A Primer for Those Interested in Ancient and Medieval Techniques

by

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Period Ink from the Modern Kitchen
Period Ink from the Modern Kitchen, Part 2: Green Ink
Period Ink from the Modern Kitchen, Part 3: Black

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http://www.bussjaeger.org/.

Introduction

I've long been interested in "obsolete" technology and techniques. A girlfriend once told me that I should have been born at least a century earlier; I'm not sure whether that was meant as a compliment. Regardless, I am fascinated by such things. That is one aspect of the Society for Creative Anachronism (a medieval history semi-recreation group, for the uninitiated) that attracted me many years. The SCA's bureaucratic cronyism and nepotism eventually turned me off of most active participation, but my liking for old tech predated that and continues. This article should be of use to artists, children's craft classes, or anyone else with interests similar to my own, whether SCA participants or not, but it is written from an historical recreation perspective for the sake of context.

I am *not* an artist, as will plainly be seen in the following pages; just a crafter who makes stuff that real artists can – hopefully – turn into works of beauty.

The difference between ink and paint is a surprisingly vague distinction. Most folks tend to think of "ink" as a fluid that stains the writing material; normal enough since most modern inks with which they have experience – ball point pens and the like – are just that. Most often, "paint" merely adheres to the surface. One of the oldest inks, probably excepting simple berry and plant juices, and one still in use, breaks that fast and loose rule. Commonly referred to today as "India ink", this is popular with graphic artists for its deep black. It is simply carbon (traditionally, lamp black) with a binder that causes it to adhere to the surface of paper; a "paint", as defined above.

At least in artistic terms, it might be better to define ink and paint by the intended use. "Paint" covers an area, small or large, obscuring the surface of the medium. Ink creates detail work *on* the medium without generally masking it (i.e.- writing). Obviously, this definition has its own problems, but it might help to know that if you are making an "ink", you'll prepare a less viscous fluid appropriate to fine detail, while a paint will be thicker, even paste-like, to glob on and cover the paper or canvas underneath. Many would argue the point, but it's useful enough for this article.

Inks

Black

As mentioned, this is one of the oldest inks. It was definitely used by the ancient Egyptians, and even in prehistoric cave paintings. Theophilus included it in his *On Divers Arts* in the Middle Ages.

This is the simplest ink I've ever made. You need only three recipe components, and few tools.

2 tablespoons powdered lamp black or charcoal
2 teaspoons powdered egg whites (or gum arabic; see text)
water

Most often, you will see period basic black ink recipes calling for lamp black (typically collected by burning an oil lamp under a plate). Lamp black has the advantage of being very finely divided, requiring little grinding to use as an ink. But it is time-consuming to collect.

I used charcoal (in my case, lumps found when cleaning my wood stove) for my first attempts, since it was readily available. I then ground it to a very fine powder with mortar and pestle. This is tedious but quicker than burning an oil lamp for days. But if you illuminate your home with lamps, as in the Middle Ages, that isn't a problem; you'll be collecting lamp black whether you like it or not.

Grind the charcoal very fine. When it starts to run in the mortar almost like a liquid, you're getting there. When the powder "squeaks" instead of crunching as you grind, it is ready. I try to do the grinding while reading or listening to music; anything

that doesn't require much other use of my hands.

Here are a couple of samples you give a visual idea of what to expect.

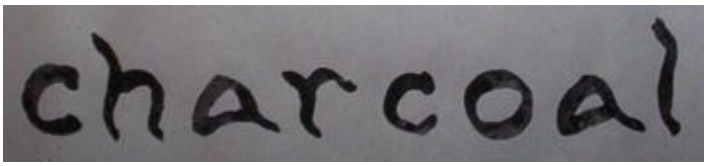
You do *not* want to grind your charcoal around your computer. If it spills... Carbon (which is what charcoal is) conducts electricity (let alone the mechanical problems from an abrasive dust); a property taken advantage of to make certain electronic components like resistors. It can be worse on electronics than water, since water eventually evaporates. I once had a laptop completely immersed in water for nearly half an hour (don't ask; but you'd better believe that briefcase got rendered darned near *air-tight* afterward). After careful dis-assembly and drying, I used that computer for another three years. A similar carbon spill would probably have permanently ruined it.

Gum arabic is a period thickener that was also commonly used in period inks. You can find it in the candy-making section of your local grocery store. Use it as you would powdered egg whites.

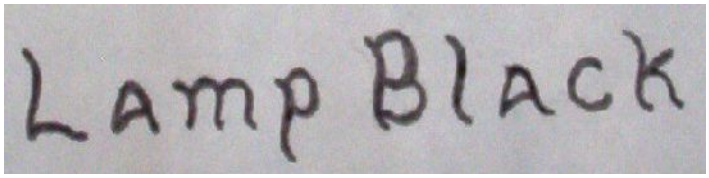
Mix the powdered charcoal with the egg white powder. I grind the two together in my mortar. Then add water to achieve the desired consistency. The ink is ready to use.

Notes on viscosity: If you use powdered egg whites (available in the baking section of most modern grocery stores), the ink will thicken after the immediate mixing. You may want to add more water later when you are preparing to write. If you use fresh egg whites, gradual thickening isn't a problem, and you will need to add less water to begin with.

I assume real scribes are familiar with the viscosity issues related to pen point size, but it had not occurred to me until I began experimenting with period inks; I'm a craftsman or technician, not an artist. What I found is that the finer (more pointed) the pen nib, the thinner or less viscous an ink you want. Fine pen point: thin ink. Chisel-tip "calligraphy" pen: thicker ink. Adjust your inks accordingly. This why I don't specify a precise amount of water (or fresh egg white).



I also collected soot (the more traditional lamp black) and prepared an ink with that.



The difference in darkness compared to the charcoal variant was caused by the amount of water added. A thinner ink writes nicer, but tends to be lighter in color.

Yes, I know my handwriting is terrible. I specifically claim to *not* be an artist. Considering my lack of graphical skills, and the pen I use, I think it suffices to make the point here. The pen?

Homemade pen.

Nothing fancy. A wooden stick, slotted on one end to accept my homemade nibs (usually wood, since it is available and cheap), and waxed (beeswax, if the period material makes you feel better). I considered making a metal ferule to hold the nibs in place, but settled for lashing. If this design is period, it is purely accidental; I did not research the pens, but simply threw something together quickly that worked for my ink tests.

Unlike iron-tannin ("iron gall") or inks, or those based on plant juice extracts, charcoal/lamp black ink doesn't stain the fibers of paper so much as it adheres to the surface (rather like paint). For this reason, little scribely ~~mistak~~... *corrections* can be made to a document by scraping the charcoal ink off and trying again. On the other hand, if the document is going to get a lot of handling (think peasant-tax reports being passed up the chain through various hands until they reach the king), charcoal ink is less durable. This should not be an issue for scrolls meant to be displayed on a wall or filed away.

Brown and Black (Tannin/Iron Ink)

This ink (and as a staining fluid, perhaps everyone can agree that it *is* an ink rather than a paint) is also very old. Romans, Greeks, and possibly the ancient Egyptians seemed to have used variants. Certainly it was well-known enough a thousand years ago for Theophilus to include it in his compendium.

It is also a little more complicated in the making than India ink.

Many period inks were based on tannin extracts from wood bark.[1] Oak galls ("oak apples", "gall nuts") were another common source. Being lazy, and not wishing to scour the local oaks for galls nor kill standing trees by stripping the bark, I considered that acorns' notorious bitterness derives from their high tannin content. I chose to make us of this readily available resource.

Extracting the Tannin

Take a quantity of acorns, crush them to expose the kernels, and place them kernel and hulls alike in a pot. The pot should be approximately half filled with the nuts. Add water to fill completely. Bring to a boil, and simmer until the liquid becomes dark (appearing rather like a good cup of -- non-period! -- coffee). Discard the nuts and retain the liquid.[2]

Crushed acorns ready to cook.

Continue simmering the liquid until the volume is greatly reduced and the liquid thickens and becomes opaque. This is the base for your ink. Be warned: This will stain fabric (and would make a nice brown dye).

Tannin extract boiled down.

Specifically, and being limited by the size of my crock pot slow cooker, I simmered roughly a pound of cracked acorns in two quarts of water. More water per quantity of nuts is good in that it will allow you to extract more tannin into solution. You will, though, need to boil the solution longer to reduce it. Two quarts of liquid will reduce to roughly half a pint (in practice, I processed enough in this batch to make a quart of tannin concentrate).

Concentrated tannin extract, canned for storage.

Despite the acidity of this solution, it will support mold growth if you plan to store it. I recommend adding common table salt to the liquid; approximately a tablespoon to the quart.[3] The jar pictured was hot packed ("canned") for long term

storage; I have smaller jars of ink set aside for regular use.

The Ink

This dark fluid may be used as a crude ink without further preparation, but it is thin and will tend to bleed through your paper. I have not tested it on true parchment; it may fare better there. However there are period remedies for that thinness that we can use.

Writing sample using plain tannin extract.

This ink will be a nice, pale brown that I think looks good on paper, if a little light for most writing. Again, I know the "calligraphy" is terrible. My mundane handwriting is terrible, too. But this is an ink-making tutorial, not a calligraphy primer.

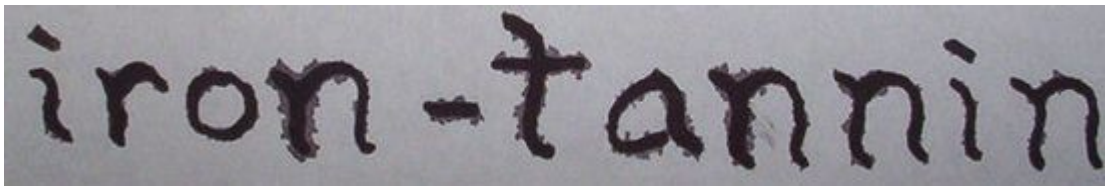
As you can see, the ink is thinner than you will normally wish to write with. There are several period ways to thicken it to a nicer consistency for writing.

Black Ink

If you prefer a darker, even black, ink, a very common period ink (more so, to judge by the references I have found, than the plain brown described above) added iron to the tannin solution. Commonly, "green vitriol" (ferrous sulfate) is specified. This produces a darker ink that gradually ages to black.

In these current middle ages, the easiest way to get ferrous sulfate is to purchase it from a chemical supplier (it is available through Amazon.com). But if you have an old automotive battery laying around, pour the battery acid into a glass jar, add some scraps of iron (nails, et cetera; don't use stainless steel), and let it sit for a couple of weeks.

But several sources describe plain iron being added to the solution. Theophilus even describes heating an iron rod and plunging that into the ink to darken it. The modern equivalent I hit upon was steel wool. I place a small bit in a jar of tannin ink and leave it there for two or three days, shaking it three or four times a day to mix it up. Then I remove the wool and strain the ink.



Iron/tannin writing sample.

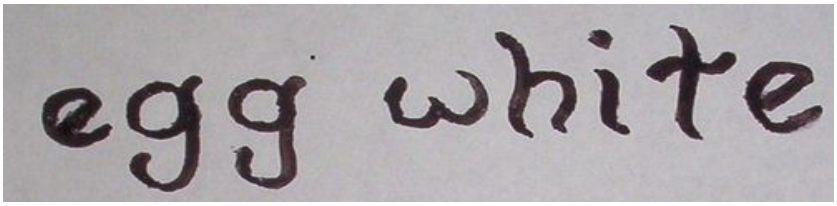
This is a much nicer color for writing. But it does bleed into the surrounding paper, spoiling the effect. Never fear; the ink-making process is not yet finished.

Viscosity

We need to thicken the ink so it is easier to write with, and bleeds less. Again, period ink recipes describe several options. Three materials that are readily available in kitchens and easy to work with are gum arabic, egg whites, and gelatin.

Gum Arabic: One of the more prevalent thickeners in period ink recipes. Gum arabic is a plant extract commonly used today as a thickener in foodstuffs. You can find it amongst candy-making supplies. Add this to your tannin solution (in small increments until it achieves a consistency that please you.

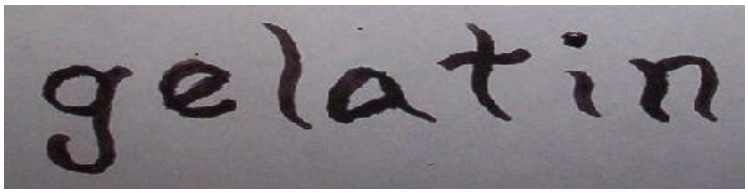
Egg Whites: Separate your own, or purchase the egg whites at the grocery store. The powdered whites are much easier to deal with when mixing ink.



Using egg whites to control viscosity and bleeding.

Much nicer. Still good color, with very little bleeding.

Animal Gelatin/Glue: Glue made from decomposed animal scraps (typically leftovers from leather tanning, or even fish bladders) was a common adhesive, and is still used occasionally today. Such glue and gelatin -- familiar to anyone who has boiled meat and bones -- were both used to increase the viscosity of ink. If you plan to boil a chicken for soup, cool the broth and save the gelatin. Otherwise, you will likely find it more convenient to obtain a box of unflavored gelatin for the grocery store. As with the gum arabic, add it to the liquid just a bit at a time until you are satisfied with the product.



Gelatin ink sample.

Also acceptable. I found the texture of the egg white-based ink just a little easier to write with, though. More experimentation with the amount of gelatin may improve that.

Possible Problems

Tannin is acidic, as mentioned. It is possible for the ink to gradually eat at and damage paper. Some medieval manuscripts do show signs of acid damage; vellum and parchment are less prone to such degradation. However, considering that a great many manuscripts using tannin/gallic inks have indeed survived, some more than a 1,000 years without obvious acid damage, I think storage conditions made a greater difference. If you are concerned about the possibility, you can raise the pH (reduce acidity) of the ink by adding crushed eggshells, as did some period ink makers. Another simple modern remedy would be sodium bicarbonate (baking soda).

Other Uses for Tannin

As mentioned earlier, tannin will stain. If it will stain fabric, it will dye fabric.

Tannin was, and still is, one of the more common chemicals used to tan (the word derives from the very word) leather. For this, skip the thickeners and ferrous sulphate.

Tannin taken internally can inhibit the uptake of metals. For this reason, some folks use it as a folk chelation remedy. Those more concerned with a post-nuclear apocalyptic scenario rather than the Middles Ages might consider its chelating properties when dealing with fallout. However, strong concentrations of tannin can cause health problems of its own including kidney damage, and the metal-uptake inhibition can lead to anemia. Unless bombs start dropping, zombies start walking, and the SHTF, I strongly discourage this. If you want tannin in more reason quantities, drink tea or red wine (tastier and a lot more fun than straight tannin anyway).

Notes:

1. On Divers Arts, Theophilus: "When you are going to make ink, cut some

pieces of [haw]thorn wood in April or May, before they grow blossoms or leaves. Make little bundles of them and let them lie in the shade for two, three, or four weeks, until they are dried out a little. Then you should have wooden mallets with which you should pound the thorn on another hard piece of wood, until you have completely removed the bark. Put this immediately into a barrel full of water."

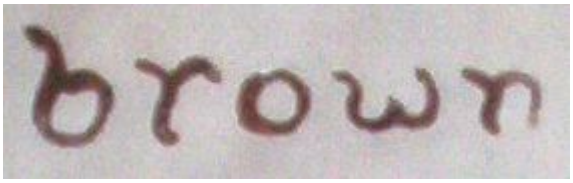
2. I adopted this process because I have an abundance of acorns and little other use for them. However, acorns are edible once the tannin is extracted. If you choose to do this, rather than merely cracking the nuts, open them and remove the kernels. Discard the hulls. When you boil them, you want to pour off the dark tannin solution, saving it for further processing for the ink, adding fresh water, and continue the simmering. Repeat until the water does not darken and the acorn meats lose their bitterness. Dry (or roast) the acorns. They are tasty as is, or sugar-coated as a candy. You may also grind the roasted acorns to make flour for bread. I prefer whole wheat flour, but a medieval peasant would eat what he could get.

Acorn kernel.

3. The salt can also act as a mordant if you use this solution as a fabric dye.

Another Brown
Roasted iron oxide

While material does adhere to the paper surface, this ink most definitely stains the paper itself. Unlike the lampblack/charcoal ink, which can be scraped away -- very carefully! -- when a mistake is made, anything that this ink touches is going to be permanently marked. With thicker parchment it should be possible to scrape away the stained material and try again (palimpsest, anyone?), but that wasn't an option with the thin commercial paper I tested.



I collected rust from assorted iron scraps, then ground it in the mortar just as the charcoal. This sample used egg whites as the binder (egg whites are the binder I use most often due to financial constraints: it's cheap, I'm broke).

Green Inks

Plants have long been source of colors for pigments, dyes, and inks. When thinking of inks, most people of my acquaintance seem to think of berries. I, on the other hand, think of laundry, stubborn grass stains, and...

A green, chlorophyll-based ink.

Pick green plants. I simply harvested clover, blades of grass, and green weeds from my front yard. Whatever your source, select the green leafy portions of the plant. Stems or flowers without chlorophyll contribute nothing to the ink's coloring.

Blanch in boiling water.

Puree. Period-style, you might strain this through a screen, or mash it in a mortar. Fortunately, we have this really nice 21st century gadget called a blender. Unless you're dead-set on authenticity, use it.

Filter the slurry to obtain the green juice. I found that the pureed mass retained fluid well enough that I had to force it through the cheesecloth I use as a filter. Specifically, I put it in my small cheese press and extracted the juice that way.

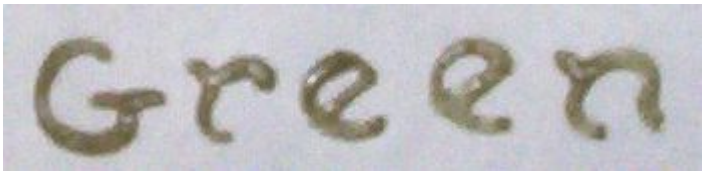
Evaporate the juice to desired consistency. You may simmer the fluid on your stove top or simply set a pan out to evaporate naturally (but *sloooowly*).

Add egg white to thicken your ink as desired. According to Theophilus (On Divers Arts) and other sources, gum arabic was also commonly used. But, though I have not researched medieval trade routes and prices, I suspect that a substance imported from half a continent or more away would be more difficult and expensive to obtain than the whites of simple eggs of chickens or swallows (African or European). High quality (and expensive!) ingredients were probably difficult to wheedle out of one's superiors. This issue remains a problem in the mundane 21st century world, as any clerk trying to get authorization for new ~~typewriter ribbons~~ er, *toner cartridges* (oops; showing my mundane age again) and copier paper during an austerity drive can attest. Being on a nonexistent budget myself for this project, I have opted for the most readily available (and cheap-or-even-free) components.

If you are new to homemade inks, you'll want to play with the viscosity of your ink. If you use a fine pointed pen, I've found that a thinner ink works better than the thicker (high viscosity) ink that works best with chisel-tip "calligraphy" pens.

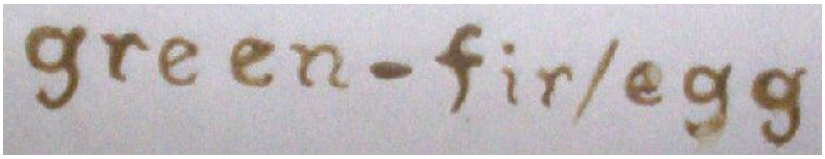
If you use powdered egg whites (readily available in the baking section of most grocery stores, and easy to deal with when making ink), bear in mind that as your ink sets, it will thicken somewhat after mixing. This isn't an issue when you use freshly separated egg whites.

If, as I did, you prepare a greater quantity of ink than you expect to use immediately, you may wish to add a tablespoon of salt per quart of ink as a preservative. It is not absolutely necessary, but may help for long term storage. Also, salt is a common mordant, fixing colors/dyes in a material. Salted ink may be less susceptible to running should some clumsy oaf spill anything on your document.



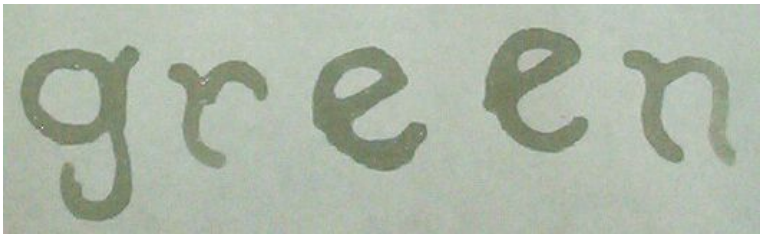
I need to work on the viscosity a little more, but you can get the idea.

I also prepared a green ink from fir needles, on the theory that scribes and artisans would try *anything* when push comes to shove.



Just to be contrary, the fir-based ink was mixed with whole eggs instead of just egg whites.

In the section on tannin/iron ink, I mentioned that Theophilus provided an ink recipe that used ferrous (iron) sulfate. Since this establishes the chemical as period, and since it's green, I just had to try it, with egg white as the binder:



This is crowding (again) my arbitrary definitions of ink/paint, since the material stays on the paper surface.

Pure ferrous sulfate should be a brighter green. I haven't run a chemical analysis, but I'm assuming that – due to the source of my sulfuric acid: car battery – there was already a fair bit of lead sulfate in solution before I added the iron. I've heard that some artist have the habit of licking their brushes to bring the bristles to a fine point. I very much advise against that when using this "green vitriol" ink.

Pigments

These are colored powders that are mixed with a binder to make paints. I don't hesitate to call these paints since these really do get glued to the paper surface. There is little if any staining effect.

Historically, artists would reduce to powder darned near any colored rock or mineral they could get their hands on. So that's what I've started doing, too. However, because of the hardness or these materials, I start by breaking them into tiny pieces, then pulverizing them with an improvised mortar/pestle:

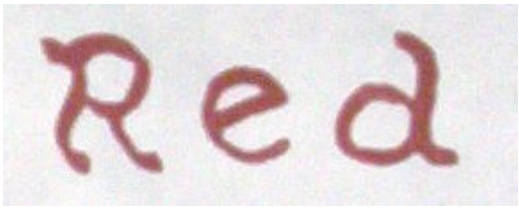
Small pipe with nipple cap for the mortar, ground down spike nail for the pestle.

I then transfer the powder to a my usual mortar to finishing reducing it to the fineness required for pigments.

Generally, I mixed one part pigment to one part egg white for the following tests. My sense is that less of the binder will work for pictures or documents that will be hung on a wall and won't be handled. But I had in mind SCA award scrolls that are likely to get rolled up and passed from hand to hand before finally reaching the awardee. More egg white binder seems to be more durable.

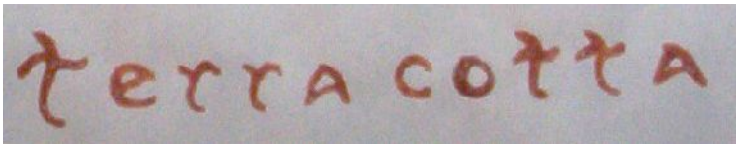
Red (iron oxide/chalk)

Iron oxide, depending on its oxidation state (and the mix of oxides in various stages) can range in color from yellow through red to brown. The brown you've seen already. I also had on hand some iron oxide of a much brighter red. This was mixed with powdered chalk. You can vary the chalk content to achieve different shades of red.



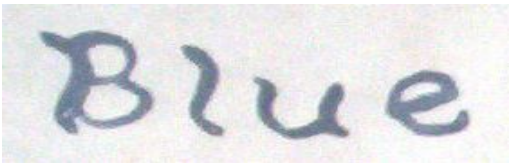
Orange (terracotta)

I had some old, broken terracotta flower pots on hand, which allowed me to try another iron oxide variant, that being the pigment that gives terracotta clay its distinctive color. I pulverized and ground the fired clay into a powder. It already being a clay, I didn't bother with a chalk extender, as with the red above.



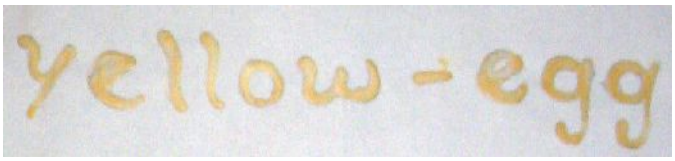
Blue (azurite)

I was fortunate enough to discover some small fragments of the mineral azurite while rock hunting. Azurite is a rather pretty blue. Mixed with egg whites, but not chalk extender, since the powdered material appeared light in shade, I got this. It turned out darker than the powdered form suggested; a nice heraldic blue for painting devices. I expect a little chalk would yield a good sky blue.



Yellow (egg)

I considered using powdered sulfur as a yellow pigment, but I while I was scrounging, I considered the powdered eggs in my kitchen. It was worth a try, eggs – whole, yolks, and whites – were definitely used in period.

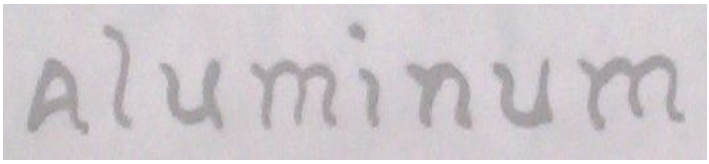


Not bad. And the whole egg serves as pigment and binder all in one.

Silver/Gray/Metal

Powdered metals were also used in period (and still are today, accounting for metallic fleck automotive paint jobs, for instance). Silver and bronze powders were comparatively common (expensive, granted). Gold flakes were used, but obviously sparingly due to the expense. Sadly, expense is still an issue for me. I have some silver, but not so much that I'm willing to grind it away in an experiment. I do, however, have a pound of finely powdered aluminum.

Aluminum, of course, is not period for medieval reenactors since it wasn't isolated as a distinct element until 1825. But since that doesn't bother armored combat fighters who use it in their armor, we won't let inconvenient facts stand in our way either as we play with the generally period *idea* of powdered metals. If, however, you are planning the ultimate period award scroll in hopes of a Laurel, for authenticity's sake start grinding up your best table service. The obsessive/compulsive authenticity mavens will undoubtedly note your sacrifice and award you appropriately.



Fine mesh powdered aluminum with egg white binder. That's something we can work with. Again, adding an extender like chalk will let you vary the shade.

(*Why* do I have a pound of powdered aluminum? Mixed with clear lacquer, another binder option for artists to consider, it makes a good modern metallic paint. Also, if you've notice the gray glass-breakage sensor strips for alarm systems, that's

aluminum; sometimes it's a metallic tape, sometimes it's painted on. It's a decent conductive trace you can apply to nearly any surface; you can mix the powder with clear nail polish to repair small breaks in rear automotive window defrosters grids, too – much cheaper than replacing the window. And if you *really* need to get a fire going for a bardic circle, despite pouring rain and waterlogged wood, mix one part aluminum with 3 parts iron oxide (see above) to make thermite; ignite it with a common sparkler; it will burn. *Hot*. Your soaked wood *will* ignite.)

But if you want a shiny surface for the arms on an AoA scroll...

Mica

In India, artists sometimes used sheets of mica as painting "canvasses". I don't have sheets of mica. My rock hunting did turn up smaller lumps and flakes of mica. It happens that mica is another *ancient* pigment; it was ground to a fine powder as used as white paint in several prehistoric cave paintings. But there are other materials that can be used for a white (chalk was and still is used).

Have you ever noticed how much fine bits of mica look like glitter?

Here's a close-up of an aluminum-painted surface with powdered mica dusted over the surface. I waited for the aluminum paint to dry, then applied a thin coat of egg whites over that. Before the whites dried, I sprinkled mica very generously over the gray area. Once that dried completely, I brushed off excess mica.

It isn't as clear in a still photo as I'd like, but the hoped-for glittery surface effect is there.

To give you a better idea of what you can do with this...

Don't laugh. I warned you that I'm not an artist. OK, then... laugh. This is just to give you sense of what's possible. Aside from my humiliating lack of artistic skill, I also mixed the red paint improperly. It seemed acceptable when I prepped it, but it quickly became clear that it was much to too thin. I got some running, and bleed from the excess water, darn it. I'll console myself with the thought that new artists can learn from my error, avoid it, and proceed directly to their own little goofs.

I did attempt mixing powdered mica with the aluminum to make a one-coat paint, but it didn't turn out well.

Unless your paint is thick, the mica doesn't stay in suspension well; constant mixing is needed. And the aluminum coats the mica flakes and masks the glitter, defeating the purpose. I actually expected that, but wanted to try it, if only to save someone else the effort of the failed experiment.

Summary

If it stains (grass, berry juice, fabric dye, et cetera), you can probably make an ink from it. Make it as dark as you can manage. You can dilute it for lighter shades

If it's opaque (preferably colorful) and you can pound it to powder, you can use it as a pigment for pain or ink. Browse through Theophilus' paint recipes and you'll see that this was the usual technique in the Middle Ages. Add neutral-colored extenders like chalk for lighter shades.

Egg whites and gum arabic were common binders and thickeners I imagine that the less generously endowed – financially speaking – were more likely to use egg whites than gum arabic due to importation costs.

Fish glues were also used. "Isinglass", an animal gelatin,* was used as a pigment binder as well as sizing for paper and parchment in period. Fish glues can can obtained through woodworker supply sources. I've also used conventional unflavored gelatin (right from the grocery store) successfully.

Milk, with pigments, was used as a paint (or "white wash", pick your definition) well into the 19th and 20th centuries. I'm unsure how medievally period the practice was; while effective, it depends on having an abundance of excess milk beyond what is needed simply as _food_; but eggs were used, so why not?. Casein extracted from milk would also serve as a paint binder, but casein – isolated, not part of milk or cheese – is not period, having been produced in the mid-18th century.

I have some concerns about the color stability of some of these inks/paints; specifically the chlorophyll greens and the egg yellow. I'm going to save samples of each, without any special handing or storage, to see if and how aging affects the colors.

* Isinglass, a gelatin made from fish bladders, and also used to clarify beer. Not to be confused with "isinglass" which was mica. Generally, you can tell which material is meant through context. If your topic is glue, pigment binders, paper treatment, or brewing, they mean the fish bladder preparation. If the subject is heat or electrical resistance, or windows or peepholes, it's mica.