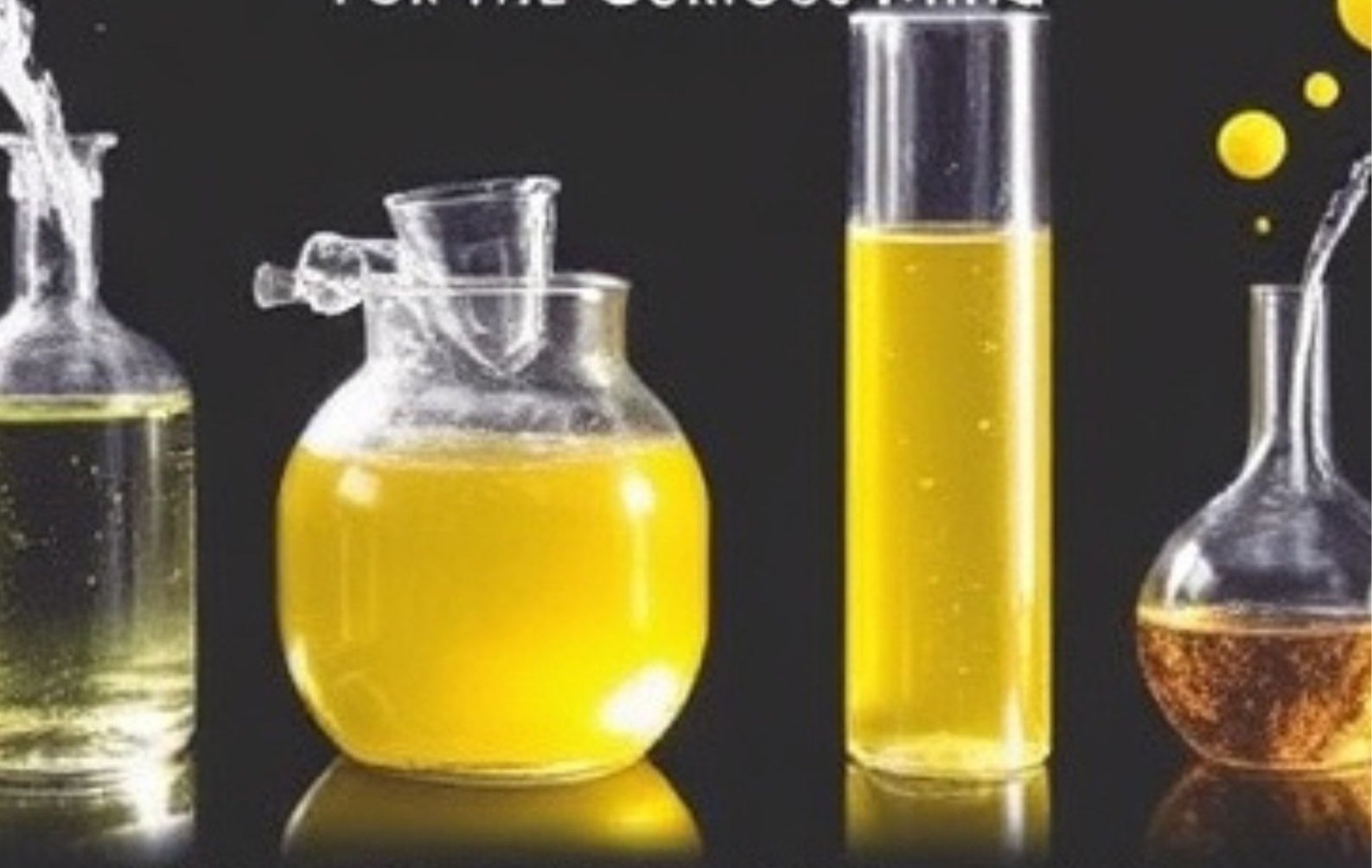
Golden Reactions

Simple Chemistry and Experiments For the Curious Mind



Take any quantity of nitro-muriate of gold, and evaporate by exposing it to a gentle heat in a glass tumbler or phial; the gold will form itself in crystals on the bottom and sides of the vessel; collect these crystals and dissolve them in ten times their weight of pure water. Then put a gill of water into a common flask, and add one ounce of granulated zinc, and one-fourth of an ounce of sulphuric acid. Hydrogen gas will be evolved, and rise through the neck of the flask, which must not be stopped. Immerse a piece of white silk in the above mentioned aqueous solution of gold, and expose it, while wet, to the current of gas as it rises from the flask; the gold will soon be revived, and the silk will become beautifully and permanently gilt. Any letters or flowers may be drawn on the silk with a camel-hair pencil dipped in the solution, and on being exposed to the action of the gas, will be revived and shine with metallic brilliancy. Note.—The silk must be kept moist with water till the gold is revived. Zinc may be prepared for the above purpose, by melting it, and stirring it continually with a stick or iron rod while it is cooling; or it may be pulverized with a hammer as soon as it becomes solid.

Proceed as directed in the last experiment, only use the nitrate of silver, (see 6) instead of nitro-muriate of gold. The process of crystalizing, re-dissolving, &c. is the same. But the crystals of silver differ in colour, being white, whereas those produced from gold are yellow. If a jar, or box be filled with hydrogen gas, and the silk suspended in it, the action of the gas, and consequently the revivification of the metals will be more uniform. For small figures, however, it may be as well to fix a stopper in the flask, having a small orifice through it, that the gas may be thrown with some force on the silk, and will have a more certain effect. A solution of muriate of tin may be managed in a similar manner, but none of these solutions can be thus revived on paper.

Lay on a smooth board, a piece of soft deer-skin leather, rather larger than the glass that is to be silvered; and on the leather, having sprinkled a little fine whiting, spread a piece of tin foil of the same size. Pour on a few drops of mercury, and brush it over the tin with a smooth brush, till every part of the tin becomes bright. Then add as much mercury as will lay on the tin, and upon this lay the glass to be silvered: on the glass lay another piece of leather, of the same size, and on that another board.—Take up the boards with the glass, and pressing the boards together, turn them with the glass, the other side up; take off the upper board, and pass the glass with the tin and leather, between two rollers, similar to those of a rolling press, for copper-plate printing; thus to press out the mercury from between the tin and the glass. Then place the glass between the boards again as before, and place a heavy weight (which cannot be too heavy, unless it breaks the glass) on the upper board, which must remain two or three days. The glass may then be taken up. The practice of some is, to lay thin paper on the mercury previous to laying on the glass; this paper, being carefully drawn out, after the glass is laid on, serves to remove the superfluous mercury, that the tin may come more nearly in contact with the glass. In this case, no rollers are used. Concave or other fancy glasses may be silvered, by making an impression with the glass, in a kind of putty, made of fine sulphate of lime and water; and placing the glass in the impression again with the tin foil and mercury, when the plaster is dry, and subjecting it to pressure two or three days in that situation. The experiment of silvering glass may be performed by rubbing a drop of mercury on a small piece of tin foil, and pressing it upon a piece of glass with the finger, or a piece of soft leather. In this case, the glass will have acquired the reflective property of a mirror; and if a similar pressure be continued a few hours, the tin will adhere permanently.

Make a sizing as strong as will flow freely from the pen, by dissolving equal quantities of gum-arabic and loaf sugar in water; write with this on paper and let it dry; then moisten the paper by breathing on it, or by holding it over hot water, and immediately lay pieces of gold or silver leaf on the lines of the writing, pressing them down gently with a dry hair pencil. Otherwise, brush gold or silver bronze lightly over the writing; but this will not have so brilliant an appearance. Allow the sizing to dry again, and then brush off the redundant gold or silver with cotton. This writing, (if performed with leaf gold or silver) may be burnished with a flint burnisher or a cornelian or blood-stone.

Gold letters may also be written or drawn with a hair pencil by means of gold bronze, mixed with weak gum-water, to which may be added a little solution of soap, which will make it run more freely. But no preparation of solution of gold has yet been discovered, which may be easily revived on paper.

Take two ounces of nut-galls in coarse powder; one ounce of logwood in thin chips; one ounce of sulphate of iron; three-fourths of an ounce of gum-arabic; one-fourth of an ounce of sulphate of copper; and one-fourth of an ounce of loaf sugar. Boil the galls and logwood together in three pints of water, till the quantity is reduced to one half. Then the liquor must be strained through a flannel into a proper vessel, and the remainder of the ingredients be added to it. The mixture is then to be frequently stirred till the whole is dissolved; after which it must be left at rest for twenty-four hours. The ink may then be decanted from the gross sediment, and must be preserved in a glass bottle well corked.

Dissolve one ounce of gum-arabic in a pint of water. In a part of this gum-water, grind a small quantify of best prussian blue; you may thus bring it to any depth of colour you choose. Indigo will answer this purpose very well, but is not so fine a colour, nor will it remain suspended so uniformly in the water.

In the above mentioned gum-water, grind very fine, three parts of vermillion with one of lake or carmine. This is a very perfect colour, but may require to be shaken up occasionally. To make the common red ink, such as is used by book binders for ruling, &c. infuse half a pound of rasped brazil-wood, for two or three days in a pint of vinegar; then filter or strain it, and add one ounce of gum-arabic, and one ounce of alum. It may afterward be diluted occasionally with water.

Steep one ounce of turmeric, in powder, in half a gill of alcohol; let it rest twenty-four hours, and then add an equal quantity of water;— throw the whole on a cloth, and express the coloured liquor, which mix with gum-water. Rum or other spirits may be substituted in the place of alcohol. A solution of gamboge in water, writes a full yellow, but comes far short of turmeric in brightness.

To the tincture of turmeric, prepared as above, add a little prussian blue. A variety of tints may be formed, by varying the proportions of these two ingredients, and no artificial colour can excel it in beauty.

To the blue ink, described at , add some finely ground lake; or instead of this, the expressed juice of the deepest coloured beets may be substituted, but is more liable to fade. With either of these a variety of tints may be formed, by varying the proportions.

Take a sheet of white paper, and wet some parts of it with a solution of sub-carbonate of potass, which must be diluted with water so as not to appear on the paper when dry. Wet some other parts with diluted muriatic acid, or with juice of lemons.— Some other parts may be wet with a dilute solution of alum; and others with an infusion of nut-galls (water in which bruised or pulverized nut-galls have been steeped.) None of these preparations must be so strong as to colour the paper any. When these are dry, take some finely powdered sulphate of iron, and rub it lightly on some parts of the paper, that have been wet with the sub-carbonate of potass, and infusion of galls. Then with the juice of violets, or of the leaves of red cabbage, write on the paper as usual with a pen.

The ink is, of itself, a faint purple; where the paper was wet with acid, the writing will be bright red; on the sub-carbonate of potass, it will take a beautiful green; on the alum it will be brown; on the sub-carbonate of potass that was rubbed with powdered sulphate of iron, it will be deep yellow; and on the infusion of galls that was rubbed with the powder, it will be black.—The juice of violets will sometimes take a brilliant yellow on the alkali if it be very strong. The juice of violets or red cabbage may be kept a long time by means of the addition of a few drops of alcohol; or the leaves may be dryed by the fire, and thus may be kept ready for use; and it is only requisite to steep them in hot water, in order to prepare the ink at any time. Note.—The yellow ink, described at writes a full red where the paper has been wet with the solution of sub-carbonate of potass; while the solution of sulphate of iron, which has no colour of itself, writes a deep yellow on the alkali, and black on the infusion of galls.

Dissolve muriate of ammonia in water, and write;—the writing will be invisible. When you would make the writing appear, heat the paper by the fire, and the writing will become black. Write with a solution of sulphate of iron—the writing will be invisible. Dip a feather in an infusion of nut-galls, and with it wet the paper, and the writing will become black.

Write with a dilute infusion of galls, it will be invisible. Dip a feather in a solution of sulphate of iron, and moisten the paper with it and the writing will become black. Write with a solution of sub-carbonate of potass; wet this writing with a solution of sulphate of iron,—it will take a deep yellow colour. Write with a solution of sulphate of copper,—no writing will be visible. Wash the paper with a solution of prussiate of potass,—the writing will then get a reddish brown colour. Write with a solution of super-carbonate of soda;—moisten the paper with a solution of sulphate of copper, and the writing will become green. Write with diluted nitrate of silver, and let the writing dry in the dark—it will be invisible; but expose the paper to the rays of the sun, and the writing will become black.

To half an ounce of essential oil of cinnamon, in a phial, add half a drachm of phosphorus. Cork the phial slightly, and set it, or suspend it near a fire, where the heat may be nearly equal to boiling; continue the heat four or five hours, shaking the phial frequently, but cautiously lest any of the oil should escape, or come in contact with atmospheric air, in which case it would take fire. The cork should be set sufficiently tight to exclude atmospheric air, but not so as to prevent the escape of any vapour that might be produced by excess of heat. The phial may be afterward removed from the fire and suffered to cool. With this phosphorised oil, any letters may be written on paper, and if carried into a dark room, will appear very bright, resembling fire. The phial should be kept corked close, except when used.

Dissolve equal parts of sulphate of copper and muriate of ammonia in water, and write. When you would make the writing appear, warm the paper gently by the fire; the writing will appear in a yellow colour; but as soon as you take the paper into the cold air, the writing will vanish. This may be often repeated.

Write on paper with a solution of sub-carbonate of potass,—the writing will be invisible. Mix together equal parts of solution of sulphate of iron, and infusion of galls; write with this mixture (which is black) on the same paper. Then add to the black liquor a little sulphuric acid, sufficient to deprive it of colour. Wet the paper with this compound; the acid will discharge the colour from the last writing, while the alkali of the first, will precipitate the gallate of iron, and the writing will become black.

Boil one ounce of powdered nut-galls, for an hour or more in a pint of white wine; filter the liquor, and when cold, wet the paper with it, or pass it on the lines with a camel hair pencil, and the writing will be much revived.

To half an ounce of nitric acid, add one drachm of cobalt, one drachm of muriate of soda, and two ounces of water; set it in a sand bath or on warm ashes, where it must remain five or six hours. Then filter the solution, (which is nitro-muriate of cobalt,) and with it draw the trees, and shrubbery of a designed picture. Then with a solution of oxide of cobalt in acetic acid, draw some distant mountains, fences, &c. and with muriate of copper, (the compound solution described at ,) draw some flowers, buildings, &c. These will all be invisible when dry; but warm the paper and the picture will appear in green, blue and yellow. It will disappear again when the paper becomes cold.

Dissolve half a pound of glue in a gallon of water, and with this sizing, mix whatever colours may be required for the work. Strike a line round the room, nearly breast high; this is called the horizon line: paint the walls from the top to within six inches of the horizon line, with sky blue, (composed of refined whiting and indigo, or slip blue,) and at the same time, paint the space from the horizon line to the blue, with horizon red, (whiting, coloured a little with orange lead and yellow ochre,) and while the two colours are wet, incorporate them partially, with a brush. Rising clouds may be represented by striking the horizon red colour upon the blue, before it is dry, with a large brush. Change some sky blue about two shades with slip blue and paint your design for rivers, lakes or the ocean.

Change some sky blue one shade with forest green, (slip blue and chrome yellow,) and paint the most distant mountains and highlands; shade them while wet, with blue, and heighten them with white, observing always to heighten the side that is towards the principal light of the room. The upper surface of the ocean must be painted as high as the horizon line, and the distant highlands must rise from ten to twenty inches above it.Paint the highlands, islands, &c. of the second distance, which should appear from four to six miles distant, with mountain green, (two parts sky blue with one of forest green,) heighten them, while wet, with sulphur yellow, (three parts whiting with one of chrome yellow,) and shade with blue-black, (slip blue and lamp black equal.) Paint the lands of the first distance, such as should appear within a mile or two, with forest green; heighten with chrome yellow and shade with black; occasionally incorporating red ochre, french green or whiting.

The nearest part, or fore ground, however, should be painted very bold with yellow ochre, stone brown, (red and yellow ochres and lamp black equal,) and black. Paint the shores and rocks of the first distance with stone brown; heighten with horizon red, shade with black. For those of the second distance, each colour must be mixed with sky blue.—The wood lands, hedges and trees of the second distance are formed by striking a small flat stiff brush end-wise, (which operation is called bushing, and is applied to the heightening and shading all trees and shrubbery of any distance,) with mountain green, deepened a little with slip blue; with which also the ground work for trees of the first distance is painted; and with this colour the water may be shaded a little under the capes and islands, thus representing the reflection of the land in the water. Trees of the first distance are heightened with sulphur yellow or french green; and shaded with blue-black. Every object must be painted larger or smaller, according to the distance at which it is represented; thus the proper height of trees in the second distance, is from one to two inches, and other objects in proportion. Those in the first distance from six to ten inches generally; but those in the fore ground, which are nearest, are frequently painted as large as the walls will admit. The colours also for distant objects, houses, ships, &c., must be varied, being mixed with more or less sky blue, according to the distance of the object. By these means the view will apparently recede from the eye, and will have a very striking effect.

Take a sheet of pasteboard or strong paper, and paint thereon with a pencil, any flower or figure that would be elegant for a border or carpet figure; then with small gouges and chisels, or a sharp pen knife, cut out the figure completely, that it be represented by apertures cut through the paper. Lay this pattern on the ground intended to receive the figure, whether a floor or painted cloth, and with a stiff smooth brush, paint with a quick vibrative motion over the whole figure.—Then take up the paper and you will have an entire figure on the ground. Note.—If a floor is to be thus painted, in imitation of a carpet, the pattern must be perfectly square, and the figure so designed, that when several of them come together, they may completely match each other; and when different colours are used in the same figure, they must be kept a little separate from each other, and wrought with different brushes.

First give the work one or two coats of straw coloured paint, composed of white lead and yellow ochre, ground in linseed oil, to which may be added a little fine litharge, that the paint may the sooner dry; when this is dry, rub it smooth with sand-paper. Then if mahogany is to be imitated, stain the work over with boiled linseed oil, coloured a little with venetian red and burnt terra-de-sienna, equal quantities. This should be applied with a short stiff brush, and spread very thin that it may not run, or drip off. Then with terra-de-sienna, ground very thick in oil, form the dark shades of the graining according to your design, with a small flat brush. For this purpose a common sash-brush may be made flat, by having a small piece of wire, or wood, bound on each side near the handle. Some of the darker shades may be drawn with burnt umber and black, ground together, which may be applied with a camel hair pencil. If any part is to be made very light, the staining may be wiped off carefully with a ball of cotton. Light stripes, or lines may be produced by drawing a piece of cork or soft wood over the work, thus taking off or removing the dark colours, that the original ground may appear.—To imitate maple, the work must be stained with yellow ochre, and burnt umber, ground together in boiled oil. Instead of burnt umber, terra-de-sienna (unburnt) is sometimes used, but as different kinds, or parcels of it, vary in colour, from yellow to brown, it may not be depended on uniformly. The birds' eyes and curls are formed by removing the staining from the ground with a piece of stiff leather, the edges of which are cut in notches so that the several points will touch the work at the same time.

If the common cakes of water-colours are to be used in this work, they should be mixed with water in which a little muriate of soda has been dissolved. Other paints may be ground in shellac varnish; or in linseed oil, but this will not dry so quick. The most proper colours for this work, on account of their transparency, are india ink, or lamp black, burnt umber, burnt terra-de-sienna, lake and gamboge or chrome yellow. These must be laid on very thin, that they may be the more transparent. Set up the glass on its edge, against a window, or place a lamp on the opposite side that the light may shine through, and with a fine hair pencil, draw the out lines of your design on the glass with black; afterward shade and paint it with the above mentioned colours, observing to paint that part of the work first, which in other painting would be done last.

The shading may be performed by laying on two or more coats of the colour, where you want it darker. If transparency is not required, a greater variety of colours may be used, and laid on in full heavy coats. Any writing or lettering in this work, must be written from right to left, contrary to the usual order. In some pieces, the body of some of the principal objects, may be left blank, so that by placing pieces of silk or paper of different colours, on the opposite side of the glass the picture will also appear in different colours, and may be changed from one colour to another at pleasure.

For this purpose a wheel must be provided that is perfectly round, and the rim of it covered with deer-skin, or buff-leather. The diameter of the wheel, for common purposes may be about two feet; but for polishing razors, and some other similar instruments, the wheel should not be more than five or six inches in diameter, and two inches thick. The steel must first be ground smooth as possible on a common, or fine grained stone; it may then be applied to the polishing wheel, which must be turned with such velocity that the surface, or rim, may move at the rate of from forty to sixty feet in a second; and the leather must frequently have a powder applied, called crocus of iron, which is prepared by calcining sulphate of iron in a crucible till it becomes a fine red oxide resembling rust. For ordinary work, the leather may be moistened with olive oil, that it may the better retain the powder; but it will give a more perfect polish if kept dry. If any perfectly plain surfaces, such as mirrors are to be polished, they must be applied to the sides of a wheel, and not to the edge or rim, in the manner of other work.

Hold the steel over a charcoal fire till it becomes blue;—let it cool. Then with equal parts of rosin and bees wax, melted together, coloured a little with lamp black, and diluted with spirits of turpentine, so as to work freely with a camel hair pencil, draw any letters or figures on the steel, while it is a little warm. When the steel has become cold, wash it over with muriatic acid, diluted with two parts water, to one of acid; thus take off the blue colour, and then wash it with clear water. Afterward the varnish, being warmed a little, may be readily washed off with spirits of turpentine, and the letters or flowers will remain blue. Note.—If letters are formed of polished steel with this varnish, and the body of the metal be also covered with it, except a small space round the letters, and then bathed with muriatic acid, the space round the letters, will become a dull iron colour, while the letters and the body of the steel will retain their polished surface and brilliancy.

Grind an ounce of native plumbago, (such as is used for making lead pencils,) very fine in a gill of spirits of turpentine; then add an ounce of clean bees wax; apply a gentle heat, till the wax is melted, and continue stirring it till it is nearly cold. Brush over the steel with this composition, and when the spirits have evaporated, rub the work hard with a piece of glove leather, and wipe off nearly all the wax, that the metal may retain its brightness. This may be applied to iron or steel in machinery, or other work, and will be found to answer a much better purpose than oil, as it is less liable to collect dust from the atmosphere, and is, in general, much more durable.

No temper can be given to steel, in which hardness is combined with tenacity, more than in that given to files, at the file manufactories, which is accomplished by the following process.—To boiling water, add about twice as much finely ground muriate of soda, as the water will dissolve, and as much rye flour as will, with the other, make a thick paste; lay a coat of this paste over the steel, (which must be ground, or filed previous to tempering,) and subject it to a full red heat, in a fire of charcoal, mixed with about a third part of animal coal, (coal of bones, horns, leather, &c.) and then suddenly plunge it three or four feet deep, in exceeding cold water. By thus immersing the steel rather deep in the water there is a double advantage; for the water which becomes heated, by contact with the steel, will rise and its place be supplied continually by fresh cold water; and at the same time, the pressure of the water on the coating of paste, will make it adhere more closely to the steel while it is cooling. The paste may then be shelled off, and the steel will be found as bright as before, or at least, will not have been essentially oxydized by the operation.

Dissolve sulphate of copper in water, in the proportion of one to three; wash the iron or steel with it, and it will instantly be covered with reduced copper. This is best performed by applying the solution with a brush, which must be followed directly with a sponge of clear water.

In this manner any letters or figures may be drawn with a camel-hair pencil, or a pen, and if it be on polished steel, the letters or flowers will assume the brilliancy of the steel and appear like highly polished copper. It may sometimes be requisite to cleanse the metal by washing it with diluted muriatic acid, that the copper may adhere the more readily. If the steel thus ornamented, be held over a charcoal fire, the copper figures become blue first; and when the steel becomes blue, the copper takes a gold colour; but is restored again to its original colour, by diluted muriatic acid.

To nitric acid, diluted with an equal quantity of water, add as much mercury as the acid will dissolve; then add to the solution, three or four times as much water, and having given the iron a coat of copper, as directed in the last experiment, brush it over in the same manner with the diluted nitrate of mercury; its appearance will be equal, if not superior to that of real silver. In this manner any common, or rough iron work, may be apparently silvered at a most insignificant expense.

Small pieces of iron may be tinned, after being filed bright, by washing them with a saturated solution of muriate of ammonia in water and dipping them, while moist, in a vessel of melted tin. If the iron is of such form as cannot be conveniently filed, it may be immersed in nitric acid, diluted with as much water as acid; when the acid begins to act sensibly on every part, it may be washed with water, and then with the muriate of ammonia, and if a little fine rosin be sprinkled on it previous to dipping it in the tin, it may be an advantage. The iron must remain in the tin till it becomes nearly as hot as the tin, otherwise it will be coated too thick. Muriatic acid may sometimes be used, instead of muriate of ammonia, and if the iron is not filed, it will answer a better purpose.

The inside of cast iron vessels may be tinned as follows: Cleanse the iron by scouring or rubbing it with a sharp grained stone, keeping the iron wet with diluted nitric acid. As the most prominent parts of the iron will be first brightened by the stone, the acid will also commence its action on the same parts, which will very much facilitate the work, while the hollows, and deeper parts of the surface, will remain untouched till the iron is nearly smooth. When this is accomplished, wash the iron with water, and then with clear muriatic acid; turn the vessel over to drain off the superfluous acid; then set it upright, and fill it with melted tin, which must be poured in cautiously, directly on the bottom of the vessel first, and the stream of tin increased till the vessel is full; then pour out the tin suddenly, and invert the vessel till it is cold. Sheets of iron are tinned, in the manufactories of tin plate, by immersing the sheets, endwise, in a pot of melted tin, the top of which is covered with about two inches depth of tallow. This tallow answers a better purpose, after it has become brown by use, than it does at first. The only preparation of the iron sheets is, to scour them perfectly clean and bright.

To an ounce of nitric acid, diluted with an equal quantity of water, add nearly an ounce of mercury, or as much as the acid will dissolve. When this is dissolved, add to the solution, gradually, half an ounce of sulphuric acid; this will precipitate the mercury in the form of a white powder; when this has subsided, pour off the acid and add clear water; thus wash the powder from the acid, then pour off the water, and while the precipitate is moist, (or if it be suffered to dry, it may be again moistened with water,) rub it over the tin with a piece of glove leather.—Then wash the tin with water, and when it is dry, rub it pretty hard with a piece of fine woollen cloth; it will resemble polished silver.

Cleanse the tin by washing it with warm soap and water, and rinse it in clear water. Then heat the tin to the temperature of bare sufferance to the hand, and pour on it, or apply with a brush or sponge, a mixture of one ounce of muriatic acid, with one fourth of an ounce of sulphuric acid, and two ounces of water; then immediately wash the tin in clear water. Another method is, to apply in the same manner a solution of two ounces of muriate of soda, in four ounces of water, with one ounce of nitric acid. In either case, if the crystalline figures are not bold enough, the operation may be repeated. If a very small figure is required, the tin may be heated nearly to flowing, and plunged into cold water, slightly acidulated with nitric and muriatic acids. If a little solder is drawn over the tin with a hot iron or copper, in such manner as to form a cross, or circle, and the opposite side of the tin be afterwards crystallized, it will have a beautiful effect.