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PLATERS' WRINKLES

And a List of the Chemical, Com-
mercial and Common Names of
Chemicals Used in the
Dipping, Plating, and
Coloring of Metals

BY

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Plating-Chemical Editor of The Metal Industry

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THE METAL INDUSTRY AND ELECTROPLATERS REVIEW is a business publication published in the interest of all of the metals except iron, and contains the most reliable information on the latest and best shop practice of the metal and plating plants.

PRINCIPAL ARTICLES

The principal articles are written by the leading practical writers of the world, and relate to the industrial arts of Smelting, Refining, Fluxing, Fusing, Alloying, Casting, Founding, Machining, Grinding, Extruding, Rolling, Drawing, Stamping, Spinning, Annealing, Smithing, Brazing, Tinning, Zincing, Cleaning, Dipping, Etching, Plating, Polishing, Coloring, Finishing, Burnishing, Enameling, Japanning and Lacquering.

The metals and alloys to which our journal relates include BRASS, COPPER, TIN, LEAD, ZINC, ALUMINUM, NICKEL, SILVER, GOLD, BRONZE.

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**THE METAL INDUSTRY
99 JOHN STREET
NEW YORK**

Platers' Wrinkles

The several editions of Platers' Wrinkles that have been found necessary during the past few years prove that this little practical work has made for itself an enviable position in the plating industry.

In this revised edition basic formulæ for a number of solutions have been included, and also considerable additional data to bring Platers' Wrinkles up to date.

—Ed.

Nickel Solutions

Formula for nickel solution for still tanks; for barrel plating the proportions may be increased to twice the amount as compared with water:

Water	1 gallon
Single Nickel Salts.....	8 ozs.
Boracic Acid.....	1 "
Sodium Chloride.....	½ "
Epsom Salts.....	1 "

For heavy white deposits of nickel upon Gray Iron or Steel:

Water	1 gallon
Single Nickel Salts.....	10 ozs.
Nickel Chloride	2 ozs.
Boracic Acid	2 ozs.
Sal Ammoniac	1 oz.
Epsom Salts	1 oz.

If one ounce of nickel fluoride is added it will stabilize the solution, give a bright deposit and prevent burning, unless an excessive current is used. All metals can be plated in the solution except zinc and die castings.

Solutions for zinc and die castings:

Water	1 gallon
Double Nickel Salts	8 ozs.
Common Salt.....	4 ozs.
Epsom Salts	1 oz.
Sodium Citrate	2 ozs.

Water	1 gallon
Single Nickel Salts.....	6 ozs.
Double Nickel Salts.....	2 ozs.
Common Salts	2 ozs.
Sodium Citrate	3 ozs.
Epsom Salts	1 oz.

Voltages required—still solutions, 3 to 4½; mechanical, 8 to 10.

Nickel chloride is a very good addition agent. If single salts are added and occasionally half an ounce

of nickel chloride per gallon of solution the nickel solution will give excellent results and other materials that are frequently added can be omitted.

When a nickel solution produces dark tones, it is deficient in nickel unless a copper salt of some form has been accidentally added.

Salammoniac or common salt added to a nickel bath in the proportion of 2 ounces to the gallon will oftentimes bring up a white color to the deposit when other methods fail.

If at any time sulphuric acid has been added to a nickel bath in excess it is well to remember that 3 ounces of 26 per cent water ammonia will neutralize 1 ounce of 66 per cent sulphuric acid.

In plating novelty work a small addition of gelatine or transparent white glue will give an exceedingly bright lustre to the nickel deposit, providing the deposit is not too heavy. Gum tragacanth and gum arabic may also be used but in very small proportions (less than one grain per gallon of solution).

Cadmium is also being used to a great extent, preferably in the metallic form as anodes. The dimensions are usually $\frac{5}{8}$ inch diameter and 9 inches long. Several of them are used on the anode poles with the nickel. When the deposit becomes dull the cadmium anodes should be hung in the solution for one or two hours until the deposit becomes bright. Then remove and repeat when necessary.

Nickel fluoride will be found more satisfactory to add to regular nickel solutions than hydrofluoric acid. One ounce may be used per gallon. It stabilizes the solution and gives brighter nickel deposits.

The voltage for black nickel solutions should not exceed one volt. Less is preferable. Otherwise gray tones will result. The solution works best neutral or slightly alkaline. Some platers use one or more brass anodes with the nickel anodes. They claim the small amount of copper and zinc reduced gives a much better black.

Rolled sheet nickel anodes of about 16 Brown and Sharpe gauge in thickness are used extensively in connection with gold and silver anodes in the baths of these metals. Platers that use them claim to obtain brighter and harder deposits than when gold or silver anodes are used exclusively.

To keep your baths up to their full working capacity, every other evening add $\frac{1}{2}$ oz. of single sulphate of nickel to each gallon of solution and once a week, pre-

ferably on Saturday, add $\frac{1}{2}$ oz. of salammoniac to each gallon; or replenish once a week and add 1 oz. single sulphate of nickel, $\frac{1}{2}$ oz. chloride of nickel and $\frac{1}{4}$ oz. nickel fluoride.

When nickel solutions are in good working condition it is easy to maintain them in that condition, even when worked constantly during the day. The amount of nickel deposited is not entirely replaced by the anodes even when as much anode surface is exposed to the action of the bath as can be conveniently placed upon the supporting rods.

In preparing black nickel baths from nickel salts, salammoniac and sulpho-cyanide of sodium are used. A deeper and richer black can be produced by adding $\frac{1}{2}$ oz. carbonate of copper dissolved in 1 oz. of 26 per cent ammonia water to each gallon of solution and using anodes of sheet brass instead of the usually prescribed nickel anodes. The color is obtained more rapidly and will color very satisfactorily with a soft buff.

Ten ounces of single sulphate of nickel added to each gallon of solution will accomplish better results than a pound of the double nickel salts. To maintain a nickel solution in constant operation, add only the single sulphate of nickel. The single sulphate of nickel dissolves very readily, especially in boiling water, and contains 50 per cent more metal than the double sulphate of nickel and ammonia, therefore enriching the bath with metal proportionately to greater extent.

If a nickel deposit stains very readily it denotes that the solution is radically alkaline. Boracic acid is highly recommended for acidulating nickel baths, but for many baths, chemically pure sulphuric acid is just as good and oftentimes better, and very much cheaper. For a one hundred gallon bath dissolve in water 10 ozs. of the acid and add to the bath at the close of the day's work, stirring thoroughly. Hydrofluoric or hydrochloric acid may also be added upon the same ratio with excellent results. The solution will be found to have cleared by morning and the staining will be overcome.

Stains are sometimes produced upon nickel deposits by contaminated rinsing waters, or by drying out in sawdust that has become sour. One of the best aids to drying out nickel or any other deposit and to prevent stains is the old-fashioned plater's compound, called whale oil soap, on account of its fishy smell, 2 ozs. of this material dissolved in each gallon of boiling water will act as a dryer. Water will completely run away from the surface of the articles, thus saving labor and much sawdust.

It is very often necessary to produce a black nickel deposit upon brass, copper or bronze goods for antique relief effect, also a good bright black with a polished surface. The simplest are sometimes the best. This finish can be produced in a few minutes. Dissolve 14 ozs. of powdered white arsenic in one-half gallon of boiling water, containing 8 ozs. of powdered caustic soda. When cool add one-half gallon more water, containing one-half ounce of cyanide of sodium. Use anodes of wrought iron. On bright surfaces a bright deposit is produced. Use the same current strength as usually used for a nickel bath.

A good method to pursue in using up parts of old nickel anodes is as follows: Procure an iron rod of not less than one-quarter inch diameter, bend one end in the form of a hook, at the other end cut a thread so that a washer and nut can be used, drill holes in the pieces of anodes, and then place them on the iron rod. When sufficient has been placed upon the rod, put the washer and nut in place; coat them and also the part of the rod exposed to the action of the solution with a little asphaltum varnish, which will prevent corrosion. This method does not expose much surface, but it is a good way to use up old pieces of anodes that would have to be sold for less than half price.

In nickel plating plumbers' hardware and other classes of goods of the cast, brass or bronze variety, especially if tin is used in their composition, the nickel deposit frequently peels from the surface; although upon articles made from sheet metal this result is not experienced in the use of the same bath. The operator looks for the cause of the trouble. Sometimes he discovers it, oftentimes not. Tin is used in the composition of the metal to produce sounder castings. When such articles are cleansed, after polishing by potash solutions or their combinations, especially in boiling solutions, an oxide of tin is produced upon the surface of the article by the action of the alkalies. This is not always noticeable; but yet it is sufficient to prevent the true adhesion of the nickel deposit.

Cyanide of sodium, unless unusually strong, will not remove it. A 2 or 3 per cent solution of muriatic acid in water will be found valuable in many cases for reducing slight oxidations very quickly, when due to tin oxide.

The pitting of nickel deposits is usually caused by a deficiency of metal in solution, or too much free acid; either case produces an excess of hydrogen gas upon the articles which appears to burn into the surface of the deposited nickel producing pitting. The remedy is to add nickel sulphate 2 or 3 ozs. to the gallon if caused

by deficiency of metal. If caused by too much free acid, add carbonate of nickel; this is best added in the plastic form. Plastic carbonate of nickel is produced in the same manner as plastic carbonate of copper from copper sulphate by adding two pounds of carbonate of soda to each pound of sulphate of nickel dissolved in boiling water. After precipitation filter carefully and rewash with hot water several times. One-half to one ounce of plastic nickel carbonate per gallon of solution will usually overcome the free acid in a nickel bath. Nickel chloride and also nickel fluoride have been found to be excellent factors in reducing pitting. The chlorine liberated combines with the hydrogen and reduces it to the respective acids. Half ounce or more should be added per gallon of solution. Repeat as required.

The peeling of nickel deposits is not always due to imperfect cleaning, imperfect removal of oxides, free acid, or free alkali in solution, but to a lack of conducting salt. This can be remedied by the addition of common salt, salammoniac, sulphate of ammonia, epsom salts or nickel chloride. When the conductivity of a nickel solution is poor dark lines will be found covered by the supporting wires or frame. A stronger current applied will not make matters any better. A conducting salt is needed 1 or 2 ozs. of which, added to each gallon of solution, will overcome this difficulty. Nickel solutions very seldom need a conducting salt; when once prepared, they do not decompose very readily, so remain quite constant. Some anodes are very hard, especially those cast in chilled moulds and do not reduce readily; any disturbance then noted, unless the bath had become contaminated with some foreign substance, would be due to a lack of metal in solution.

The difference in temperature between Summer and Winter has a very decided effect upon nickel solutions. A bath may work very well all through the Summer and Fall, but as cold weather approaches the work does not come from the bath satisfactorily, oftentimes dark or grayish, and in some cases peeling results. The solution oftentimes deposits crystals on the anodes or tanks under such conditions. This is because the salts are less soluble at the lower temperature.

If you have live or exhaust steam this trouble can be very easily overcome in the following manner: Procure a lead pipe with not less than a half-inch aperture, connect this with your regular steam pipes with valve connections. Have the pipe sufficiently long so that it can be immersed in the bottom of the tank and come up on the opposite side and then on the outside of the tank so that the condensed steam can run into a pail or other receptacle. Have a valve connection on the outlet also,

so that the steam can be controlled. In very cold weather if the steam is allowed to pass through the pipe for fifteen minutes the temperature of the solution will be raised to the normal (70 degrees), thus overcoming the difficulties noted.

Hot nickel solutions are being used to an advantage especially upon plain metal surfaces. The temperature ranges from 100 degrees to 160 degrees Fahr. However, hot solutions must contain more metal than normal solutions. Agitation, both mechanical and by air pressure is necessary when high currents are used to prevent hydrogen occlusion.

The formula for such solutions should approximate as follows:

Water	1 gallon
Single Nickel Salts	1½ to 2 lbs.
Boracic Acid	3 to 4 ozs.
Common Salt	1 to 1½ "
Epsom Salts	1½ to 2 "
Nickel Fluoride	1 to 1½ "

When a very hard nickel deposit is required, yet adherent and ductile, cobalt chloride should be added to the nickel solution; one-half ounce to one ounce per gallon of solution will give the desired results. Repeat at stated intervals in combination with single nickel salts.

BRASS, BRONZE AND COPPER BATHS

Formula for still solutions. For barrel or mechanical plating the proportions given may be increased to twice the amount. As a rule for mechanical solutions the sodium cyanide and conducting salts will have to be increased by 25 per cent above amounts given for still solutions, even though the proportions of the basic formula have been doubled.

Copper Solution, Alkaline

Water	1 gallon
Sodium Cyanide	4⅓ ozs.
Copper Cyanide	4 "
Bicarbonate of Soda.....	¾ "
Bisulphite of Soda.....	½ "

Copper Solution Acid

Water	1 gallon
Copper Sulphate	1¾ lbs.
Sulphuric Acid, 66%.....	4 ozs.
Powdered Alum	1 oz.

Dextrine, Transparent Glue, and Corn Syrup, may be used as additional agents in proportions of ⅛ oz. per gallon or more.

For brightening purposes $1/32$ ounce hyposulphite of soda may be added.

Bronze Solution

Water	1 gallon
Sodium Cyanide	4½ ozs.
Copper Cyanide	3¼ "
Zinc Cyanide	¾ "
Bicarbonate of Soda.....	½ "
Bisulphite of Soda.....	½ "

Brass Solution

Water	1 gallon
Sodium Cyanide	4½ ozs.
Copper Cyanide	3 "
Zinc Cyanide	1 "
Bicarbonate of Soda.....	1 "
Ammonium Chloride	½ "

If the anodes coat over in the brass solution with a basic zinc oxide, then very small proportions of caustic soda should be added to the solution, but not more than $1/8$ ounce per gallon at one time. Repeat at intervals until the anodes clear up.

As a brightening agent one grain of powdered white arsenic dissolved in double its weight of caustic soda and a little warm water should be added per gallon of solution at intervals of one hour or more until the brass deposit becomes clear and bright. An excess of arsenic is always detrimental.

Anodes for the respective solutions should be alloyed as follows: Copper, 99 per cent copper, 1 per cent zinc. Bronze, 90 per cent copper, 10 per cent zinc. Brass, 80 per cent copper, 20 per cent zinc. Cast anodes give the best results.

Quite frequently brass or bronze solutions become sluggish and will not give uniform results even when several agents are added to increase their activity. When such results develop, reduce the solution with water at least one-third, add small proportions of sodium cyanide and as a rule the solutions will become normal again. The solution removed may be heated to 180 to 200 degrees Fahr., and metal cyanides added to increase the metal content. Then use as a stock solution for replenishing.

A little water of ammonia or sal ammoniac added to a brass bath will frequently clear the deposit, especially when muddy, thus avoiding the use of arsenic.

In plating cast iron, if the deposit peels, or is not clear, add one or two ounces of bicarbonate of soda or one or two ounces of bisulphite of soda to each gallon of solution.

In bronze plating considerable arsenic can be used in the bath to produce a satisfactory color; this gives a similar color to the deposit as tin does in the cast bronzes of the foundry.

A copper solution, containing one-eighth ounce or less of zinc in each gallon of solution, will produce a better and brighter deposit. If the bath deposits a muddy color, add about one ounce of hyposulphite of soda per 100 gallons of solution. Repeat if necessary.

Bronze baths, also brass baths when made up new, are best prepared, first as a copper bath, and then a concentrated solution of zinc cyanide in sodium cyanide, one part of the former to three-quarters part of the latter, added until the desired color is obtained. To each pound of zinc cyanide used add 1 ounce of caustic soda.

Ammonia or arsenic should not be added to a copper bath if dark or peeled deposits are to be avoided. A little bisulphite of soda will be found good practice. This acts as a conducting salt as well as forming cuprous sulphite in solution, which is readily soluble in the cyanide and produces a softer deposit and cleaner anodes.

Avoid adding too much arsenic to a brass solution, for grayish tones are produced. It will be found impossible to produce a rich lustre by the acid dips when much arsenic is contained in the brass deposit. Oftentimes a brass deposit, when acid dipped, will save considerable labor in scratch brushing, especially in gilded finishes, where a rich background is necessary.

The metal cyanides should always be used in preparing silver, copper, bronze and zinc solutions whenever possible. Any metal salt dissolved in cyanide automatically becomes converted to the metal cyanide. Sodium salts when required for conductive purposes can be added more economically and efficiently as separate factors.

The following comparative figures show the economy of copper cyanide over the copper carbonate. Copper carbonate contains 50 per cent metal and 50 per cent carbonate and requires $1\frac{3}{4}$ pounds of sodium cyanide to convert to the double cyanide and give a small excess of free cyanide. Copper cyanide contains 70 per cent metal and 30 per cent cyanogen and requires $11\frac{1}{3}$ ounces to equal one pound of carbonate of copper. The copper cyanide only requires 12 ounces of sodium cyanide to put it in solution. When a carbonate is required 4 ounces of soda ash (58 per cent) added will be ample. Both combinations give identically the same results as a replenishing medium. The saving is apparent in that 1 pound

of sodium cyanide may be eliminated on each 8 ounces of copper put in solution, which equals 40 per cent metal.

When your acid copper baths commence to give trouble, add common alum to them in the proportion of 1 or 2 ounces to the gallon, before making any further additions. If this does not overcome the trouble your bath needs metal, it is then advisable to reduce the bath somewhat with water. Then add as much sulphate of copper as your bath will absorb over night. This can be readily accomplished by suspending the copper salt in the usual acid dipping baskets made from earthen ware or aluminum upon your negative or work poles, or common burlap bags can be used for the purpose. Free sulphuric acid is required for anode reduction as well as conduction, just as free cyanide is used in cyanide solutions.

When a brass solution produces a bronze or low brass tone, it does not need zinc or ammonia, but copper. If the brass foundry alloys are studied it will be found that two or even three parts of copper to one of zinc give yellow tones; also equal parts of these metals produce bronze or reddish yellow colors. If this is borne in mind, considerable trouble from white or grayish brass colors will be avoided. Add only copper after a bath is once prepared, when metal is necessary. If the deposit should then show a reddish or bronze tone, a little zinc cyanide mixed with water of ammonia and stirred in the bath will produce a good brass color.

Conducting salts for copper and bronze solutions consist of sodium bisulphite, sodium sulphite, caustic soda, soda ash and hyposulphite of soda and for brass solutions, soda ash, caustic soda, aqua ammonia, carbonate and chloride of ammonia. The metal cyanides consist of the following proportions of metal and cyanogen:

Silver Cyanide	—80 per cent. metal—20 per cent. cyanogen
Copper Cyanide	—70 per cent. metal—30 per cent. cyanogen
Zinc Cyanide	—55 per cent. metal—45 per cent. cyanogen

Voltages necessary are as follows: still solutions, copper, brass and bronze—3 to 4; mechanical solutions—7 to 10; acid copper (still)—1; agitated—2 to 3.

ZINC, TIN AND LEAD SOLUTIONS

Alkaline Zinc Solution

Water	1 gallon
Sodium Cyanide	7 ozs.
Zinc Cyanide, 55%	8 "
Sodium Sulphate	4 "
Sodium Fluoride	1 "
Caustic Soda, 76%	1/2 "
Corn Syrup	1/2 "

Temperature of solution 120 to 140 degrees Fahr. at 4 volts. Alkaline zinc solutions are best adapted for steel and wrought iron. They do not give satisfactory results upon cast iron. Fifty per cent of the chemicals given may be used and still give good results.

Acid Zinc Solutions

Water	1 gallon
Zinc Sulphate	1½ lbs.
Sodium Fluoride	2 ozs.
Magnesium Sulphate	2 "
Corn Syrup	4 "

Temperature of solution 100 degrees Fahr. at 4 volts. Use anodes of cast zinc containing 1 per cent aluminum. The proportions given for acid solution may be increased 50 per cent for barrel plating with an increase in voltage of 100 per cent.

Alkaline Tin Solutions

Water	1 gallon
Caustic Soda, 76%	4 to 8 ozs.
Tin Chloride, crystallized	2¾ to 8 ozs.
Powdered Rosin, yellow	10 grs. to ⅛ oz.

Temperature 180 to 200 degrees Fahr. at 1 to 1½ volts.

Acid Tin Solution

Water	1 gallon
Phosphate of Soda	3 ozs.
Tin Chloride	1 "
Common Salt	1 "
Tartaric Acid	¼ "

Temperature of solution normal to 100 degrees Fahr. at 1 to 2 volts. Anodes of pure tin should be used.

Alkaline Lead Solution

Water	1 gallon
Caustic Soda, 76%	24 ozs.
Lead Acetate, crystallized	8 "
Powdered Yellow Rosin	¼ "

Temperature 180 to 200 degrees Fahr. Voltage 1½ to 2½.

Acid Lead Solutions

Water	1 gallon
Lead Fluosilicate	10 to 14 ozs.
Hydrofluoric Acid	8 to 12 "
Boracic Acid	2 ozs.
Gum Arabic	⅛ to ¼ oz.
Water	1 gallon
Hydrofluoric Acid, 40%	2 lbs.
Boracic Acid	12 ozs.
Dry Lead Carbonate	16 "
Gum Arabic	⅛ to ¼ oz.

Temperature 80 to 100 degrees Fahr. at 2 volts. Use anodes of pure sheet or cast lead.

GOLD, SILVER AND PLATINUM PLATING BATHS

Gold solutions may be prepared from the chloride or fulminate, but as they must eventually be converted to the cyanides of the metal, it is always advisable to use the cyanides. Likewise silver solutions are sometimes converted direct from the nitrates to the cyanides, which is bad practice. Silver chloride is still used extensively but silver cyanides are more efficient. Solutions prepared from silver cyanide can be more readily controlled, because they contain very little inert salt (except what is added as a conducting salt) and require much less sodium cyanide in their preparation.

Gold Solutions

Water	1 gallon
Gold Trisalyt, 40% Fine Gold.....	½ oz.
Sodium Cyanide	¼ "
Sodium Phosphate	¼ "
Sodium Bisulphite	⅛ "
Water	1 gallon
Gold Chloride	⅓ oz.
Sodium Cyanide.....	1 "
Sodium Phosphate	¼ "
Sodium Bisulphite	⅛ "

Temperature 140 to 160 degrees Fahr. Voltage 2 to 2½. The proportions given may be decreased for flash deposits, or increased for cold solutions or heavy deposits.

Silver Solutions

Water	1 gallon
Sodium Cyanide	3½ ozs.
Silver Cyanide, 80% Fine Silver.....	3 "
Ammonium Chloride	½ "
Water	1 gallon
Sodium Cyanide	7 ozs.
Silver Chloride	4 "
Ammonium Chloride	½ oz.

Temperature 80 degrees Fahr. Voltage ¾ to 1.

Potassium carbonate may be used as a conducting agent, but as the material is less active than ammonium chloride, 1 ounce should be used. The proportions given in formula for silver plating may be decreased or increased according to requirements.

Equal parts of nitric acid and water will dissolve silver much faster than when the acid is used alone, especially when the mixture is slightly heated upon a water bath.

Cyanide of nickel can be used in gold or silver baths to a certain extent. In silver baths one-quarter the amount of silver used per gallon can safely be added. In gold baths one-eighth the amount can be used. Cadmium is also used in silver baths to harden the deposit and reduce cost. Cadmium can also be used in green gold solutions

to replace silver. However, equal parts of cadmium and silver give the best results.

It is difficult to prepare a cadmium cyanide. Cadmium chloride dissolved in sodium cyanide should be used or cadmium trisalyt.

Muriatic acid gives better results than salt when precipitating chloride of silver from the nitrate solution. The reason is that nitric acid is formed by the reaction, and this is more readily washed out than nitrate of soda that is produced when salt is used.

In plating soft metal goods with silver, especially for cheap finishes, or where oxidized or gray effects are necessary, a ten-minute deposit in the nickel bath helps to save silver. If the silver deposit cuts through, whitish background due to the nickel deposit still results, where a copper or brass deposit would have to be "doctored up."

For bright silver baths, benzole will be found a good substitute for bisulphide of carbon; it stays up in the solution better. Dissolve in strong cyanide solution in the regular manner, and add about a teaspoonful to every ten gallons of solution. Do not confound benzole with benzine, as this is a different product, resembling bisulphide of carbon, but not so dense.

French grays can be produced directly from a specially prepared silver bath; the bath usually consists of the regular bath, to which is added arsenic dissolved in caustic soda. The articles after plating in the regular bath are immersed in the bath for a minute or two; a dark gray silver is produced which, when relieved or burnished in the regular manner, produces an excellent French gray.

In silver plating, when desirable to produce a hard silver deposit, considerable cyanide of nickel can be added to the silver bath. In a like manner the cyanide of nickel can be added to the gold bath. It produces a harder and clearer deposit that does not tarnish as readily as baths made up with gold alone. The method is much used in gilding low karat watch cases and also upon gold-filled cases.

When preparing a new silver bath be careful not to add too much free cyanide to the bath. It is better to have a little of the silver salt undissolved in the bottom of the tank than an excess of cyanide. New baths are sometimes very erratic. A little water of ammonia added to a new bath helps to age the solution, and a little ammonia added when the anodes have a tendency to turn dark or black will be found of value. If too much cyanide has been added to the bath at any time, add a little nitrate of sil-

ver, one-quarter ounce to a gallon. This will be found better practice than trying to take up the free cyanide with chloride or cyanide of silver. Potassium or sodium nitrate is formed, but this does not harm the bath unless an excess is added.

Silver solutions when freshly prepared often act erratically. The silver deposits dark, and granular, and due to the low voltage the anodes do not readily yield up their metal. If small amounts of ammonium chloride, or potassium carbonate, does not correct the trouble then it is advisable to increase the internal resistance by adding very small portions of a brightening colloid. The brightening agent is best prepared by using

- Ether1 part
- Bisulphide of Carbon—just so much as the ether will absorb by constant agitation at intervals of about an hour.
- Aqua Ammonia, 26%—very small amount, but as much as the mixture of ether and bisulphide of carbon will take up.

Usually from $\frac{1}{2}$ gram to 1 gram of bisulphide of carbon per gallon of new solution is ample combined with the ammonia and other, so one ounce $437\frac{1}{2}$ grams would be ample for an equal number of gallons.

Add sparingly as it is much easier to add to a solution than take away again.

Trouble frequently occurs in flashing the nickel deposit in the silver striking bath, the result being a violet coating which readily peels. The following method to overcome the necessity of a silver strike for this class of work will be found excellent. After cleansing, flash in the warm cyanide of copper bath for three or four seconds, then the usual washing. A five or ten minute deposit in the nickel bath, the usual wash again and place in the cyanide of copper bath for a few minutes or until the nickel deposit is coated with copper, rewash and immerse in a dilute cyanide of mercury bath. A solution containing four ounces of cyanide and one-quarter to one-half ounce of yellow oxide of mercury will be satisfactory. Then wash and place in the regular silver bath. This appears to be a good many operations, but they are quickly accomplished when performed continuously and the results are sure and imperfect deposits are thus avoided.

Silver cyanide should always be used in preparing silver solutions. It should be understood, however, that when

silver nitrate or silver chloride is dissolved in sodium cyanide silver cyanide is automatically formed. When the nitrates or chlorides are used the solutions build up in density at least 50 per cent more rapidly, but the constant use of silver cyanide for replenishing purposes avoids this increase in inert materials.

Platinum Solution

Water	1 gallon
Platinum Chloride	½ oz.
Caustic Potash	¼ oz.
Phosphate of Soda.....	6 ozs.
Bicarbonate of Soda.....	1 oz.
Potassium Nitrate	1 "
Boracic Acid	1 to 2 ozs.

Temperature 160 degrees to 180 degrees Fahr. Voltage 5 to 6.

All the salts except the boracic acid may be added to one-quarter of the water, at a temperature of 160 degrees Fahr. Boil for half an hour, then add the boracic acid. Replace the water lost by evaporation. This solution plates very bright.

ELECTRO-COLORING AND OXIDIZED FINISHES

Light Green Gold Solutions

Water	1 gallon
Gold Trisalyt, 40% Fine Gold.....	⅓ oz.
Silver Trisalyt, 30% Fine Silver.....	1/10 "
Cream of Tartar.....	¼ "
Sodium Cyanide	2 to 3 ozs.
Water	1 gallon
Gold Chloride	¼ oz.
Silver Chloride	1/20 "
Cream of Tartar.....	¼ "
Sodium Cyanide	3 to 4 ozs.

Temperature 80 to 100 degrees. At 3 to 4 volts. Anodes 14 karat green gold or platinum.

White Gold Solution

Water	1 gallon
Sodium Cyanide	1 oz.
Gold Trisalyt	½ "
Silver Trisalyt	⅓ "
Cadmium Trisalyt	¼ "
Ammonium Chloride	½ "

Use 18 karat white gold anodes. Voltage—4. Temperature 120°—140° F.

Dark Green Gold (Smut)

Water	1 gallon
Gold Trisalyt, 40% Fine Gold.....	½ oz.
Silver Trisalyt, 30% Fine Silver....	1/6 "
Cyanide of Lead.....	1/18 "
Sodium Cyanide	4 ozs.
Water	1 gallon
Gold Chloride	⅓ oz.
Silver Chloride	1/12 "
Cyanide of Lead.....	1/13 "
Sodium Cyanide	⅝ "

Temperature 80 to 100 degrees Fahr., at 3 to 4 volts.
Anodes 14 karat green gold or platinum.

The chlorides of gold and silver may be used, if so desired, for light and dark green gold solutions. The metal content of solutions prepared from these materials should always equal amounts given in formulæ.

In preparing dark green golds with antique effects the solution should be made up of fine gold and silver, and when the light green gold is produced arsenic dissolved in pure caustic soda should be used; one part of the soda dissolved in a little hot water will dissolve 2 parts of arsenic; also lead cyanide can be used. By careful additions very beautiful antique effects can be produced, especially if the articles are lacquered. Afterwards the aniline colors soluble in denatured alcohol can be applied with camels' hair brushes, producing very fine effects upon the surface of the metal. This must be very dilute; the colors readily penetrate into the lacquer, producing a transparent effect.

In addition to the above some platers prefer the use of lead in producing green golds. When using lead as an addition procure dry carbonate of lead and dissolve in caustic soda, producing a concentrated solution. Add sufficient to give the desired results.

Immersion or Dip Gilding Solutions

Water	1 gallon
Gold Trisalyt 40% fine gold.....	½ oz.
Sodium Cyanide	3 ozs.
Soda Ash 58%.....	6 "
Sulphite of Soda.....	1 oz.
Water	1 gallon
Gold Chloride	⅓ oz.
Sodium Cyanide	4 to 5 ozs.
Soda Ash 58%.....	6 ozs.
Sulphite of Soda.....	1 oz.
Water	1 gallon
Sodium Ferrocyanide	2½ oz.
Gold Trisalyt or Chloride	½ "
Caustic Soda 76%	½ "
Soda Ash 58%	1 "
Phosphate of Soda	4 "
Sodium Cyanide, 96-98%	1/16 "

Temperature of immersion gold solutions—140° to 160° F.

Use a cast iron kettle heated with iron steam coils for best results.

Salt Water Gilding Solutions

Water	1 gallon
Gold Trisalyt, 40% Fine Gold.....	2 pennyweights
Phosphate of Soda.....	2½ ozs.
Soda Ash 58%.....	6 "
Sulphite of Soda.....	¾ "
Yellow Prussiate of Potash or Soda...	2 ozs.
Sodium Cyanide	1/16 to ¼ oz.

Water	1 gallon
Gold Chloride	1½ ozs.
Phosphate of Soda.....	2½ "
Soda Ash, 58%	½ oz.
Sulphite of Soda.....	¾ "
Yellow Prussiate of Potash or Soda..	4 ozs.
Sodium Cyanide	1/16 to 1/8 oz.

Temperature 160 degrees Fahr.

The salt water unit consists of a porous clay jar to hold the solution; a coil of heavy sheet or cast zinc to entirely surround the porous jar; copper rod one-quarter inch in diameter securely fastened and raised above the zinc coil to be used as cathode or work rod. The outer receptacle should be of heavy copper sheet, dimensions ample to hold the porous cell and zinc coil and leave sufficient space not less than four inches between the inside of the copper receptacle and the zinc cylinder.

Small steam coils of copper pipe should be used in the copper receptacle for heating purposes. An iron receptacle can be used in the place of the copper one, but the steam coils must be copper. The receptacle, zinc cylinder and porous jar must all be the same height to keep the solution at a uniform level.

The salt solution, which acts as the electrolyte, consists of granular rock salt 1½ pounds, sal ammoniac 2 ounces, water 1 gallon. Temperature of salt solution 180 degrees Fahr. Of gold solution 160 degrees Fahr.

Rose Gold Solutions

Water	1 gallon
Gold Trisalyt, 40% Fine Gold.....	1½ ozs.
Soda Ash, 58%.....	¾ oz.
Yellow Prussiate of Potash or Soda..	2 ozs.
Sodium Cyanide	1/16 to 1/8 oz.
Water	1 gallon
Gold Chloride	1 oz.
Soda Ash, 58%	¾ "
Yellow Prussiate of Potash or Soda..	3 ozs.
Sodium Cyanide	1/16 to 1/8 oz.

Temperature 180 degrees Fahr. Voltage 5 to 6.

Many platers in the coloring of jewelry claim that for rose gold only pure gold should be used in the form of cyanide of gold. A nearly boiling solution and a high voltage should be used for good results.

In producing rose gold tones upon brass articles a smut is required for good results. The smut is a darkened surface which when relieved upon the high lights in the usual manner before gilding gives the ground for the rose. The smut can be prepared by using:

Hot Water	1 pint
Muriatic Acid	1 pint
Sulphate of Copper.....	4 ozs.

This is always used warm; if the surface is too dark, it is run through the cyanide dip to lighten the color

SILVER FINISHES

French gray finishes are still in vogue. For a good imitation without using any silver in the solution proceed as follows: Take some of the regular nickel solution and add all the common salt it will take up. Dead dip the brass articles and copper plate them in the acid copper bath for a few minutes; then polish or burnish the high lights; place in the salt nickel bath for three to five minutes. Wash and dry out in the usual manner. A finish equal to many regular silver grays will result.

In producing what used to be termed the Butler or Etruscan silver finish, with a dead black background, the same methods can be pursued as in producing Colonial or brush brass finish. Deaden the surface with the aid of a soft brass wire scratch-brush, pumice stone and water. Dry out and lacquer. Then paint in dead black (Japalac), which should dry for five or ten minutes; then the high lights should be relieved in the usual manner, using a mixture of equal parts of boiled linseed oil and turpentine and finish with clean rags.

In the same manner the old English antique brass can be produced upon brass or brass plated goods, or rich effects upon copper or copper plated goods.

In producing oxidized silver effects when a good dark color is desirable. After silver plating, copper for a few seconds in a regular cyanide of copper bath, then wash and immerse in a cold sulphuret solution, made up as follows: Two ounces sulphuret of potassium and one-half ounce of water of ammonia to each gallon of water. Scratch-brush wet, adding a little sal soda to the brush water and then scour in any of the usual methods. This leaves the silver with a good white color beneath, instead of a grayish tone. For a French gray, scratch-brush the oxidized surface by applying a little pumice stone, moistened with water, to the brush. In this manner a gray tone is produced. Go over the high lights with a plater's hand brush and pumice stone to get contrast.

Green Upon Any Metal

Water	1 gallon
Bichromate of Potash.....	12 ozs.
Copper Sulphate	4 "

Anodes of carbon. Temperature normal at 2 to 4 volts.

Soft Black for Antique Finishes

Water	1 gallon
Double Nickel Salts.....	5 ozs.
Sulphate of Copper	2 "
Common Salt	2 lbs.
Aqua Ammonia, 26%.....	6 ozs.

Temperature normal at 2 to 3 volts. Nickel anodes. Dissolve salts in hot water and cool to normal.

Arsenic Black

Water	1 gallon
Caustic Soda, 76%	5 ozs.
White Powdered Arsenic.....	10 ozs.
Sodium Cyanide 98%.....	½ "

Use anodes of iron, carbon or nickel. Dissolve the caustic soda and arsenic in part hot water. Add balance cold. Use at normal temperature. Two to three volts.

Antimony for Gray Tones

Water	1 gallon
Carbonate of Soda, Crystallized.....	16 ozs.
Sulphide of Antimony (Red or Yellow)	8 "

Temperature 180 degrees Fahr. Anodes of carbon. Voltage 1 to 2.

Arsenic Solution, Acid

Muriatic Acid	1 gallon
White Powdered Arsenic.....	12 ozs.
Carbonate of Iron.....	12 "
Water	2 qts.

Dissolve the arsenic in half the acid by heat. Temperature normal. Use anodes of carbon or nickel.

Arsenic Black for Die Castings. Immersion Solution

Water	1 gallon
Caustic Soda 76%	5 ozs.
Powdered White Arsenic	2½ "
Sodium Cyanide	2 "

Temperature of solution 180 degrees Fahr. Agitate the solution.

Black Nickel Solution

Water	1 gallon
Double Nickel Calts	8 oz.
Sulphocyanide of Sodium.....	2 "
Zinc Sulphate	1 "
Ammonia Water	⅛ "

Use anodes of nickel at normal temperature; one-half to one volt.

Black Nickel Solution (Haas*)

Water	1 gallon
Double Nickel Salts	12 oz.
Sodium Sulphate	2 "
Rochelle Salts	½ "
Zinc Sulphate	½ "

Use anodes of nickel at normal temperature; .5 to .75 volt when electrodes are 3" apart. C.D.—1 amp. per sq. ft.

Black on Zinc

Water	1 gallon
Nitrate of Manganese.....	2 ozs.

Hardware Greens

Water	1 gallon
Hyposulphite of Soda	8 ozs.
Lead Acetate, Nitrate of Iron, or Nickel Sulphate	2 to 8 ozs.

Temperature 160 to 200 degrees Fahr.

French Bronze Color

Water	1 gallon
Copper Sulphate	1¼ lbs.
Chlorate of Potassium.....	1¼ "

Nickel sulphate also gives good results. Four to six ounces should be used. Temperature of solution 200 degrees Fahr. Best results are obtained upon copper or copper plated surfaces.

Ammonia Black Solution for Brass Goods

Water	2 gallons
Aqua Ammonia, 26%	1 qt.
Carbonate of Copper.....	16 ozs.
Sal Soda Crystals.....	8 "

Add the water last. Temperature 180 degrees Fahr.

Brown Colors on Brass

Water	1 gallon
Copper Sulphate	1½ lbs.
Potassium Chlorate	6 ozs.
Nickel Sulphate	3 "

Water	1 gallon
Sulphate of Copper.....	3 ozs.
Potassium Chlorate	3 "
Acetate of Copper.....	3 "
Hyposulphite of Soda.....	3 "

Water	1 gallon
Caustic Soda, 76%.....	3 ozs.
Polysulphide	2 "

Water	1 gallon
Sal Soda Crystals.....	16 ozs.
Water Ammonia	16 "
Acetate of Copper.....	16 "

Clay Yellow on Copper

Water	1 gallon
Nickel Sulphate	12 ozs.
Copper Sulphate	2 "
Chlorate of Potassium	¼ to ½ oz.

For darkened browns on copper the copper and potassium chlorate may be increased as the proportions of nickel and copper sulphate are decreased.

Use all solutions at a temperature of 160 to 200 degrees Fahr. Immerse the articles, scratch brush and repeat when necessary to obtain desired tone.

Verde Green Solutions

For copper or copper plated articles, when dark verde greens are desired, oxidize the copper surface as desired before applying the verde solution.

Tiffany Green

Water	1 gallon
Sulphate of Copper.....	8 ozs.
Sal Ammoniac	8 "
Common Salt	4 "
Chloride of Zinc.....	1 oz.

Acetate Acid, 28%.....	2 ozs.
Glycerine	1 oz.

Mix in boiling water. Apply cold by immersion or brush. Repeat as desired to obtain color.

Water	1 gallon
Copper Sulphate	8 ozs.
Sal Ammoniac	6 "
Acetic Acid	2½"
White Vinegar	6 "
Granular Rock Salt.....	6 "

Mix as above and use the same.

Verde Green to Apply with Brush to Copper, Brass, Bronze, or Oxidized Surfaces

Water, Hot	3 quarts
Muriatic Acid	1 quart
Verdigris	3 lbs.
Copper Carbonate	8 ozs.
White Arsenic Powdered.....	8 "
Sal Ammoniac	3 lbs.

Dissolve the arsenic separately in the muriatic acid by the aid of heat. Add to the water and the mix in other ingredients. All verde finishes should be lacquered and waxed to preserve the finish.

Sulphide of barium should be used in preference to sulphuret of potassium in producing rich shades of brown upon copper or copper plated articles. The same methods are pursued as in using sulphuret or polysulphide of potassium.

Flemish iron is produced upon imitation hammered iron work by coating with dead black Japalac, drying, then rubbing down with emery and a little oil. The surface is then acquired to protect against rust. This is used largely upon antique hanging lamps, old armor, etc.

Nitrate of iron gives better results in producing hardware greens upon cast brass or sheet metal goods than acetate of lead. The usual method is pursued of dissolving the nitrate of iron in hyposulphite of soda—one ounce of the iron in four to eight ounces of the soda in each gallon of water. Use hot.

In producing oxidized effects upon coffin hardware some consumers prefer the green gray tone. This is produced by using a weak solution of polysulphide of potassium to which is added a little ammonia and used only slightly warm. The articles are immersed without scratch-brushing until the green is produced.

The Old Brush or Colonial brass finish can be produced upon sheet brass goods without previous polishing in the following manner: Acid dip the goods in the reg-

ular manner and then brush them with a brass wire machine. Scratch-brush, moistening the articles with a little pumice stone and water. Then dry and lacquer in the usual manner.

When coloring up plain oxidized copper surfaces, after relieving, to produce the mottled effect, use Vienna lime on the buff. This gives a clearer color to the copper and the oxidize. Rouge compositions oxidize the relieved copper and give a reddish tinge to the black, necessitating the rewashing of the articles before lacquering. Vienna lime prevents this and the articles can be lacquered from the wheel.

The burnt brass effect upon brass-plated antique iron or other metals is produced by rubbing down with sea sand and water, then lacquering in the usual manner, then mix up burnt sienna or burnt umber with a little turpentine, linseed oil and copal varnish. The articles should dry for a short time, then be wiped out irregular to give the appearance of scouring away the burnt surface.

Imitation verde tones or any contrasting color can be produced by mixing dry colors in turpentine, using a little turpentine copal varnish, and mixing to the proper consistency and applying as stated before. These colors give opaque tones, providing too much varnish is not used. Then dry in fifteen minutes. All metals should be lacquered before applying. The colors dry into the lacquered surface, giving permanent results.

In producing dark bronze tones upon copper or copper plated articles, use in connection with the sulphuret of potassium a little sulphate of ammonia (this is a neutral salt) in the place of the water ammonia. A one-quarter ounce of the sulphuret and one-eighth ounce of the sulphate of ammonia dissolved in a gallon of cold water will be found an excellent solution for bronze tones. These bronze tones should be scratch-brushed dry with an old or very soft brush.

Brass articles when immersed in a hot solution, consisting of one-half ounce of golden sulphuret of antimony and four ounces of caustic soda in each gallon of water, become oxidized with a pleasing brown shade. This will become darker if immersed in a dilute solution of sulphate of copper, used cold about four to eight ounces to the gallon. Several immersions in the same manner give deeper brown tones; when relieved give very pleasing effects upon brass.

Polychrome Finish

This finish is being used very extensively at the present time on all types of lighting art objects, etc.

Metallized plaster casts in reproduction of ancient art metal goods are a basis for this finish in endless variety. The basic finishes are brass finished in gold lacquer, sprayed or chemically bronzed, silver, nickel and frequently gold. The latter is usually a dull semi-lustre finish.

All articles should be lacquered before the colors are applied, as the lacquer acts as a size for the colors. Colors ground in Japan dryers are the ones most used, but any type of quick-drying color can be used. Dry colors mixed to a fluid paint with French alcohol varnish make a good medium especially if some fusel oil is added to prevent too rapid drying. Such colors are usually applied with small brushes. Girls become adept in applying Polychrome finishes.

DIPS AND MATTS

It is well to note that aluminum dipping baskets cannot be used in potash solution or in muriatic or hydrofluoric acids. These chemicals dissolve aluminum very rapidly, while the strong mineral acids, such as sulphuric or nitric acids, have no perceptible action upon the metal.

To produce the matt surface upon articles made up from aluminum, first wash in benzine or gasoline, then immerse momentarily in a warm potash solution, then rewash and immerse in clear aqua fortis. This removes the oxide formed in the potash and leaves the metal clear and white.

In bright dipping small articles that would not pay to wire up, use aluminum dipping baskets with as large a mesh as possible. You will find that this is a money saver in acid in the course of a year. The acid has very little, if any, action upon the baskets. The acid runs away from the baskets more readily on account of the many exits furnished by the mesh.

Hydrofluoric acid pickles used in removing fire scale or sand from iron or brass castings when in use for some time, can have their action considerably increased by adding 2 or 4 ounces of sulphuric acid to each gallon of solution. This is also permissible when preparing new pickles. The small amount of free acid added produces a greater action upon the surface of the articles to be cleansed.

It is sometimes found difficult to produce a very bright luster upon sheet brass goods, even when the articles have been previously immersed in the regular aqua fortis firing off dip. This may be due to the composition of the metal. In such a case after the usual bright dip, re-

immerse in the hot potash cleaning bath for a few seconds, then remove and allow to drain well. Do not wash in cold water as customary. Then plunge in the bright dip and remove as rapidly as possible, wash and dry out in the usual manner, a clear bright luster will result.

The best method to pursue in neutralizing the free acid in the pores of iron castings after pickling in hydrofluoric acid or any other acid, is to prepare a warm bath of commercial sulphate of ammonia. See that the articles are boiled out well in boiling water. They should then be immersed in the sulphate of ammonia solution for ten or fifteen minutes. This method will give a more satisfactory deposit especially when nickeling iron. Always add a little sal soda to the water in which iron or steel articles are immersed after cleaning or scouring while waiting for plating, this prevents oxidation.

Bright acid dips according to most text book formulas should be prepared in the proportion of one part sulphuric acid to half part aqua fortis. These proportions work very well after the bright dip has been working for some time and needs replenishing. But such a dip when newly prepared according to the proportion mentioned produces an Ormolu tone to the surface. Bright dips for brass gives better results when prepared from the following proportions:

Oil of Vitriol	1 gallon
Aqua Fortis	1 "
Muriatic Acid	½ oz.
Water	1 qt.

For gilding metal, copper, or low brass two parts of aqua fortis to one part oil of vitriol should be used by measure, then add the muriatic acid and water in the proportion mentioned.

Always remove fire scale from copper, bronze or brass before bright acid dipping. Solution commonly used is:

Water	1 gallon
Sulphuric Acid, 66%.....	10 ozs.
Bichromate of Soda.....	1 oz.

Temperature 120 to 140 degrees Fahr.

To preserve the action of the bright acid dip, after removing the fire scale, dip the copper, bronze or brass articles in a nitric acid dip for a moment. Then dip directly in the bright dip.

Nitric Acid, 38%.....	1 gallon
Calcined Soot	½ oz.

To remove fire scale from iron or steel, without sulphuric acid or muriatic, use crude sodium bisulphate.

Water	1 gallon
Crude Sodium Bisulphate.....	1½ to 2 lbs.

Temperature 200 degrees Fahr.

Iron or steel can be electrically pickled with the same solution.

Use lead-lined tanks with burned in seams and anodes of heavy plate iron (the steel parts to be pickled becoming the cathodes). Use 10 volts and a high current. The scale will be removed instantly. Connect the positive current to the iron anodes. Carbon can be used. Temperature 180 degrees Fahr.

Paints or enamels as well as japans and lacquers can be removed from metal surfaces almost instantly in the same manner, i. e., electrically. Iron tanks should be used. The positive current should be connected directly to the iron tank. The articles from which the paints or enamels are to be removed become the cathodes. Use a voltage of 6 to 10 with a high current.

Water	1 gallon
Caustic Soda	6 to 8 ozs.
Soda Ash	6 to 8 "

Ormolu dips for brass should be prepared as follows: Add all the oxide of zinc nitric acid 38 degrees will take up. It should have the appearance of a heavy white wash solution. Heat up the mixture by surrounding the receptacle with hot water. Then add sulphuric acid to regulate the matt finish.

Sulphuric acid in excess gives a velvet matt, so by varying the amount of sulphuric acid, coarse or fine matt finish will result. All brass articles should be bright acid dipped before matt dipping. After matt dipping and water washing use a dilute sodium cyanide dip to remove acid stains and even up the color.

Water	1 gallon
Sodium Cyanide, 96-98%	2 to 4 ozs.

Dip for removing Fire Scale from Sterling Silver

Water	1 gallon
Sulphuric Acid, 66%	1 pint
Bichromate of Soda	2 ozs.

Temperature 180 degrees Fahr.

To prevent fire scale in annealing sterling silver use 25% sodium cyanide, 25% common salt and 50% soda ash. It will be found that as low as 10% sodium cyanide will do, increasing the other parts proportionately.

Heat in a cast iron or steel pot to 1250 deg. Fahr. Immerse the silver until it becomes cherry red. Then quench in water. The silver will be uniformly heated and all danger of fire scale eliminated.

Electro Strip for Gold

Water	1 gallon
Sodium Cyanide, 96-98%.....	5 ozs.
Yellow Prussiate of Potash or Soda..	4 "

The articles to be stripped should be the anodes.

Cathodes should be of sheet carbon. The action is just the reverse from plating. Use a hot solution with a strong current at 4 to 6 volts. Keep the articles agitated while stripping.

A similar method can be used for stripping plated deposits from articles that have failed. Nickel, copper, brass and silver may be readily stripped from any base metal in the following solution:

Sulphuric Acid, 66°.....	1 gallon
Water	1 pint
Glycerine	1 oz.

The articles to be stripped become the anodes. Cathodes may be of carbon, lead or copper.

Acid Strip for Nickel Deposit Upon Copper, Brass or Bronze

Sulphuric Acid, 66%.....	1 gallon
Nitric Acid, 38%.....	1 quart
Water	½ pint

Heat the solution. Avoid an excess of water. If the brass, etc., is rough after nickel is removed, add more sulphuric acid until the brass becomes smooth.

If the dip works slowly add small proportions of nitric acid. Small iron castings that have foundry sand burnt in them should be pickled by tumbling in a wooden oblique tumbling barrel. A solution of

Water	1 gallon
Hydrofluoric Acid	1 pint

will be found effective.

For removing oxide or scale from small articles of iron or steel tumble in a solution of

Water	1 gallon
Crude Sodium Bisulphate	8 ozs.

To cleanse and brighten small steel articles tumble in a solution of

Water	1 gallon
Soda Ash, 58%.....	2 to 4 ozs.
Sodium Cyanide, 96-98%.....	⅛ to ¼ oz.

To remove burs and rough edges, use boiler ashes and a little ash and water. Tumble until removed. For bright finish follow up after drying out with macerated leather to which is added a little Vienna lime.

Brass, copper or bronze articles may be tumbled in macerated leather and Vienna lime, or ball burnished, using neutral borax soap chips as a lubricant. Sodium acid phosphite is used to replace cream of tartar in tumbling operations.

Chemical, Commercial and Common Names of Chemicals Used in Dipping, Plating and Coloring of Metals

A good deal of confusion often exists because of the indiscriminate use of the chemical, commercial and common names of substances in formulæ for dipping, plating, coloring, and lacquering of metals. Often in my own experience, when experimenting with various formulæ, both native and foreign, the terms given have been somewhat confusing and required a search.

ACIDS AND ACID COMPOUNDS

Acetic Acid. $\text{HC}_2\text{H}_3\text{O}_2$; hydrogen acetate, acid of vinegar.

Acid Phosphate. $\text{CaH}_4(\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$; soluble acid phosphate; super-phosphate of lime.

Amyl Acetate. $\text{CH}_3\text{CO}_2\text{C}_5\text{H}_{11}$; banana oil.

Amyl Nitrite. $\text{NO}_2\text{C}_5\text{H}_{11}$; isoamyl nitrite.

Amyl Valerianate. $\text{C}_6\text{H}_9\text{CO}_2\text{C}_5\text{H}_{11}$; apple oil; amyl valeriate.

Benzoic Acid. $\text{C}_6\text{H}_5\text{CO}_2\text{H}$; acid plenylformic.

Boracic Acid. H_3BO_3 ; boric acid; hydrogen borate.

Carbolic Acid. $\text{C}_6\text{H}_5\text{OH}$; phenol; phenic acid; phenylic acid.

Carbonic Acid. H_2CO_3 ; hydrogen carbonate.

Chromic Acid. CrO_3 ; anhydrous chromic acid; chromium trioxide.

Citric acid. $(\text{CO}_2\text{HCH}_2)_2\text{C}(\text{OH})\text{CO}_2\text{H}$; acid of lemons.

Formic Acid. HCOOH .

Hydrocyanic Acid. HCN ; prussic acid.

Hydrofluoric Acid. HF ; fluoride of hydrogen.

Gallic Acid. $\text{C}_6\text{H}_2(\text{OH})_3\text{CO}_2\text{H} \cdot \text{H}_2\text{O}$; tryoxybenzoic acid.

Lactic Acid. $\text{CH}_3\text{CHOHCOOH}$; acid of milk.

Malic Acid. $\text{COOHCH}_2\text{CH}(\text{OH})\text{COOH}$; apple acid, oxysuccinic acid.

Nitric Acid. HNO_3 ; aqua fortis.

Nitro-Hydrochloric Acid. Aqua Regia; nitromuriatic acid. (Solvent for gold and platinum.)

Oxalic Acid. $\text{H}_2\text{C}_2\text{O}_4$; hydrogen oxalate.

Phosphoric Acid. H_3PO_4 ; ortho-phosphoric acid.

Glacial Phosphoric Acid. HPO_3 .

Plumbic Acid, Anhydrous. PbO_2 ; lead dioxide; lead peroxide; lead superoxide.

Pyrogallic Acid. $\text{C}_6\text{H}_3(\text{OH})_3$; pyrogallol.

Salicylic Acid. $\text{C}_6\text{H}_4(\text{OH})(\text{COOH})$; ortho-hydroxybenzoic acid.

Selenous Acid. H_2SeO_3 ; selenious acid.

Stearic Acid. $(\text{CH}_3\text{CH}_2)_{16}\text{CO}_2\text{H}$; stearinic acid; acid cetylacetic.

Sulphuric Acid. H_2SO_4 ; oil of vitriol; vitriolic acid.

Sulphurous Acid. H_2SO_3 .

Tartaric Acid. $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$; acid of tartar; dextrotartaric acid.

ALCOHOLS

Alcohol. C_2H_5OH ; ethyl alcohol; ethyl hydrate; spirits of wine.

Amyl Alcohol. $CH_3CH_2CH_2CH_2OH$; fusel oil, potato oil; potato spirit; grain oil.

Methyl Alcohol. CH_3OH ; wood alcohol; wood naphtha; wood spirit.

ALCOHOL SOLVENTS

Benzine. Petroleum ether.

Benzene. C_6H_6 ; benzol.

Solvent Naphtha. 160° benzol.

Sulphuric Ether. $(C_2H_5)_2O$; ether.

Bisulphide of Carbon. CS_2 .

ALUMS

Alum. $Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$; sulphate of aluminum and potassium.

Ammonia Alum. $Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$; sulphate of aluminum and ammonium.

Burnt Alum. Dried alum; aluminum-potassium sulphate calcined.

Chrome Alum. $K_2(SO_4) \cdot CrSO_4 \cdot 24H_2O$; double sulphate of chromium and potassium.

Roach Alum. Roman alum; red alum.

Soda Alum. $Al_2Na_2(SO_4)_4 \cdot 24H_2O$; sulphate of aluminum and sodium.

ALUMINUM COMPOUNDS

Aluminum Chloride. (a) $Al_2Cl_6 \cdot 12H_2O$; (b) Al_2Cl_6 .

Aluminum Hydrate. $Al(OH)_3$; aluminum hydroxide; hydrated alumina.

Aluminum Nitrate. $Al(NO_3)_3$; nitrate of alumina.

Aluminum Oxide. Al_2O_3 ; alumina (emery and corundum are varieties of the oxide).

Aluminum Sodium Fluoride. $3NaF \cdot AlF_3$; cryolite.

Aluminum Sulphate. $Al_2(SO_4)_3$.

AMMONIUM COMPOUNDS

Ammonia, Solution of. NH_4OH ; ammonia; ammonia water; ammonium hydrate; spirits of hartshorn.

Ammonium Acetate. $NH_4(C_2H_3O_2)$.

Ammonium Arseniate. $(NH_4)_3AsO_4$.

Ammonium Benzoate. $(NH_4)C_7H_5O_2$.

Ammonium Bromide. $(NH_4)Br$.

Ammonium Carbonate. $(NH_4)_2CO_3$; neutral carbonate of ammonia; volatile salt.

Ammonium Bicarbonate. NH_4HCO_3 ; acid carbonate of ammonia; ammonium-hydrogen carbonate.

Ammonium Chloride. NH_4Cl ; sal ammoniac, muriate of ammonia.

Ammonium Citrate. $(NH_4)_3C_6H_5O_7$.

Ammonium Nitrate. NH_4NO_3 .

Ammonium Oxalate. $(NH_4)_2C_2O_4 \cdot H_2O$.

Ammonium Phosphate. $(NH_4)_3PO_4$; ammonium di-phosphate.

Ammonium Sulphate. $(NH_4)_2SO_4$.

Ammonium Sulphide. $(\text{NH}_4)_2\text{S}$; sulphuret of ammonia.

Ammonium Sulphydrate. $(\text{NH}_4)\text{HS}$; hydrosulphide of ammonia; ammonium and hydrogen sulphide.

Ammonium Sulphocyanide. NH_4SCN ; ammonium sulphocyanate.

Ammonium Tartrate. $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$.

Ammonium Valerianate. $\text{NH}_4\text{C}_5\text{H}_9\text{O}_4$.

ANTIMONY AND ITS COMPOUNDS

Antimony, Metallic. Sb; regulus of antimony.

Antimony, Butter of. SbCl_3 ; antimony trichloride; chloride of antimony.

Antimony Glass. Sb_2O_3 ; Sb_2O_4 ; Sb_2O_5 ; vitrified antimony; gray oxide of antimony; vitrified oxide of antimony.

Antimony Pentasulphide. Sb_2S_5 ; antimony sulphide.

Antimony, Red. Sb_2S_3 ; crocus of antimony.

Antimony Tartrated. $\text{K}(\text{SbO})\text{C}_4\text{H}_4\text{O}_6$; tartar emetic; antimony-potassium tartrate.

ARSENIC AND ITS COMPOUNDS

Arsenous Acid. As_2O_3 ; white arsenic, arsenous anhydride.

Arsenic Disulphide. As_2S_2 ; realgar; red orpiment; ruby arsenic; red arsenic glass.

Arsenic Fluoride. AsF_3 ; arsenic trifluoride.

Arsenic Pentasulphide. As_2S_5 ; persulphuret of arsenic.

Arsenic Trichloride. AsCl_3 chloride of arsenic.

Arsenic Trisulphide. As_2S_3 ; yellow orpiment; yellow sulphide of arsenic; king's yellow.

BARIUM COMPOUNDS

Very few of these compounds are used in electroplating. They consist of the acetate, arsenate, bromide, carbonate, chloride, chlorate, ferro-cyanide, hydrate, iodide, nitrate, oxalate, monoxide, phosphate and sulphate.

Barium Sulphide. BaS , is the only compound in general use. Sulphide of barium, barium mono-sulphide, baric sulphide.

CALCIUM COMPOUNDS

Calcium Carbonate. CaCO_3 ; chalk; limestone; marble; calcite; calc spar.

Calcium Chloride. CaCl_2 ; muriate of lime.

Calcium Hypochlorite. $\text{Ca}(\text{ClO})_2 \cdot 4\text{H}_2\text{O}$; bleaching powder.

Calcium Hydrate. $\text{Ca}(\text{OH})_2$; slaked lime.

Calcium Oxide. CaO ; quicklime.

Calcium Sulphate. CaSO_4 ; plaster of paris; gypsum.

There are many other calcium compounds, but they have no connection with plating.

COBALT COMPOUNDS

- Cobalt Chloride. CoCl_3 (cobaltic); CoCl_2 (cobaltous).
 Cobalt Cyanide. $\text{Co}(\text{CN})_2$.
 Cobalt Nitrate. $\text{Co}(\text{NO}_3)_2$.
 Cobalt Sulphate. CoSO_4 .
 Cobalt Ammonium Sulphate. $\text{CoSO}_4(\text{NH}_4)_2\text{SO}_4 + 6\text{H}_2\text{O}$.

COPPER COMPOUNDS

- Copper Acetate. $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$; crystallized verdigris; neutral or normal acetate of copper.
 Copper Arsenite. CuHAsO_3 ; Scheele's Green.
 Copper Carbonate. $\text{Cu}_2(\text{OH})_2\text{CO}_3$; dicupric carbonate of copper; green copper carbonate; Brunswick green.
 Copper Chloride. CuCl_2 ; cupric chloride; neutral chloride of copper.
 Copper Cyanide. $\text{Cu}(\text{CN})$.
 Copper Nitrate. $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$; cupric nitrate.
 Copper Oxide. Cu_2O ; red oxide of copper; suboxide.
 Copper Sulphate. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$; blue vitriol; blue stone; blue copperas; Roman vitriol.
 Cupric Oxide. CuO ; oxide of copper, black oxide of copper.

GOLD COMPOUNDS

- Gold Chloride. AuCl ; aurous chloride; gold monochloride.
 Gold Cyanide. $\text{KAu}(\text{CN})_2$; gold-potassium cyanide; potassium cyanaurate.
 Gold Fulminate. $\text{Au}(\text{HN})\text{NH}_2 \cdot 3\text{H}_2\text{O}$; auroamidoimide; a precipitate from chloride by ammonia.
 Gold Monoxide. Au_2O ; aurous oxide.

IRON COMPOUNDS

There are a great variety of iron compounds; many of them of no interest to the electroplater.

Citrate of Iron and Ammonia. Ammonio-ferric citrate.

Chloride of Iron. FeCl_3 ; Ferric chloride; perchloride of iron; permuriate of iron; sesquichloride of iron.

Ferric Ferrocyanide. $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$; prussian blue; ferrocyanide of iron.

Ferric Hydrate. $\text{Fe}(\text{OH})_3$ hydrated oxide of iron; moist peroxide of iron.

Ferroso-Ferric Oxide. $\text{FeO} \cdot \text{Fe}_2\text{O}_3$; magnetic oxide of iron.

Ferrous Ammonium Sulphate. $\text{Fe}(\text{SO}_4) \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$; Mohr's Salt.

Oxide of Iron. Fe_2O_3 ; Ferric oxide; iron peroxide; red oxide of iron; rouge; Indian red.

Sulphate of Iron. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$; green copperas; green vitriol.

LEAD COMPOUNDS

Lead Acetate. $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{PbO} \cdot \text{H}_2\text{O}$; sugar of lead; plumbic acetate.

Lead Carbonate. $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$; white lead.

Lead Oxide. PbO ; litharge, yellow oxide of lead; lead monoxide.

Lead Cyanide. $\text{Pb}(\text{CN})_2$.

Lead Silicate. PbSiO_3 .

Lead Fluoride. PbF_2 .

Lead Fluoborate. $\text{Pb}(\text{BF}_4)_2$.

Lead Sulphate. PbSO_4 .

MAGNESIUM COMPOUNDS

Magnesium Carbonate. MgCO_3 .

Magnesium Chloride. $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$.

Magnesium Oxide. MgO ; Calcined magnesia.

Magnesium Sulphate. MgSO_4 ; Epsom salt; cathartic salt.

MANGANESE COMPOUNDS

Manganese Acetate. $\text{Mn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$.

Manganese Carbonate. MnCO_3 .

Manganese Dioxide. MnO_2 ; black oxide.

Permanganate of Potassium. KMnO_4 ; permanganate of potash.

Permanganic Acid. HMnO_4 ; hydrogen permanganate.

MERCURY COMPOUNDS (QUICKSILVER)

There are a large number of mercury compounds. I give only those of interest to the plater.

Mercuric Chloride. HgCl_2 ; corrosive sublimate; bichloride of mercury; perchloride of mercury.

Mercuric Cyanide. $\text{Hg}(\text{CN})_2$; cyanide of mercury; bichloride of mercury; prussiate of mercury.

Mercurous Nitrate. HgNO_3 ; subnitrate of mercury.

Mercuric Oxide. HgO ; red precipitate.

Mercuric Sulphide. HgS ; vermilion; red sulphide of mercury; cinnabar.

NICKEL COMPOUNDS

Nickel Cyanide. $\text{Ni}(\text{CN})_2 \cdot 4\text{H}_2\text{O}$; single cyanide of nickel.

Nickel Sodium Cyanide. $\text{Ni}(\text{CN})_2 \cdot \text{NaCN}$; double cyanide of nickel.

Nickel Acetate. $\text{Ni}(\text{C}_2\text{H}_3\text{O}_2)_3$.

Nickel Carbonate. NiCO_3 .

Nickel Chloride. NiCl_2 .

Nickel Fluoride. NiF_2 .

Nickel Fluoride Ammonia. $5\text{NiF}_2 \cdot 6\text{NH}_3 + 8\text{H}_2\text{O}$.

Nickel Hydrate. $\text{Ni}(\text{OH})_3$; nickelic hydrate.

Nickel Oxalate. $\text{Ni}(\text{C}_4\text{H}_4\text{O}_6)_2$.

Nickel Oxide. Ni_2O_3 ; peroxide of nickel; sesquioxide of nickel.

Nickel Ammonium Sulphate. $\text{NiSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$; double salts.

Nickel Sulphate. $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$; single salts.

Nickel and Potassium Sulphate. Double sulphate of nickel and potassium.

PITCH COMPOUNDS

Pitch. Black pitch; boiled pitch; stone pitch; wood pitch.

Burgundy Pitch. White pitch; Burgundy resin.

Canada Pitch. Hemlock gum; hemlock pitch.

Mineral Pitch. Asphaltum; bitumen.

PLATINUM

Platinic Chloride. PtCl_4 ; chloride of platinum; perchloride of platinum; tetra-chloride of platinum.

Platinum Ammonium Chloride. $\text{PtCl}_2 \cdot 2\text{NH}_4\text{Cl}$; ammonium chloro-platinate.

Platinum Hydrate. $\text{Pt}(\text{OH})_4$.

PLUMBAGO

Graphite. C+impurities; black lead.

POTASSIUM COMPOUNDS

Potassium Acetate. $\text{KC}_2\text{H}_3\text{O}_2$; acetate of potash; diuretic salt.

Potassium Carbonate. K_2CO_3 ; salt of tartar (pearl-ash impure).

Potassium Bicarbonate. KHCO_3 ; potassium hydrogen carbonate; acid potassium carbonate.

Potassium Cyanide. KCN ; cyanide of potash.

Potassium Ferricyanide. $\text{K}_3\text{Fe}(\text{CN})_6$; red prussiate of potash.

Potassium Ferrocyanide. $\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$; yellow prussiate of potash; ferro-prussiate of potash.

Potassium Hydrate. KOH ; caustic potash; hydrated oxide of potash.

Potassium Nitrate. KNO_3 ; nitrate of potash; saltpeter.

Potassium Binoxalate. KHC_2O_4 ; salt of sorrel; essential salt of lemons.

Potassium Sulphate. K_2SO_4 ; normal potassium sulphate; vitriolated tartar.

Potassium Bisulphate. KHSO_4 ; potassium hydrogen sulphate; acid potassium sulphate; bisulphate of potash.

Potassium Sulphocyanide. KCNS .

Potassium Tartrate. $\text{K}_2\text{C}_4\text{H}_4\text{O}_6$; soluble tartrate; neutral tartrate; tartrate of potash.

Potassium Bitartrate. $\text{KHC}_4\text{H}_4\text{O}_6$; (argols impure); cream of tartar; crystals of tartar; acid tartrate of potassium.

SILVER COMPOUNDS

Silver Chloride. AgCl .

Silver Cyanide. AgCN .

Silver Nitrate. AgNO_3 ; lunar caustic.

Silver Oxide. Ag_2O .

Silver Sulphide. Ag_2S ; sulphuret of silver.

SODIUM COMPOUNDS

Sodium Carbonate. Na_2CO_3 ; sal soda; soda crystals; washing soda.

Sodium Bicarbonate. NaHCO_3 ; sodium hydrogen carbonate.

Sodium Chloride. NaCl ; common salt; marine salt; muriate of soda.

Sodium Fluoride. NaF .

Sodium Hydroxide. NaOH ; caustic soda; hydrate of soda.

Sodium Hyposulphite. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$; hypo; sodium thiosulphate.

Sodium Nitrate. NaNO_3 cubic niter; Chilian salt-peter.

Sodium Nitrite. NaNO_2 .

Sodium Phosphate. Na_3PO_4 ; tribasic phosphate of soda; tasteless salt; ortho-phosphate of soda.

Sodium Acid Phosphate. Na_2HPO_4 (dibasic); NaH_2PO_4 (monobasic).

Sodium Pyrophosphate. $\text{Na}_4\text{P}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$.

Sodium Silicate. Na_2SiO_3 ; water glass; soluble glass.

Sodium Sulphate. Na_2SO_4 ; Glauber's salt.

Sodium Acid Sulphate. NaHSO_4 ; nitre cake; bisulphate of sodium.

Sodium Sulphite. Na_2SO_3 .

Sodium and Potassium Tartrate. Rochelle salts.

SULPHUR COMPOUNDS

Liver of Sulphur. Mixture of potassium polysulphides with potassium sulphate.

Precipitated Sulphur. Milk of sulphur.

Sodium Polysulphides. Na_2S_2 ; Na_2S_3 ; $\text{Na}_2\text{S}_4 \cdot 6\text{H}_2\text{O}$; $\text{Na}_2\text{S}_5 \cdot 6\text{H}_2\text{O}$.

Sodium Sulphocyanide. NaCNS .

Potassium Sulphocyanide. KCNS .

Ammonium Sulphocyanide. NH_4SCN . Used in oxidizing and black nickels.

TIN COMPOUNDS

Stannic Acid. H_2SnO_3 ; precipitated as a white powder.

Stannic Chloride. SnCl_4 ; bichloride or perchloride of tin.

Stannic Oxide. SnO_2 ; mineral cassiterite; tin stone; flowers of tin.

Stannic Sulphide. Sn_2S_3 ; used in bronze powders.

Stannous Chloride. $\text{SnCl}_2 + 2\text{H}_2\text{O}$; tin salt; tin chloride.

Stannous Sulphide. SnS ; sepia powder.

Stannous Oxide. SnO ; tin oxide.

ZINC COMPOUNDS

Zinc Carbonate. ZnCO_3 ; white powder.

Zinc Chloride. $\text{ZnCl}_2 + \text{H}_2\text{O}$; muriate of zinc.

Zinc Cyanide. $\text{Zn}(\text{CN})_2$.

Zinc Oxide. ZnO ; zinc white.

Zinc Sulphate. $\text{ZnSO}_4 + 7\text{H}_2\text{O}$; white vitriol.

Zinc Sulphide. ZnS ; zinc blende.

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