury in the Canadian Environment*, p.78 (1979) NRCC No. 16739

² Ductile malleable mass which may be cut with a knife; atomic number 80; valences 1 and 2; group 2B element of periodic table; natural isotopes 202 (29.80%), 200 (23.13%), 199 (16.84%), 201 (13.22%), 198 (10.02%), 204 (6.85%) and 196 (0.146%); electrical resistivity 95.76 microhm cm at 20 deg C; forms alloys with most metals except iron and combines with sulfur at ordinary temp; reacts with HNO₃, hot concn H₂SO₄, and ammonia solutions to form Hg₂NOH (Millon's base); std electrode reduction potential: eo (aq) Hg/Hg₂⁺ equals -0.854 volts; eo (aq) 2 Hg/2Hg₂⁺ equals -0.789 volts Budavari, S. (ed.). *The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals*. Whitehouse Station, NJ: Merck and Co., Inc., 1996. 1006

³ Studies indicate that mercury compounds, once deposited on soil, are absorbed to the soil and do not leach. Mercuric sulfide has been found to strongly adsorb to soil, and even with weathering, any mercury released from the mercuric sulfide is readsorbed by the soil. *Hazardous Substance Data Base*, National Library of Medicine, 2003

⁴ Gastrointestinal absorption is minimal (0.01%) partly due to the formation of sulphur laden compounds on the surface of the metal. Ingestion of a large amount of elemental mercury has occurred without adverse effect. Lin, J. L. and Lim, P. S. *Massive oral ingestion of elemental mercury*. Journal of Toxicology & Clinical Toxicology 1993; 31(3): 487-92

⁵ Metallic mercury and mercurous salts (e.g., Hg₂Cl₂) are poorly absorbed (<0.10%) following oral exposure Friberg, L. and Nordberg, F., 1973. *Inorganic mercury - a toxicological and epidemiological appraisal*. In: Miller, M.W. and Clarkson, T. W. eds. *Mercury, mercurials and mercaptans*. Charles C. Thomas Co., Springfield, Il. pp. 5-22.

from controls⁶. Cinnabar also does not emit mercury vapor under normal temperature conditions⁷. As mentioned earlier, cinnabar, which is mercury tightly bound to sulfur, is essentially immobile in the landscape, except for dust carried from the area by wind or precipitation runoff.

⁶ Except for increases in the intestinal contents and kidneys, tissue mercury concentrations in mice given mercuric-sulfide did not differ significantly from those of untreated mice. Ryan, D. M., Sin, Y. M., and Wong, M. K. Uptake, *Distribution and Immunotoxicological Effects of Mercury in Mice. Environmental Monitoring and Assessment*, Vol. 19, Nos. 1-3, pages 507-517, 20 references, 1991 [NIOSH]

⁷ Mercury solidified/stabilized as mercuric sulfide (HgS, black) emitted no Hg vapor. Hamilton, W. P., and Bowers, A. R., *Determination of acute Hg emissions from solidified/stabilized cement waste forms*. Waste Management; 17 (1). 1997. 25-32.