Vermilion

Category: Alchemy

Therasia von Tux, Barony 1000 Eyes

specific art form: pigment

this is the Sept 2001 revised edition (one small "oops" corrected)

Entry contents:
1 vial vermilion/cinnabar (POISON!!! PLEASE DON"T OPEN THE BOTTLE)
1 piece cinnabar
1 copy of *Artists' Pigments*, for the Gettens et al. article
(a copy of Cennini can be found with my "St. George" shield, in the Fine Arts category; copies of Pliny and Theophilus can be found with my silver entry, in the Alchemy category)

A piece of cinnabar collected by a friend and on display at the McLaughlin Mine, Napa Co., CA (It's a lot prettier than most of my samples)

The first known mention of mercuric sulfide as a mineral is in Theophratus's *Lapidary*. Theophrastus called it cinnabar, which is the name still in use today. The Romans called it minium, and it was so valuable as a red pigment that the Roman government made it a nationalized monopoly and regulated the price.[1] It does need to be said that the Romans used the name minium for any high-quality mineral red, regardless of whether it was cinnabar or hematite.[2]

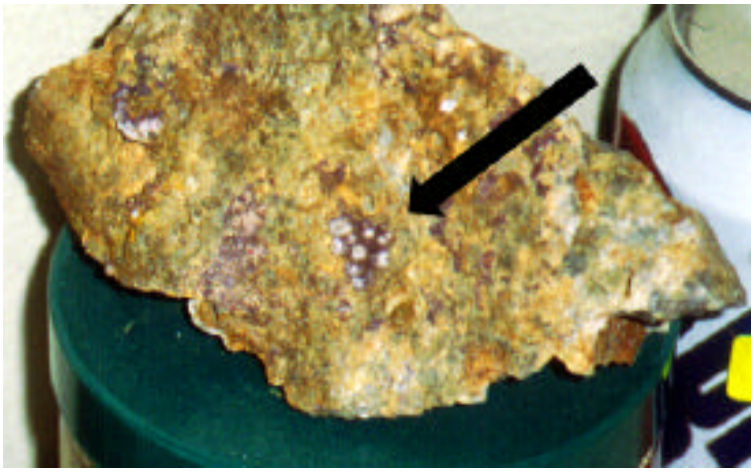
Minium was being adultrated with "red lead" as early as Imperial Rome, though it is difficult to determine whether Pliny meant red litharge or lead carbonate. Adulteration continued until the name shifted, and came to mean just red lead by Early Gothic. [3, 4]

---

[1] Pliny, Book XXXIII: sections XXXVI-XLI, using the Loeb numbering system.
[2] Ibid.
[3] Ibid.
[4] Though historians would quibble about this, I tend to prefer to the art history divisions of history rather than the academic history divisions. Most everyone knows what the Renaissance is, but would be confused if I called it "Early Modern History."

Recipes for artificial mercuric sulfide (vermilion) can be found as early as the eighth century.[5] Thompson implies a distinction between the mineral cinnabar and the manufactured vermilion,[6] but here he is wrong. More-recent research shows that it is extremely difficult to distinguish between the natural vs. artificial (i.e., "dry-process" vermillion) mercuric sulfides,[7] even when using an electron microscope. Just because a painting is medieval does not automatically mean it was painted with artificial HgS.

The first method of getting mercury red is simply finding a cinnabar deposit with good color to the mineral. Separating the cinnabar from the host rock, and then crushing it is all that is required. It is tedious but it is quite easy, and poses a lower health risk than making HgS artificially. (In fact, if you crush and grind your cinnabar in water, and transfer it to your pigment container wet, the primary health risk of breathing in dust-sized HgS particles is greatly diminished.) My crushed cinnabar pigment came from the tailings pile of the Red Bird mine 10 miles southeast of Lovelock, NV.



Really ugly botroidal cinnabar that's not a good candidate for being ground straight into pigment (this sample was collected at the Reddington mine, just south of the McLaughlin mine in Napa Co., CA) It's samples like this that explain why a lot of HgS was manufactured artificially.

The method of making vermilion from its constituent elements is straight-forward. Two parts sulfur and one part mercury are placed in an airtight vessel and placed on a moderate heat source. Though the ratio of mercury to sulfur in vermilion and cinnabar is 1:1, the excess sulfur is lost through either combustion with the oxygen inside the vessel, or through conversion into a straw yellow fume.[8] Though Theophilus's instructions are to make the vessel as airtight as

---

[5] Gettens et al., 1993, p.161.

[6] Thompson, D.,1956.

[7] There are actually two processes to make artificial mercuric sulfide. The "Dry Process" was the method used in period, whereas the "Wet Process" is more modern and not discussed here. While natural and dry-process HgS are indistinguishable, wet-process HgS can be distinguished from the first two analytically (Gettens et al., pp.160-163).

possible, my one attempt at artificial HgS produced both an initial yellow fume, followed by a red fume. Obviously I did not achieve a sufficiently tight seal on my container, though I did used the heaviest and most heat-worthy sealant grease from my gas extraction line in the lab where I worked. I did remove the vessel when the crackling sounds stopped, (combustion of sulfur? boiling of mercury?), as Theophilus recommends.[9] The cecesion of the sound coincided with the red fume. The slightly less than 1 milliliter amount of bright red HgS seems not to have suffered from the lack of airtightness. It had a disappointing amount of white impurities in it, however, which I removed with nitric acid afterward (not a period process at all - but it's quicker than picking the impurities out by hand, and unlike hand picking, a little nitric can be safely applied and neutralized in the fume hood). My conjecture is that the impurity was a sulfate mixed in with the sulfur or was created while making the vermilion.

Please don't do this at home.

I set my HgS experiment up in the fume hood at the lab I worked at. I used a solid-nickel vessel designed for the pressure differences of a gas extraction vacuum line with extremely reactive atmospheres. This vessel was slated to be destroyed due to mercury contamination (!) so the opportunity to attempt the making of HgS just couldn't be passed up. The heat source was not the coal that Theophilus recommended (a coal fire in the fume hood just didn't seem like a good idea…), but was a modern tube furnace into which the nickel vessel was lowered. The vessel had to quenched when removed from the furnace since nickel holds onto heat better than the ceramic or glass.

My starting ingredients were mercury I retorted in my fume hood (approx. 3 ml) and white sulfur I collected at Wilbur Springs, CA, where sulfur, cinnabar, gold and hydrocarbons are actively depositing at the numerous hot springs in the area. The cinnabar I used was from the open pit of the inactive Reid mine in Napa Co., CA.

The hot spring near Wilbur Springs, CA, where I collected my white sulfur. The white color is due to the particle size of the sulfur deposited by the hot waters of the spring. The black color is from a sulfurphilic bacteria that grows in many of the mineral springs in the California Coast Ranges. The photo does nothing to convey just how bad this spring smelled.

[8] It is possible that these may be one and the same, but I have insufficient information on color of the gaseous sulfur compounds and therefore hesitate to assume.
[9] Theophilus, p. 40.

The surprise is that when I did an X-ray fluorescence analysis of the natural vs. artificial HgS, the artificial had small amounts of iron contamination, whereas the natural HgS had a tiny amount of calcium, probably from the calcite that hosted the original cinnabar, plus a little iron. The color of the two was almost the same. And now I made a really stupid mistake - I didn't label the bottles as to which sample was which before I packed them up (all my bottles of toxic pigments these days are stored out of reach inside bigger bottles with Teflon seated lids). So I don't know which batch it is that I brought with me today. I think it might be the natural, but without easy access to an x-ray fluorescence spectrometer, I can't tell by looking at them. I deliberately made very small batches of HgS, and have no intention to use them ever (no mercury is good mercury). I made them just for the satisfaction of having done so, and will probably never make more. Without access to a well-outfitted lab and fume hood, I would never have tried making the artificial HgS.

Mercury compounds are nasty. Please don't try this at home.

Sources

An abridged version of Pliny is available from Penguin Classics, though this translation is flawed by bad word choice in the sections on pyrometalurgy, pigments and rocks. It is especially so in book XXXIII in the discussion on mercuric sulfides, where the translator replaces every use of the Latin word "minium" with "cinnabar," ignorant of the fact the Latin minium covers more minerals than just cinnabar, as mentioned earlier in this documentation.

The Loeb edition of Pliny is unabridged and is mostly error-free; it is also not cheap. I own the Penguin edition of Pliny, but I get the Loeb edition from the library when I want to do real research. For research purposes, the Loeb Pliny is the preferred edition. Purists can also access the Latin text of Pliny at the historical Latin books website hosted by the history department at the University of Kansas.

Theophilus and Ceninni are the other primary sources. Since the publication of the *Artists' Pigments* series by the National Gallery at the Smithsonian, I no longer use Daniel Thompson's earlier *Materials and Techniques of Medieval Painting* for pigment information, which more modern research has superceded.

Cennini, C., *The Craftsman's Handbook*, trans. by Thompson, D. V., 1933, Yale University Press, 142 pp. (available as a Dover book)

Gettens, R., Feller, R., and Chase, W., "Vermilion and Cinnabar," 1993, in: Roy, A., Ed., *Artists' Pigments, v. 2*, Oxford University Press, pp.158-182.

Pliny the Elder, *Natural History*, Volume 9 (Books 33-35), trans. By H. Rackham,1958, Loeb Classical Library/Harvard University Press, 430 pp., ISBN 0-674-99433-7. [This is the edition currently available with the least errors.]

Pliny the Elder, *Natural History, libre xxxiii*, Latin text webbed by Bill Thayer, 1999, http://www.ukans.edu/history/index/europe/ancient_rome/L/Roman/Texts/Pliny_the_Elder/assessments.html (accessed Apri 17, 2001).

Pliny the Elder, *Natural History : A Selection*, trans. By Healy, J. F., 1991, Penguin USA, 399 pp., ISBN: 0140444130. [This is the edition I DON'T recommend, due to bad word choices in the translation in the sections covering mining and minerals]

Unfortunately signs like this have become all too common in the American West, because of mercury from acid mine drainage and from automobile emissions

Theophilus, *On Divers Arts* (*De Diversis Artibus*), trans. by Hawthorne, J., and Smith, C., 1979, Dover Publications, 216 pp., ISBN 0486237842.

Theophrastus, *De lapidibus*, trans. by Eichholz, D. E.,1965, Clarendon Press (Oxford), 141 pp.

Thompson, D. V., 1956, *The Materials and Techniques of Medieval Painting*, Dover Publications.