



Iron gall Ink

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Prior to 1600, the three most typical inks are carbon ink, walnut ink and iron gall ink.

Iron gall (also called oak gall) ink is by far the most common, reliable and versatile of the three, with hundreds of recipes available from a huge variety of period sources. While the supporting ingredients vary - for example in binding agents, the source of the Iron, the use of wine or water - the two basic ingredients are 'galls' and Iron.

Galls are abnormal growths on certain trees, most notably cypress and oak. For our purposes, we are dealing with the common oak galls available in Insulae Draconis: acorn and marble galls, also commonly known as oak apples.

The most common recorded varieties of the recipe have the same 4 ingredients; galls, ferrous sulphate, gum arabic and water. This basic formulation appears for well over a thousand years, and it was in use right up to the last century.

What colour can I expect?

The inks I have made have been different every time: a purpley black, brownly black. It varies depending on the way you process the galls, the age of the galls, the hardness of the water and so on.

The ink may seem pale when you first apply it, darkening and blackening as it dries, oxidising in air. This is absolutely typical, and part of its charm.

The Ingredients...



The Gall

Oak galls are a strong source of tannic acid. If you're wondering could you use strong tea the answer is yes. Dried pomegranate rinds are also a good source, though I haven't yet tried those. Oak galls occur when a gall wasp lays its egg in a developing leaf bud. The tree's tissue grows around the larva, helped on by larval secretions, and the larva feeds and develops within the protective hard bubble. When the larva is grown, it burrows out of a small hole, leaving the gall on the tree. These would have been plentiful when the country was covered in oak forests. They're not quite so easy to find nowadays, but it's worth having a rummage around under oak

trees of any age. The fallen galls last a long time after falling.

Different recipes call for galls collected at different times, some while green with insect still inside, some later. Beggars can't be choosers, so I take any gall I can get.

The chemical composition of galls varies depending on the gall-forming agent and the plant in question. The "Aleppo" gall is particularly rich in tannic acid (65%) and gallic acid (2%) and is praised in many period sources as the best type of gall to use for this type of ink. Aleppo galls, collected in Asiatic Turkey, principally in the province of Aleppo, are collected before the insect escape. They are hard and heavy, without perforations, dark bluish-green or olive green, nearly spherical in shape and are sometimes called blue or green galls. In the British Isles we get Acorn and Marble galls, which typically contain 45-50% tannic acid.

All galls can be used at all stages, so don't get too concerned about the type you're looking for. The most period solution for your persona is the easy, local one - making ink was a considered a general domestic duty in literate houses. There is a recipe included in *Le Ménagier de Paris*, ostensibly written as a guide for a young housewife on how to perform household tasks and be a good wife dating to 1393.

There are two ways to prepare the galls in recipes:

- 1) roughly broken up and fermented over time - anything from a couple of days to 3 months
- 2) finely ground and heated, often with something like vinegar or wine - I've generally gone with this method as I am impatient and this takes less time. I also don't really like dealing with mouldy crusts, which is something that is specifically mentioned in recipes where the galls are left to ferment for 8 weeks. However the mould is essential to raise the concentration of purer gallic acid from the gallotannic brew it forms on. It makes better ink, so later period recipes tend to stress longer fermentation times.

The goal of either method is to concentrate the gallic acid to react with the iron sulfate, our next ingredient, to produce the black ink with the purple or brown tinges.



Ferrous sulphate (Copperas or Green Vitriol)

Ferrous Sulphate is lovely to look at with its soft pale green crystals and is the best ingredient to use where a recipe calls for Copperas or Green Vitriol/vietriall. In ancient times, copperas ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) was extracted by evaporating water from ferrous earths or from water collected in mines. In later period crystals were “grown” on ropes submerged in iron-heavy water in barrels, or, towards the end of the 16th century, by adding sulphuric acid to iron nails. For more information on the preparation of vitriol, refer to *Manuscript Inks* by Jack C. Thompson. Don't worry about the different forms of iron sulphate available; in the end all iron sulfates dissolve in water to give the same complex $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$.

Other names include Sal Martis, sulfate of iron, English or Roman vitriol. Period vitriol would frequently have contained large amounts of copper or aluminium and plenty of other contaminants.

Water

The water you use will influence your end result - you will often find modern adaptations of recipes will call for distilled water to remove contaminants from your ink or to take the guesswork out of measuring the ph. However, consider:

- period ink makers would have used whatever water was at hand, whether hard (full of limestone deposit and therefore alkaline) or soft. I tend to use rain water to remove chlorine as a contaminant, as that does seem decidedly not period.
- hard water from a limestone area would naturally tend to neutralise the rather acidic nature of Iron gall ink.

Some recipes will use vinegar or wine instead of/in addition to water, especially where the gallic acid is being extracted by heat rather than fermentation over time as this provides an extra injection of acetic acid. This evaporates once you write with the ink but helps the oxidizing (darkening) process, ultimately helping the ink become waterproof and permanent.

Gum arabic

Gum arabic is a natural amber coloured gum extracted from acacia trees. The Acacia tree is native to Egypt and the Levant, hence gum 'Arabic'. It's an ingredient in medieval pigments and adhesives - you can gild with a gum arabic mix.

It's now common as a food stabiliser, for the same properties it adds to ink:

- as thickener (making it flow better)
- as a binder (making it 'stick' to the page better with a glossier and more brilliant appearance)
- as a suspension agent, stopping the ink particles from settling

It is by far the most popular binding agent mentioned in Iron gall recipes.

You could substitute egg white which I have also seen though I think this may shorten the life expectancy of your ink.

You can either get the large lumps and grind it yourself, buy it already ground into a powder or buy the artist's liquid solution. If you are using the pre mixed gum arabic liquid you should use twice as many ml as grams specified, so if 20 grams of powder is suggested substitute with 40 ml of liquid gum.

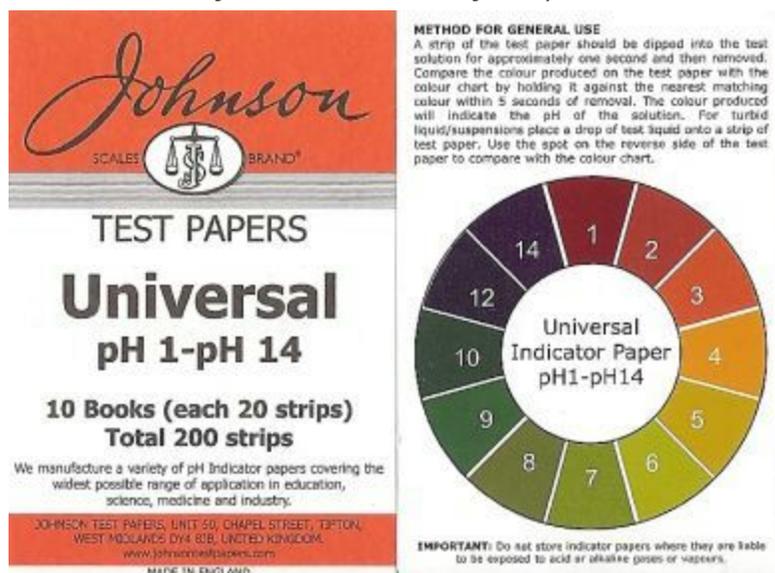
A basic recipe (cooked method)

- 1 litre of water (rainwater) or a mixture of water and cheap white wine
 - 30 - 35 grams of powdered galls
 - 25 grams of ground gum arabic/50ml liquid gum arabic
 - 20 grams iron sulfate.
- 1) Break the galls and then grind them.
 - 2) Divide the water more or less evenly between two jars and soak the powdered oak galls in one. You can skip this step if you like or are in a hurry, but letting them soak increases the quality, anything from overnight to five days. Mark the point on the jar where the water level is at the start. If the powder has soaked up a lot of water top it back up to that mark again. Makes a brown sludge.
 - 3) Heat this mixture for 20 minutes over medium heat, the liquid will reduce.
 - 4) Mix the powdered gum arabic with a small amount of water to make a smooth paste. Leave to one side for now. You may prefer to use liquid gum arabic.

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- 5) After the 20 mins of step 3, strain through tightly woven cloth to remove the powdered galls. Clean the pot to remove any residue and then return the strained mixture to a low heat.
 - 6) In the other jar mix your ferrous sulphate with the the rest of the water, it will turn an orangey yellow.
 - 7) Turn off the heat and introduce the ferrous mixture to the strained gall solution, you should see it turning dark immediately and may notice a strong smell of iron.
 - 8) Stir in your gum arabic solution.
 - 9) Optional: add the finely crushed sterilised shell of an egg to help neutralise acidity.
 - 10) Filter the ink before use to remove any remaining gall residue or eggshell.

Potential Problems

- 1) Well the most famous one is the acidity: documents kept in poor conditions have effectively been 'eaten' by the acidic ink. Always clean your pen nibs thoroughly! The best way to counter this is to mix in some ground sterilised egg shell or cuttlefish bone then strain your ink through filter paper (coffee filter paper works well) into your storage bottles. What you are doing is adding an alkaline - calcium carbonate - to your acid to move your ph level closer to neutral which is ph7.



The stronger the acid the closer to ph1 (deep red) a universal indicator will show. 1 - 6 is an acid, 7 is neutral and 8 - 14 are alkaline or base. Pro tip - when you dip in a ph strip the ink naturally colours it black. you need to watch for the coloured damp patch above the dip line, so be careful not to dip too deeply when testing.

- 2) The ink is too pale!
Don't worry too much if it's pale when you first apply the ink to page. Part of the ink's charm is in how it deepens to black as it oxidises. If it's still too pale the next day, it's too dilute or you've added too little ferrous sulphate.
- 3) The ink is too runny!
Add some more gum arabic. You could try rescuing small amounts with some artist's liquid gum arabic or some egg white, before dosing the whole batch.
- 4) It's not flowing properly!
Probably too much gum arabic: try diluting a small amount with vinegar or white wine. Or you might not have strained it thoroughly enough. Try pouring it through a paper coffee filter.

- 5) Hey it smells funny...how long does it keep? Gooooood question! I threw out my very first batch because I read in a recipe it only kept for 6 weeks, but have since learned that people have been using their ink years later. As long as there's no mould forming, it's kept in a suitably airtight bottle that was thoroughly cleaned before use and it's not gone sludgy, just keep using it.
- 6) Hey, it dried out before I could use it! Genevieve says: reconstitute with distilled or purified water, and test to see how dark it is. If it still oxidises, it's good to use.

Challenges of historic recipes

Quantities change or make no sense anymore - do you know is a Parisien quart the same as a US quart? What's a penny weight?

People like their inks their own way for their own pens. I might like mine thicker than you do, I love the purple tinge someone else might prefer the brown. Ink makers will give their recipe based on the quantities that gave them the result they like.

Bottom line: don't get too bogged down in finding exact measurements. The correct quantities are the ones that give you a result that works and a consistency you like - remember, even the water you use will affect the outcome, so you **will** need to tweak things.

Recipes

The earliest I've come across a reference is late Roman, that specifically mentions a mixture of galls, ferrous and gum.

Martianus Minneus Felix Capella's *De Nuptiis Philologiae et Mercurii et de septem Artibus liberalibus libri novem* (On the Wedding of Philology and Mercury and of the Seven Liberal Arts in nine books; 420 AD)

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"To make 3 quarts of ink, take 2 ounces each of galls and gum arabic, and 3 ounces of copperas. Break the galls and soak them for 3 days, then boil in three half gallons of rainwater or water from a still pond. And when they have boiled long enough so that nearly half the water has boiled off—that is, there is only about 3 quarts left—take off the fire, and add the copperas and gum, and stir until cool. Store in a cold, damp place. Note that after 3 weeks, it will spoil. "

Le Ménagier de Paris

A Medieval Household Book, translated, with critical introduction, by Gina L. Greco & Christine M. Rose, Cornell University Press, Ithaca and London, 2009, p. 336.

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"Take halfe a pint of water, a pint wanting a quarter of wine, and as much vineger, which being mixed together make a quart and a quarter of a pint more, then take six ounces of gauls beaten into small powder and sifted through a sive, put this powder into a pot by it selfe, and poure halfe the water, wine and vineger into it, take likewise foure ounces of vietriall, and beat it into powder, and put it also in a pot by it selfe, whereinto put a quarter of the wine, water, and vineger that remaineth, and to the other quarter, put foure ounces of gum Arabike beaten to powder, that done, cover the three pots close, and let them stand three or foure daies together, stirring them every day three or foure times, on the first day set the pot with gauls on the fire, and when it begins to seeth, stir it about till it be thoroughly warme, then straine it through a cloath into another pot, and mixe it with the other two pots, stirring them well together, and being covered, then let it stand three daies, til thou meanest to use it, on the fourth day, when it is setled, poure it out, and it wil be good inke. If there remaine any dregs behind, poure some raine water that hath stand long in a tub or vessell into it, for the older the water is, the better it is, and keepe that untill you make more inke, so it is better then clean water."

Source: A Booke of Secrets [...] written first in Italian, and now newly translated into English, by W.P., London, Edward White, 1596

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" To make common yncke of Wyne take a quart, Two ounces of gomme, let that be a parte, Five ounces of galls, of copres take three, Long standing dooth make it better to be; If wyne ye do want, rayne water is best, And as much stufte as above at the least: If yncke be to thick, put vinegar in, For water dooth make the colour more dimme. In hast for a shift when ye have a great need, Take woll, or wollen to stand you in steede; which burnt in the fire the powder bette small With vinegre, or water make yncke with all. If yncke ye desire to keep long in store Put bay salte therein, and it will not hoare. Of that common yncke be not to your minde Some lampblack thereto with gomme water grinde "

A Book Containing Divers Sorts of Hands, by John de Beau Chesne and M. John Baildon, published in 1571.

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"To make good ink for writing, particularly for books.- Take 4 bottles of good wine, white or red, and 1 lb. of galls, slightly bruised, which must be put into the wine, and allowed to stand for 12 days, and be stirred every day with a stick. The twelfth day it must be strained through a strainer of fine linen, and must be poured into a clean jar, and put on the fire to get hot, until it almost boils. Then remove from the fire, and when it has cooled so as only to be tepid, put into it 4 oz. of gum-arabic, which must be very bright and clear, and stir it with a stick, then add ½ lb. Roman vitriol, and stir it continually with the stick, until all things are well incorporated together, and let it cool and keep for use. And note, that ink made with wine is good for writing books upon the sciences, because, when books are written with it, the letters

do not fade, and can hardly be scraped out or discharged from parchment or paper. But if they are written with ink made with water, it is not so, for they can easily be scraped out, and it may happen that the letters written with it will fade. 4 bottles of wine, or water, or half of each. 1 pound of galls of xij. oz. to the pound. 4 oz. of gum Arabic. 6 oz. Roman vitriol. And if you took equal parts of each, galls, gum, and vitriol, as much of one as of the other, by weight, it would still be good; as for instance, 6 oz. of each, would be sufficient for the said 4lbs. of wine or water, or wine and water mixed as before.”

From the manuscripts of Jehan Le Bégue, composed in Paris in 1431, which are found in Original treatises, dating from the XIIth to XVIIIth centuries on the arts of painting, in oil, miniature, mosaic, and on glass; of gilding, dyeing, and the preparation of colours and artificial gems; preceded by a general introduction; with translations, prefaces, and notes. By Mrs. Merrifield. v. 1, Merrifield, Mary P. (Mary Philadelphia), London, J. Murray, 1849, p. 68.

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And a relatively modern one, to show the basic recipe endured:

“Aleppo galls (well bruised), 4 ounces; clean soft water, 1 quart; macerate in a clean corked bottle for 10 days, or even longer, with frequent agitation; then add 1 1/4 ounces gum-arabic (dissolved in a wine-glassful of water); lump sugar 1/2 ounce; mix well, and afterwards further add 1 1/2 ounces sulphate of iron (green copperas) crushed small, agitate occasionally for 2 or 3 days, when the ink may be decanted for use; but it is better if left to digest together for 2 or 3 weeks. When time is an object, the whole of the ingredients may be at once put into a bottle, and the latter agitated daily, until the ink is made; and boiling water instead of cold water may be employed. The above will make 1 quart of beautiful ink, writing pale at first, but soon turning intensely black.”

Dick's Encyclopedia of Practical Receipts and Processes, [no date] circa 1870

Other recipes for period inks

2 descriptions of 'traditional' Arabic ink, transcribed from a series called 'The Calligrapher', available on YouTube. <https://www.youtube.com/playlist?list=PL858AE6D0AE848965>

Dr Sheemy's recipe:

Put half-cup of rice on the fire, til it's black - do not add water or oil to the pan. Keep on the fire til very dry and hard and black. Grind it fine. Add arabian gum. Add a little water. Makes very good ink for writing.

Iranian maker's recipe:

Get soot from the chimney of the village bakery (carbon). Add arabian gum for glazing and shine. Also add water. This ink must be shaken very well. Make a large batch, and sling the bottle between the legs of your camel on long journeys.

For modern users, keep the bottle on your motorcycle.

Brazilwood red ink

When I made this recipe I was able to source an ethical source of the brazil wood chips, but they are proving more and more difficult to obtain. I blogged about experimenting with it here:

<https://pontagedue.wordpress.com/2013/01/28/more-messing-about-with-ink/> I used an ounce each of alum and gum arabic but I would use more gum next time.

To seeth Brasill in another way. To an ounce of Brasill, take the third part of a quart of beere, wine or vinegar, put it in a new pot let it stand a night, in the morning set it on fire and let it seeth till it be halfe consumed, then for euery ounce of Brasill, take two pennyworth of alum, beaten to a powder, and as much beaten gum Arabike, stir them wel together, and let them seeth againe, but if you desire to have it somewhat dark, then scrape a little chalke into it: when it seetheth, let it not seeth over the pot, and being cold, strain it through a cloath, and put it into a glasse well stopped.

This recipe was taken from *A Booke of Secrets: Shewing diuers ways to make and prepare all sorts of Inke, and Colours: as Black, White, Blew, Greene, Red, Yellow, and other Colours. Also to write with Gold and Silver, or any kind of Mettall out of the Pen; with many other profitable secrets as to colour Quills and Parchment of any colour: and to graue with Dtrong Water in Steele and Iron. Necessary to be knowne of all Scriueners, Painters and others that delight in such Arts.* Translated out of the Dutch into English, by W.P., London, 1596.

Materials sources for your own projects

Cornelissen & Son, artists' colourmen: <http://www.cornelissen.com/>

Gum arabic solid or liquid, loads of containers for inks...and commercial oak gall and other historic inks for those who prefer to shop

Intra laboratories: <http://www.intralabs.co.uk/>

Ferrous sulphate in small quantities, available by post

<http://wildcolours.co.uk>: Ferrous sulphate, calcium carbonate and oak gall extract. I don't know how you you could work out how much extract you would substitute for actual oak galls though.

Lady Órlaith, or other friends who live in the country: for oak galls.

John Neal Bookseller: for Aleppo galls

http://www.johnnealbooks.com/prod_detail_list/s?keyword=galls

More research

- Iron gall website - http://irongallink.org/igi_index.html
- A small number of Medieval to Early Modern ink & pigment recipes compiled from various historical and contemporary sources, mostly from European or Western countries.-
<http://travelingscriptorium.library.yale.edu/2012/02/29/a-small-booklet-containing-medieval-ink-pigment-recipes/>
- http://www.nationalarchives.gov.uk/museum/item.asp?item_id=8 has a lovely image of an oak gall recipe stamped with the Tower of London stamp
- <https://scribescribbling.wordpress.com> - A recently discovered blog by a SCA scribe in the US, Ian the Green, who also leads a Facebook group called "Scribal Bookclub for SCAdians" <https://www.facebook.com/groups/355185804550483/>
- *The Materials and Techniques of Medieval Painting*, Thompson, Daniel V., Dover Publications, New York, 1956