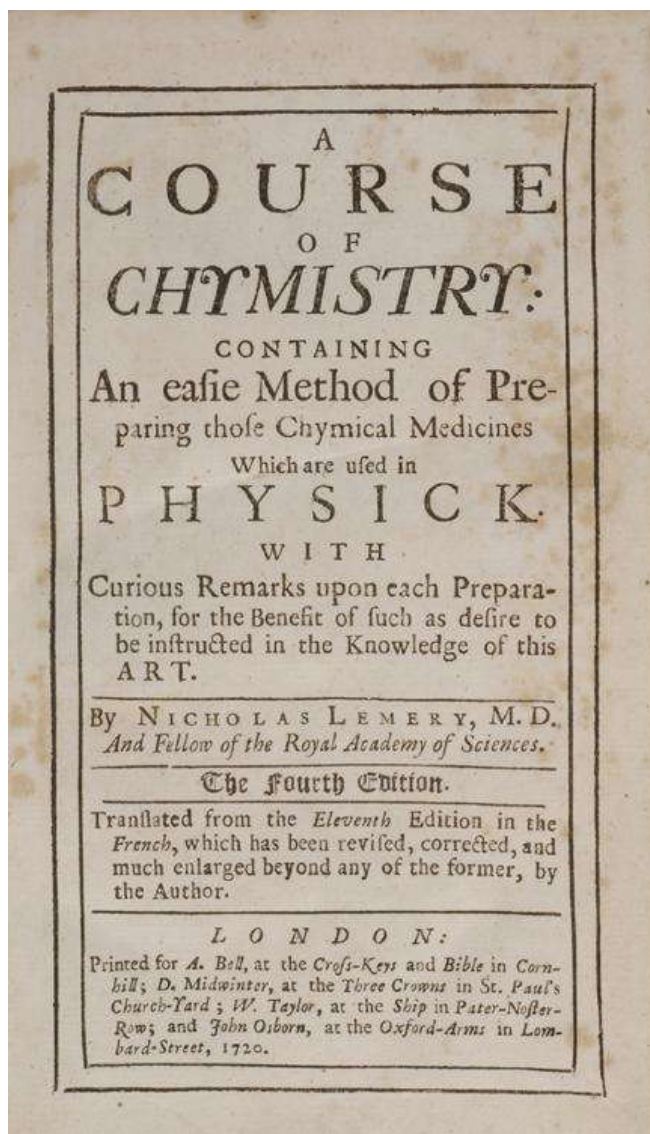


Recipes From France for Great Chemistry

While the observable world is open for all to see, industrial processes have usually been hidden behind trade secrets and the rigid guild system. Industrialists paid good money to protect their monopolies; that is what kings are for! But, in France, the King sponsored science for everyone in the context of the Jardin du Roi. Great scientists were paid to study botany and chemistry and to teach courses to the general public in Paris. As part of these courses they wrote textbooks, in which actual recipes were given for the production of “chymical medicines.” One of the most successful of these royal lecturers was Nicolas Lemery (1645-1715).



His famous textbook, *Cours de Chymie*, was first published in 1675. My copy is an English translation from 1720.



One of the most useful aspects of this work is the clear recipes given for many industrially and medically important substances. Lemery considered all the possible sources for raw materials: animals, vegetables and minerals. Isn't it strange that after 400 years, political forces would try to restrict chemistry to the study of only virtual reality. Lemery's primary focus was on substances of medical interest, but all the known chemicals were used in the preparation of the *materia medica*.

Fulminating Gold

Lemery starts off his practical part of the book with a discussion of gold. He explains how to purify it. But, the longest part of this chapter is devoted to a discussion of *aurum fulminans*.

Take some gold and beat it into very thin sheets.
Place it in a matrass and add aqua regia a little at a time
Until all the gold is dissolved.
Pour the solution into a glass vessel.



Matrass

Pour water on the solution to dilute it.
Add ammonia solution until all the precipitate
Has separated to the bottom.
Decant off the remaining solution
And wash the precipitate.
Dry carefully on filter paper.

When *aurum fulminans* is heated over a hot flame, it violently explodes! But, what is this substance? It is now known that it is a non-stoichiometric mixture of gold(III) with ammonia and chloride. The product of the decomposition includes nitrogen and hydrogen gas. The explosion also produces a purple haze composed of gold nanoparticles. Rudolph Glauber (1604-1670) used this effect to goldplate objects. But Jacob Berzelius (1779-1848) was badly injured when a glass full of fulminating gold exploded in his hand.

Magistry of Tartar

The French were intimately acquainted with *cream of tartar* ($\text{KC}_4\text{H}_5\text{O}_6$). It could be scraped off the inside of wine barrels after fermentation. It even occurred as crystals on the corks of bottles of wine. It was widely used in cooking. But, there was also a “more refined” version that was called the *magistry of tartar*. Lemery includes a recipe for its production from cream of tartar.

Place the cream of tartar in a glass vessel.
Add drop by drop *spirit of vitriol*.
Continue until no effervescence is observed.
There will be a precipitate in the bottom of the vessel.
Place the solution over a sand bath
And carefully evaporate the supernatant.
The final product will be much whiter than common
Cream of tartar.

The reaction is initially an acid-base reaction since hydrogen tartrate is a base. The concentrated sulfuric acid will neutralize this base. But, the decolorization is produced by the reaction of concentrated sulfuric acid with the purple dyes in wine. The final product is a mixture of cream of tartar, tartaric acid and potassium hydrogen sulfate. Lemery notes that there is more product than was initially provided by the raw cream of tartar. The importance of visible effervescence for early chemists was often noted. Good chemists still watch their reactions!

Phosphorus from Urine

Urine is produced in copious amounts by all mammals. Farmers often find a use for all the materials found on a farm. In the 17th century, Hennig Brand was carrying out experiments on urine to try and make the philosopher’s stone. Instead, he discovered *phosphorus*. Lemery includes his own recipe for this process.

Collect copious amounts of urine from beer drinkers.
Concentrate the urine until it has the consistency of honey.

Set aside in a cool place for four months.

Mix two pounds of the concentrated urine

With 4 pounds of sand in a glass retort.

Place this in a reverberatory furnace

With a well luted glass receiver containing water.

Heat slowly to bring over a black, stinking oil.

Then increase the heat until a white smoke

Appears in the neck of the receiver.

Continue until no more comes over.

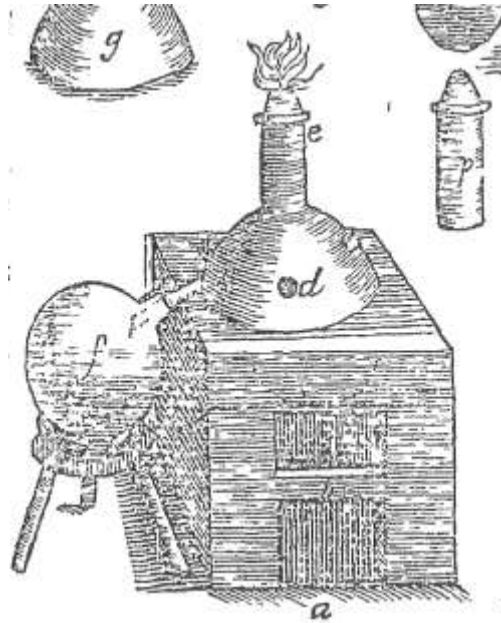
Let the receiver cool and

Use water to remove the contents of the receiver.

The phosphorus and the oil will sink to the bottom
and the supernatant can be drawn off.

The phosphorus and the oil
can then be separated by gentle heat.

The phosphorus must be kept under water
in a sealed vessel.



Reverberatory Furnace with Retort and Receiver

Phosphorus is one of the most fascinating pure elements. It bursts into flame spontaneously in air. When sealed in a vessel with a little oxygen, it glows for a very long time. It is very poisonous and must be used with great care. A very good story is found in the book by John Emsley: *The 13th Element: The Sordid Tale of Murder, Fire, and Phosphorus* (Wiley, 2002).

While the chemistry book by Lemery is more than 300 years old, the sound chemistry contained in it remains valid. The results of more than 100 recipes are discussed in terms of concepts current in his own time, but the procedures can be followed today and will produce the same results.