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INK (*Encre*, Fr.; *Tinte*, Germ.) is a coloured liquid for writing on paper, parchment, linen, &c. with a pen.

Black ink.—Nut-galls, sulphate of iron, and gum, are the only substances truly useful in the preparation of ordinary ink; the other things often added merely modify the shade, and considerably diminish the cost to the manufacturer upon the great scale. Many of these inks contain little gallic acid, or tannin, and are therefore of inferior quality.

To make 12 gallons of ink we may take,—

12 pounds of nutgalls,
5 pounds of green sulphate of iron,
5 pounds of gum Senegal,
12 gallons of water.

The bruised nutgalls are to be put into a cylindrical copper, of a depth equal to its diameter, and boiled, during three hours, with three fourths of the above quantity of water, taking care to add fresh water to replace what is lost by evaporation. The decoction is to be emptied into a tub, allowed to settle, and the clear liquid being drawn off, the lees are to be drained. Some recommend the addition of a little bullock's blood or white of egg, to remove part of the tannin. But this abstraction tends to lessen the product, and will seldom be practised by the manufacturer intent upon a large return for his capital. The gum is to be dissolved in a small quantity of hot water, and the mucilage, thus formed, being filtered, is added to the clear decoction. The sulphate of iron must likewise be separately dissolved, and well mixed with the above. The colour darkens by degrees, in consequence of the peroxidizement of the iron, on exposing the ink to the action of the air. But ink affords a more durable writing when used in the pale state, because its particles are then finer and penetrate the paper more intimately. When ink consists chiefly of tannate of peroxide of iron, however black, it is merely superficial, and is easily erased or effaced. Therefore, whenever the liquid made by the above prescription has acquired a moderately deep tint, it should be drawn off clear into bottles, and well corked up. Some ink makers allow it to mould a little in the casks before bottling, and suppose that it will thereby be not so liable to become mouldy in the bottles. A few bruised cloves, or other aromatic perfume, added to ink, is said to prevent the formation of mouldiness, which is produced by the ova of infusoria animalcules. I prefer digesting the galls to boiling them.

The operation may be abridged, by peroxidizing the copperas beforehand, by moderate calcination in an open vessel; but, for the reasons above assigned, ink made with such a sulphate of iron, however agreeable to the ignorant, when made to shine with gum and sugar, under the name of japan ink, is neither the most durable nor the most pleasant to write with.

From the comparatively high price of gall-nuts; sumach, logwood, and even oak bark, are too frequently substituted, to a considerable degree, in the manufacture of ink; but always injuriously.

The ink made by the prescription given above, is much more rich and powerful than many of the inks commonly sold. To bring it to their standard, a half more water may safely be added, or even 20 gallons of tolerable ink may be made from that weight of materials, as I have ascertained.

Sumach and logwood admit of only about one half of the copperas that galls will take to bring out the maximum amount of black dye.

Chaptal gives a prescription in his *Chemie appliquée aux Arts*, which, like many other things in that book, are published with very little knowledge and discrimination. He uses logwood and sulphate of copper, in addition to the galls and sulphate of iron; a pernicious combination productive of a spurious fugitive black, and a liquor corrosive of pens. It is, in fact, a modification of the vile dye of the hatters.

Lewis, who made exact experiments on inks, assigned the proportion of 3 parts of galls to 1 of sulphate of iron, which, with average galls, will answer very well; but good galls will admit of more copperas.

Gold ink is made by grinding upon a porphyry slab, with a muller, gold leaves along with white honey, till they be reduced to the finest possible division. The paste is then collected upon the edge of a knife or spatula, put into a large glass, and diffused through water. The gold by gravity soon falls to the bottom, while the honey dissolves in the water, which must be decanted off. The sediment is to be repeatedly washed till entirely freed from the honey. The powder, when dried, is very brilliant, and when to be used as an ink, may be mixed up with a little gum water. After the writing becomes dry, it should be burnished with a wolf's tooth.

Silver ink is prepared in the same manner, with silver leaf.

Indelible ink.—A very good ink, capable of resisting chlorine, oxalic acid, and ablution with a hair pencil or sponge, may be made by mixing some of the ink made by the preceding prescription, with a little genuine China ink. It writes well. Many other formulæ have been given for indelible inks, but they are all inferior in simplicity and usefulness to the one now prescribed. Solution of nitrate of silver thickened with gum, and written with upon linen or cotton cloth, previously imbued with a solution of soda, and dried, is the ordinary permanent ink of the shops. Before the cloths are washed, the writing should be exposed to the sun-beam, or to bright daylight, which blackens and fixes the oxide of silver. It is easily discharged by chlorine and ammonia.

A good permanent ink may be made by mixing a strong solution of chloride of platinum with a little potash, sugar, and gum to thicken. The writing made therewith should be passed over with a hot smoothing iron, to fix it.

Red ink.—This ink may be made by infusing, for 3 or 4 days in weak vinegar, Brazil wood chipped into small pieces; the infusion may be then boiled upon the wood for an hour, strained, and thickened slightly with gum arabic and sugar. A little alum improves the colour. A decoction of cochineal with a little water of ammonia, forms a more beautiful red ink, but it is fugitive. An extemporaneous red ink of the same kind may be made by dissolving carmine in weak water of ammonia, and adding a little mucilage.

Green ink.—According to Klaproth, a fine ink of this colour may be prepared by boiling a mixture of two parts of verdigris in eight parts of water, with one of cream of tartar, till the total bulk be reduced one half. The solution must be then passed through a cloth, cooled, and bottled for use.

Yellow ink is made by dissolving 3 parts of alum in 100 of water, adding 25 parts of Persian or Avignon berries bruised, boiling the mixture for an hour, straining the liquor, and dissolving in it 4 parts of gum arabic. A solution of gamboge in water forms a convenient yellow ink.

By examining the different dye-stuffs, and considering the processes used in dyeing with them, a variety of coloured inks may be made.

China ink.—Proust says, that lamp-black purified by potash lye, when mixed with a solution of glue, and dried, formed an ink which was preferred by artists to that of China. M. Merimée, in his interesting treatise, entitled, *De la Peinture à l'Huile*, says, that the Chinese do not use glue in the fabrication of their ink, but that they add vegetable juices, which render it more brilliant and more indelible upon paper. When the best lamp-black is levigated with the purest gelatine or solution of glue, it forms, no doubt, an ink of a good colour, but wants the shining fracture, and is not so permanent on paper as good China ink; and it stiffens in cold weather into a tremulous jelly. Glue may be deprived of the gelatinizing property by boiling it for a long time, or subjecting it to a high heat in a Papin's digester; but as ammonia is apt to be generated in this way, M. Merimée recommends starch gum made by sulphuric acid to be used in preference to glue. He gives, however, the following directions for preparing this ink with glue.

Into a solution of glue he pours a concentrated solution of gall-nuts, which occasions an elastic resinous-looking precipitate. He washes this matter with hot water, and dissolves it in a spare solution of clarified glue. He filters anew, and concentrates it to the proper degree for being incorporated with the purified lamp-black. The astringent principle in vegetables does not precipitate gelatine when its acid is saturated, as is done by boiling the nutgalls with limewater or magnesia. The first mode of making the ink is to be preferred. The lamp-black is said to be made in China, by collecting the smoke of the oil of sesame. A little camphor (about 2 per cent.) has been detected in the ink of China, and is supposed to improve it. Infusion of galls renders the ink permanent on paper.

Sympathetic ink. The best is a solution of muriate of cobalt.

Printers' ink. See this article.

By decomposing vanadate of ammonia with infusion of galls, a liquid is obtained of a perfectly black hue, which flows freely from the pen, is rendered blue by acids, is insoluble in dilute alkalis, and resists the action of chlorine. Whenever the metal vanadium shall become more abundant, as it probably may ere long, we shall possess the means of making an ink, at a moderate price, much superior to the tannate and gallate of iron.

To prepare the above vanadic salt cheaply, the cinder or hammerschlag obtained from the iron made at Ekersholm, in Sweden, or other iron which contains vanadium, being reduced to a fine powder, is to be mixed with two thirds of its weight of nitre, and one third of effloresced soda. The mixture is to be ignited in a crucible; cooled and lixiviated, whereby solutions of the vanadates of potash and soda are obtained, not pure, indeed, but sufficiently so for being decomposed, by means of sal ammoniac, into a vanadate of ammonia. This being rendered nearly neutral with any acid, constitutes an excellent indelible ink.

Ink, *indelible*, may be prepared by adding lamp-black and indigo to a solution of the gluten of wheat in acetic acid. This ink is of a beautiful black colour, at the same time cheap, and cannot be removed by water, chlorine, or dilute acids. M. Herberger gives the following directions for its preparation:—

Wheat-gluten is carefully freed from the starch, and then dissolved in a little weak acetic acid; the liquid is now mixed with so much rain water that the solution has about the strength of wine vinegar, *i. e*. neutralizes 1/16 of its weight of carbonate of soda. 10 grs. of the best lamp-black and 2 grs. of indigo are mixed with 4 ozs. of the solution of gluten and a little oil of cloves added. This ink may be employed for marking linen, as it does not resist mechanical force.

Ink, *indelible*, of Dr. Traill, is essentially the same as the above.

French indelible ink consists of Indian ink diffused through dilute muriatic acid, for writing with quills, and through weak potash lye for writing with steel pens.

Ink, *blue*. Mr. Stephen's patent blue ink is made by dissolving Prussian blue in a solution of oxalic acid. The blue should be washed in dilute muriatic acid.

M. Hornung has given the following, as the best formula for blue ink:—

Mix 4 parts of perchloride of iron, in solution, with 750 parts of water, then add 4 parts of cyanide of potassium dissolved in a little water; collect the precipitate formed, wash it with several additions of water, allow it to drain until it weighs about 200 parts; add to this one part of oxalic acid, and promote the solution of the cyanide by shaking the bottle containing the mixture. The addition of gum and sugar is useless, and even appears to exercise a prejudicial effect on the beauty of the ink. It may be kept without any addition for a long time.

Rev. Mr. Reade's inks.—A series of writing inks of a new composition have been made the subject of a patent by the Rev. J. B. Reade, F.R.S., and they seem to deserve public patronage. They resist equally acids and alkalis, and are well adapted to metallic pens. His inks for marking linen are not acted upon by cyanide of potassium or chloride of lime. His process for obtaining a soluble Prussian blue is new to the chemical world, and inclines to raise a doubt as to the elementary nature of iodine. In the course of his researches, he has discovered two new salts of gold, which he has named ammonia-iodide, and ammonia-periodide, of gold. His specification runs thus:—

1stly. I manufacture in manner following, a blue writing ink, which is wholly free from acid, and therefore well adapted for use with steel pens. I first obtain a solution of iodide of iron by the process ordinarily followed for that purpose, and then dissolve therein half the weight of iodine already employed. I next pour this mixture into a semi-saturated solution of yellow prussiate of potash, employing a weight of this salt nearly equal to the whole weight of iodine used in the above iodine solution. A decomposition of the materials, thus brought together, immediately takes place, when the cyanogen (of the prussiate of potash) and iron combine, and are precipitated in a solid form, and the potassium (of the prussiate) and iodine combine to form a neutral iodide of potassium, which remains in solution with a little excess of iodide of iron. I next filter and wash the solid precipitate of cyanogen and iron (which is soluble Prussian blue), and finally dissolve it in water, which forms the blue ink required. In this process, it will be observed that neither any acid nor persalt of iron is employed, as is usual in the formation of Prussian blue.

I was led to these results by a microscopical examination of the metallic colours in salts of the ashes of plants. I employed iron and iodine to produce the same effects in pure salts; and in the course of my experiments, I ascertained that these two substances (iron and iodine) have so great an affinity for each other, that when placed together without any water, or when rubbed together, they very speedily form a liquid, containing an excess of iodine in solution, which, being added to a solution of prussiate of potash, gives the compound of cyanogen and iron, or soluble Prussian blue,

which has been just described. The addition of water alters the character of this iodine solution; without water, it turns litmus paper green, and with water it has the usual acid reaction, thus apparently confirming Davy's original doubt as to the elementary character of iodine.

2ndly. I form a neutral iodide of potassium, of great purity, and wholly free from alkaline reaction, in manner following: I take the solution which remained over from the process first described, after the Prussian blue had been precipitated, which solution consisted, as before stated, of a neutral iodide of potassium, with iodide of iron in excess; and I get rid of that excess by the well known process of fusion and crystallization. The result is an iodide of potassium, which is as pure as when iodine and potassium are made to act directly on one another, and is perfectly free from the alkaline reaction on turmeric paper, which invariably characterizes the most careful preparations of this salt when carbonate of potassa is employed (as usual) in its manufacture. It is also much less deliquescent than the ordinary iodide of potassium of commerce, and, on account of its great purity, much to be preferred in medicinal preparations.

3rdly. I manufacture a blue ink of peculiar intensity, and, therefore, particularly suitable for printing purposes, by using the same materials, and manipulating them in the same way as first described, with the exception that for the iodine wherever it is used, I substitute bromine, and rub up the precipitate in oil.

4thly. I form a bromide of potassium of great purity, and wholly free from alkaline reaction, by treating the bromide of potassium, which remains over in a state of solution from the process last before described, in the same way as the iodide of potassium solution is directed to be used under the second head of this specification.

5thly. I manufacture a very superior black writing ink, by adding to gall ink of a good quality soluble Prussian blue, described under the first head of this specification. The addition of this Prussian blue makes the ink, which was already proof against alkalines[sic], equally proof against acids, and forms a writing fluid, which cannot be erased from paper by any common method of fraudulent obliteration, without the destruction of the paper.

6thly. I manufacture in manner following a red writing ink, which is generally superior to the common solutions from peach wood and Brazil wood, not only in permanent brilliancy of colour, but also in its freedom from acid, and consequent fitness for use with steel pens. I first boil cochineal repeatedly in successive quantities of pure water, till it ceases, or nearly so, to give out any colouring matter. I then boil it in water containing liquor ammoniæ, which combines after the manner of an alkali with an acid, with the residue of colouring matter, and leaves the insect matter nearly white. The liquid products of these successive boilings are then thrown together into an earthenware vessel, and, in order to get rid of a peculiar element or principle, still combined with the colouring matter, and which has a great affinity for iron, I precipitate the colouring matter with ammonia-bichloride of tin. The precipitate is afterwards dissolved in ammonia, and protiodide of tin added, till a sufficient degree of brilliancy of colour is obtained, which completes the process, water being added *ad libitum*, according to the degree of body required to be given to the ink.

7thly. I manufacture by the improved process following a marking ink, which may be used with steel pens, and is not only of great intensity of colour, but comes out most readily on the application of heat. I rub together in a mortar nitrate of silver and the proper equivalent of tartaric acid in a dry state. I then add water, on which crystals of tartrate of silver are formed and the nitric acid set free. I next neutralize this acid by adding liquor ammoniæ, which also dissolves the tartrate of silver. I finally add gum, colouring matter, and water, in the usual way, and in quantities which may be

varied at pleasure. By this process the nitric acid, which is essential to a good marking ink, is retained, and the tartrate of silver formed is soluble in less than half the quantity of liquor ammoniæ ordinarily required when tartrate of silver is the basis of the ink. The tedious operation of filtering and washing the carbonate of silver in order to form the tartrate is also thereby entirely dispensed with.

8thly. I manufacture in manner following a marking ink, differing from the preceding and all other marking inks containing salts of silver only, in this respect, that it cannot be acted upon by the common solvents of salts of silver, as cyanide of potassium, or chloride of lime, and is so far, therefore, more indelible. I take the ink, as it has been formed by the process last described, and add to it an ammoniacal solution of an oxide or salt of gold. I have used for this purpose the purple of Cassius, the hyposulphite of gold, the ammonia-iodide of gold, and ammonia-periodide of gold. The two last salts, which I believe to be new salts, I obtain by dissolving iodine in liquor ammoniæ, under the application of heat; an operation, however, which requires to be conducted with great caution, in order to prevent the formation of the explosive compound, the teriodide of nitrogen. This iodine solution is a very speedy solvent of gold. If gold leaf be placed upon it without the addition of water, a black oxide of gold is formed, which immediately dissolves, but if it be diluted with water, the process of oxidation is less rapid, and the gold leaf assumes a fine purple colour (not black), before solution. This salt of gold crystallizes in four-sided prisms, which are soluble in water. A few drops of this solution placed on a slip of glass generally form microscopic arborescent crystals, from which, under the application of heat, both the iodine and ammonia may be volatilized, and arborescent metallic gold alone remains. If a moderate heat only is employed, one equivalent only of iodine is expelled, and white crystals of ammonia-iodide of gold remain.

9thly. I manufacture a blue printing ink by taking the soluble precipitate of cyanogen and iron, obtained by the process described under the first head of this specification, and rubbing up the same in oil, after the manner ordinarily followed in the manufacture of printing inks; or by boiling down the blue writing ink, produced by the said process to a sufficient consistence, and then rubbing up the same in oil.

10thly. I manufacture a black printing ink by boiling down the black writing ink, produced from the materials, and by the process described under the fifth head of this specification, and rubbing it up in oil as aforesaid.

11th. I manufacture a red printing ink by taking the ammoniacal solution of cochineal, obtained by the process described under the sixth head of this specification, and rubbing it up in oil, adding protiodide of tin according to the degree of lustre required; or by boiling down the red writing ink, produced by the said process, to a sufficient consistence, and then rubbing up the same in oil as aforesaid.

And 12th, I manufacture a black printing ink by boiling chips of logwood (for which an extract of logwood may be substituted), or other dye woods, containing colouring matter and tannin, along with as much of proto-salt or persalt of iron or copper, or other precipitate of tannin, as will be equal to about twice the weight of the tannin contained in the wood or extract employed; whereby I obtain a black or blueish black precipitate; the blueness of which I diminish, as may be required, by the addition of bichromate of potash, more or less. I finally rub up the whole in oil as aforesaid, adding a small quantity of the lamp-black, or other black colouring matter, ordinarily employed in the manufacture of black printing inks.