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SOME NOTES ON PHOTOGRAPHY ON METAL PLATES

in January 1850

By the Baron Gros (J. B.-Louis)

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Work illustrated.

NOTES ON METAL PLATE PHOTOGRAPHY

Working for several years with photographic processes and with the electro-chemical part that goes with them, as for example the application of a layer of chemically pure silver on coated plates that already have been used to make prints or which are of poor quality, I was struck by the lack of precision in the explanations in some of the works I consulted; and because I know from experience that he who wants to learn is happy when no detail is left out, I thought that, if I would speak of the attempts I have made, I would be sure not to be vague, relying especially on numbers, dimensions, weights and on the thousand small things that are often neglected/disregarded. One will understand then why I will explain, perhaps too much, in the notes that follow, many things that seem easy to guess or grasp. I only write them, moreover, in response to those who have pressed me on this subject.

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They assure me that I could perhaps be useful to several amateurs, and especially the merchants, who prefer a kind of practical and very detailed manual to uncertain theories that I could not even give them. If it were not so, I would have at least stated the status of photography on metal plates in January 1850. Is it not easy to predict that soon it will have run its course, and its rival on paper is bound to replace it one day because of its incontestable advantages. The above was in some way the preface to the first edition of this brochure, which M. Roret advertised the same day, I believe, that I was ordered to go to Toulon and left for Athens. I could not forget to include in my luggage a complete apparatus and during the fifteen or twenty days I was in Greece, I fixed on metal the admirable monuments of the Acropolis.

The plates made by the processes that these notes describe, are, according to the amateurs and artists to whom I was happy to show them, vigorous and limpid, which encouraged me to recommend again to those occupied with photography, these same processes, that M. Roret asks me today to describe a second time.

Saint-Germain-en-Laye, 15 juillet 1850

ABOUT THE PLATES

[p. 3]

Everyone knows how difficult it is to find good coated plates [doublé], and it is almost impossible to make a passable proof on those that have already been used several times, especially if they have been passed through gold chloride. Also, for more than four years, I have decided to silver my plates electro-chemically. I found two real advantages in following this method; the first was to utilize a large number of plates, which I could no longer use, and the second was to obtain in my preparations a greater sensitivity to the sun's rays.

Here are two experiments that I often repeated and which always gave me the same results. I took a new coated plate [doublé], as nice as possible, silvered half of it using the battery. I polished the

entire plate, as usual, and already, after this first preparation, I realized that the silvered half appeared blacker and deeper than the side that was not. I had the plate absorb iodine and bromine necessarily under the same conditions; I made a proof

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with it, and the side with the galvanized coating was sharper, warmer and more harmonious than the other side. Here is the second experiment: a proof likewise made with a plate prepared like the above, gave me the following results: the bare side came out well and could have been considered a rather good proof, the silvered side was overexposed and we can conclude that it had received too much light.

Everyone will conclude from these two facts, rather often repeated, the same conclusions as me: The sensitive layer put on top of the chemically pure silver, is better than the one prepared on the coated plate. To these advantages there is a third since M. Rochaz, of Lyon, had the good idea to lightly silver his plates for every proof he made. It is evident that to proceed as he counseled, one always works under almost identical conditions, which in photography is an incontestable tool. Now, I only use my old plates, and if I have to buy new ones, I buy the least expensive, and I would immerse them in a silver bath, even before making the first proof.

POLISHING THE PLATES THAT ONE WANTS TO SILVER

[p. 5]

Remove the image, as usual, with crumbled earth [rotten stone] or porphyritic pumice stone, and oil of pétrole acidulée [acidulated solution?] if the plate has been passed through gold chloride, or with alcohol mixed with 1/15 ammonia in volume and a little less of sulphuric ether, if it was not fixed; but before giving it the final polish, dry it well with the powders used in photography and cotton or polishers. Then, put it on top of the iodide box, and let it take on a violet or blue tint. If the image was not completely erased, it will re-appear at several points. Otherwise, you will not perceive any trace. Polish it again, if required, or take off only the iodide layer, then burnish the plate completely as if you wanted to use it to make a proof; but carefully clean the edges and the small holes made by the stylus [poinçon] because the dust particles or the bumps there will disturb the electric current in the bath, and you will see formed behind them and always perpendicularly, from top to bottom, dark lines where the silver

[p. 6]

will not be deposited, and which will be lighter the further it is away from the obstacle that produced them. The process with iodine is all the more reason indispensable, because if you immerse a plate whose image has been badly removed/ effaced into the metallic bath, it will reappear when the silver will have acquired a certain thickness; and it will be necessary to remove it again and consequently lose both time and metal. It is useless to silver a plate whose old silver is pierced or cracked, so that the copper is visible and that slight cavities are formed. The plate would probably whiten out; the print that one would make on top of it would come out, but the holes, the scratches, the fissures would never disappear, and would be like so many imperfections that would spoil the ensemble of the image. One could again have the copper plates planed perfectly, on which one could then place a layer of silver ; this is an attempt I have not made, but these plates are made in M. Christofle's atelier, and those that were given to me to try, gave me very beautiful images.

VARNISH USED TO PREVENT THE SILVER FROM SETTLING ON THE BACK OF THE PLATES

If a coated plate was immersed in the bath, without the copper side being protected from any contact with it, it is evident that it will be silvered on both sides, and that one would thus spend twice what is necessary. Therefore one must cover the backs of the plates with a coating that can not be attacked by cyanides, and so, consequently, will not be altered. Here is one of them, I think, that brings together more or less these qualities and which withstood, at least for a certain time, the tests that I made. Take Vernis copal [copal is a resin made from tropical trees], which is sold under this name by all those who sell colors, pour it into a small cup, a quantity equal to about a glass of Bordeaux wine. With a flat brush crush two trochisques [cone-shapes containing medicines: one lights the end to make fumigations] of lead chromate, each the size of a unshelled hazelnut, into the varnish. The varnish will become a little thicker than it was and will yellow. With your flat brush, apply a coating on the back of the plate, absolutely like you were varnishing a picture, but not completely to the edges. Put the plate on a completely horizontal table, and let it dry for twenty-four hours. At the end of this time, the varnish can be immersed in the bath. It is useless to take off the varnish after having made an image. It can be fixed in gold chloride, as if the plate was bare, and often I have passed the same plate two or three times in the chloride and after silvered it fifteen or twenty times, without touching this layer of varnish. It will alter quickly only if it was in contact with the silver bath before being completely dry. If you want it to harden in just a short time, heat the plate with the flame of an ethanol lamp [esprit-de-vin], just after you have varnished it; the heat will quickly enflame the copal; put it out immediately and put the plate on a horizontal surface. You may put the plate in the bath when touching the varnish leaves no trace.

HOLES TO MAKE IN THE PLATE, TO SUSPEND IT IN THE BATH

p. 9:

Whatever the size of the plate, make small holes in three of its angles. The bodkin/needle or drill you will use, should be pressed into the side intended to receive the silver, so that the copper burrs, pushed out by this bodkin, are on the other side; remove these burrs with a soft file.

The three small holes, of about a millimeter in diameter, are indispensable not only to suspend the plate lengthwise and widthwise in the bath, but also keep it in a position parallel to the soluble anode, opposite to which it will be placed. If it was held only by one point, the plate may pivot at the least impulse of the liquid, and the side that comes closest to the anode will have a coating of silver thicker than the side which is further away.

To summarize, whether your plate is new or old, smooth down the edges to facilitate the action of the polishers; [p. 10 Flatten the four angles so that they fit under the knobs of the polishing board;

Make a hole in three of these angles and in the center of the small flat area that you have just made there;

File down the burrs of these holes;

Varnish the copper side, and let it dry well;

Remove the image, if there is one, and polish the plate as carefully as if you were going to make a proof.

The plate will then be ready to be put into the metal bath, and I will say later how it is to be placed. I will again speak of this plate, after having received a layer of silver that will give it a beautiful creamy white color, it has to be prepared so that it can easily absorb the substances that make it sensitive to the sun.

PREPARATION OF THE SILVER BATH

p. 11

The doses that I will give here will make a liter of liquid into which to immerse the plates to be silvered. These doses consequently will be doubled if two liters are desired, and so on.

In a chimney with a good draw, or outdoors, place an ordinary basin, like those used to wash hands, for example, and at the bottom of this basin a small tripod high enough to support a glass sphere above an ethanol lamp.

In this glass sphere, which should be ten or twelve centimeters in diameter, put ten grams of pure silver, granulated or wire, cut into very small pieces. Pour onto this silver forty grams of pure nitric acid. Place the sphere on the tripod and light the lamp underneath, taking care, at the beginning to not make the flame too intense, which could burst the sphere. The basin, moreover, is only there to collect the silver liquid, if such an accident happens. The sphere fills immediately with reddish vapors, dangerous to breathe, [p. 12 and which is given off in abundance. The acid quickly will begin to boil; so turn up the flame a little and let the acid boil for half an hour or forty-five minutes, the time necessary for the ten grams of silver to be completely dissolved; which will be all the more faster if the silver will have been reduced or cut into smaller pieces, and if you stirred the acid more frequently, by lifting the sphere by neck and give it a slight movement of rotation. The vapors that will be emitted at this moment will be almost colorless and not plentiful, and no trace of silver will appear in the liquid. Pour what is in the sphere into one of these small porcelain beakers from Bayeux and put that over the flame of the lamp, the same place where the sphere was, so as to make all of the liquid that has just formed evaporate. This operation is almost as long as the first. Little by little the solution thickens, white crystals appear on the edges, and a film forms on the surface. After all evaporation has stopped, there remains at the bottom of the capsule 12 or 15 grams of white salt of disordered crystals (unclear?), which is nothing else than silver nitrate; but, during this second operation, what is in the capsule has to be stirred constantly with a glass stick, even when the salt is no longer giving off any vapor. This precaution is indispensable to block the silver nitrate from settling at the bottom, and from taking on a slate-grey color which would become a dark black. It goes without saying that one must avoid touching the silver nitrate with his fingers, or let it fall on any cloth [p. 13 because it will stain indelibly all organic substances.

If the silver that was dissolved is pure, no green color will be produced during the evaporation of the liquid; if, on the other hand, which almost always happens, this silver contains copper, one will see the crystals that begin to form produce a very pronounced green-grey, but which will disappear more or less when the salt will have lost all of its humidity.

There are, therefore, two eventualities to expect in this operation and I do not react the same way in each of these.

If the silver is pure, if I do not perceive any green color which signals the presence of copper, I melt the 12 or 15 grams of silver nitrate in a half-liter of distilled water, in a rather large bottle corked with emery, and I dissolve at the same time, in another bottle that also contains a half-liter of distilled water, 10 grams of white cyanide of potassium for every gram of pure silver that I converted into nitrate, that is 100 grams, since there were 10 grams of silver that were reduced by the nitric acid.

The 15 grams of silver nitrate are almost instantaneously dissolved in the half liter of distilled water, the 100 grams of potassium cyanide will also quickly melt in the other

half liter of water, which takes on a dirty brown color; pour a small amount, a half glass for example, of the potassium cyanide solution in the silver nitrate solution. This latter, which was clear and limpid, except perhaps having a slight milky appearance, immediately fills with numerous, large white flakes; one must briskly stir the bottle/flask that holds them, [p. 14 continually adding little by little the rest of the cyanide water; the white precipitate soon diminishes and disappears when the two half liters of the different solutions are mixed together. However, if the precipitate was not completely dissolved after this mixture, one must add directly into the liquid some grams of potassium cyanide, and stir until it is dissolved and there are no longer any white or brown flakes at the bottom of the vase; then one filters with paper, and one obtains a liter of a liquid perfectly limpid, light yellow-gold in color and ready to be used; it is a liter of silver bath composed of a double cyanure from this metal and potassium.

Assuming the second hypothesis, that where the silver contains copper, whose presence will be evident by the green color of the salt and the liquid, here is how to proceed:

Dissolve 15 grams of this silver nitrate in two liters of filtered water in a large flacon stopped up with emery; then drop into this solution, little by little, a small quantity of water saturated with sea salt and well filtered; what a wine glass of Madeira wine could contain is more than sufficient. At the moment when the salted water touches the silver solution that was limpid, or whose appearance looked like unclarified whey, it will fill with numerous thick, very white flakes; briskly stir the flacon, adding some drops of salted water, and let it all rest for ten minutes, being careful to place the flacon in a dim area, or to cover it with a black cloth; because this white precipitate would change to violet in several minutes, then turn black, where it is struck by a too intense light from the window.

[p. 15:

The white precipitate settles to the bottom of the bottle, and the liquid that floats above becomes limpid. Then pour 25 or 30 drops of salted water in the bottle; if it only whitens where it falls, do not continue to pour; but if they still determined an abundant precipitate, add again to it, and stir briskly the whole after which it should rest and again, out of direct light.

It is easy to understand that his operation has as its goal to assure that if all the silver in the liquid is combined with the chloride of sea salt, in order to form this white precipitate that is insoluble in water; which is nothing else than silver chloride.

When the salted water no longer leads to precipitate, decant the liquid with care by tipping carefully the bottle, and leaving only the water that would take with it part of the deposit if poured. Replace with new water that which you have thrown out, agitate forcefully so as to wash well the silver chloride, let it stand again, decant a second time, fill up again the bottle, briskly stir and let it stand.

All of these washings will have taken with them almost all of the copper nitrate and other substances in the solution. Replace finally the water in the third washing with a bit less than a liter of distilled water. Then weigh 100 grams of white potassium cyanide, either in powder or pieces, and begin by putting directly a fourth in this liter of water at the bottom of which is the white precipitate. Agitate the bottle until the cyanide is dissolved; then add half of the remaining 100 grams, stir again, [p. 16 right away until the precipitate, which will have turned brown, is completely dissolved. You will have a dirty looking liquid, but without a trace of of cyanide or silver chloride. Filter through paper and in the light, that which is no longer has any drawbacks [inconvenient], and you will

have about a liter of a limpid solution that has a slight yellow-gold color and will be ready for use. This will still be a liter of a double of silver cyanide and potassium cyanide.

If, before the filtering, the potassium cyanide was not sufficient to dissolve entirely the silver salt, there will remain in the liquid dirty brown flakes forming a rather copious deposit at the bottom of the vessel [vase]. Then you will add cyanide stirring briskly until all of the precipitate disappears; after you will filter.

These silver baths stain animal and vegetative substances, and release a certain amount of cyanogène which it is wise to be protected from. Also one should avoid touching the liquid with one's hands, especially if a cut or a slight scratch has taken off a part of the epiderm. It is sufficient to say that there is in their composition a rather large quantity of prussic acid, so that one should handle them with caution, and place the vats that contain them outside of the apartment, in open air, if possible, or at least in aerated rooms, and where one doesn't sleep; my vats are adjusted and covered with a glass panel that prevents any evaporation.

GALVANIZED BATTERIES

p. 17:

I have long abandoned the simple battery, which one could however make good use of, especially for small plates. It consists of a porcelain or crystal vase 12 to 15 centimeters high and 10 to 12 centimeters in diameter, into which I pour the silver bath. I place into the center of this bath a hollow cylinder, made of demi-porcelain débourdie [warmed?] and forming a diaphragm that I fill with water saturated with sea salt at 15 degrees du acidimeter. I give the same level to the two solutions in contact with the diaphragm. I attach the plate that I want to silver to one of the ends of the red copper wire, which is 1/2 millimeter thick and 25 or 30 centimeters long, and I fix it there with a small whole cut into one of its angles. At the other end of the copper wire I adhere in the same way a bit of zinc having a surface about equal to the half of that of the plate. First I put the zinc in salted water contained in the diaphragm, and then, in one movement, I place the plate in a silver bath, the varnished side turned towards the porous tube. Thus I place in my device as many pairs, plate and zinc joined by a [p. 18: copper wire, that it can hold, and I get very good results. But there is in this way of proceeding inconveniences that are easy to understand. The silver bath alters with contact with the salted water through the diaphragm. This porous tube also takes off a part of the silvered solution by absorption. Finally the bath soon becomes thin [loses the metal], and it is necessary to recharge it often with metal, an operation that is always long and delicate.

I thought that it was better to use an isolated battery, a vat à décomposition [breaking up] and a soluble anode that, immediately returning to the metal bath the silver that the plate takes away, would always maintain it thus at the same degree of saturation.

I tried almost all the batteries indicated by writers, and I adopted that of Daniell with several modifications that very much simplify the attentions it can demand.

It is composed, as we know, of two metals, zinc and copper, of which the first is put in water slightly acidulous with sulfuric acid, and the second in a solution saturated with copper sulfate. These two solutions are separated by a porous diaphragm which is intended to prevent their mixing, without, however, blocking the passage of the electricity that is always carried from the zinc to the copper through the liquid. This battery, modified according to the taste or the needs of the operator, but always based upon the same principles, is easy to set up and clean, and perfectly fulfills our goal.

Here is how I lay out that which I use: I take one of those glass jars, those used for preserves, and I choose one that is 21 centimeters high on the inside, and 13 centimeters in diameter (See figure 1). I cut a [p. 19 red copper plate 15 centimeters high and long enough so that when rolled it will form a cylinder that will be put in the bottle just to a certain height (figure no. 2). Unfolded/uncurled, it will be 15 centimeters by 39, and a thickness a little less than 1 millimeter. I make a small copper shelf (*galerie*) 5 centimeters high and 12 in diameter (exterior) and 9 in diameter on the interior; figure 3 demonstrates this. It is made to crown the copper cylinder and to prevent the sulfate crystals from falling into the water saturated with this salt, with which they are in contact by the numerous small holes cut into the walls of this shelf. One can remove it when one wants, and with it all the crystals it holds, which makes the cleaning of the battery very easy. An opening is made on one of the points of its circumference to allow the passage of the end of a rolled piece of paper.

I melt a stick of zinc 3 centimeters in diameter (fig. 4) and I pierce it right through 2 centimeters from one of its ends, so that it can be suspended by a copper rod, which holds it so that it can rest on the two sides of the diaphragm. The zinc and the copper cylinder will have necessarily an end projecting and pierced, to which one can, with a small pressure screw, fit the wires that conduct the electricity. The projection fixed to the copper sheet has to be long enough to extend 2 centimeters beyond the edges of the jar. I put the copper sheet into the glass bottle and on top of the cylinder it makes, I fit [p. 20 the small shelf which I fill beforehand with sulfate of copper crystals. It should not extend beyond the edges of the bottle; then in the center of this double apparatus I put a half-baked clay cylinder, closed at the bottom and 22 centimeters high with the exterior diameter being 8 or 8 1/2 centimeters (fig. 5). I then place in the diaphragm the zinc rod that I amalgamated. I fill the same diaphragm with water lightly acidulous with pure sulfuric acid, 30 or 40 drops should do, and I pour the water saturated with copper sulfate into the bottle, just enough so that it covers the sulfate crystals on the small shelf. The level of the two liquids separated by the thickness of the diaphragm should be about the same, however, allowing a centimeter higher for the acidulous water in which the zinc is bathed; I attach to the ends of the copper sheet and the zinc rod, the conductor wires made of red copper, having less than 1/2 millimeter of diameter and a length of 50 centimeters for the wire of the copper rod, and 1 meter for that of the zinc rod. Beforehand I turn these wires on a glass rod 5 millimeters in diameter, which serves as a mold and which is easily removed, and I make flexible spirales with the copper wires to make the apparatus more convenient. The wire, which comes from the copper, communicates through a trough to a brass rod to which will be hung a clean (virgin) silver plate or soluble anode; and the wire coming from the zinc will be fixed to another copper rod, from which the plate de doublé that is to be silvered is hung in the metallic bath. Figure 7 represents the battery ready to act at the moment when the two conductor wires that are turned in a spiral come into contact.

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A single element, that is a single battery, a single bottle thus prepared, suffices to silver small plates; but it is a bit slow to use with large plates. For these large plates, which I use almost exclusively, I use two batteries like the one I described, and thus I have a battery that is active throughout the day. It goes without saying that, when one uses two elements rather than one, it is always the copper conductor of the first battery that communicates to the soluble anode, and that the wire attached to the zinc is attached to the copper of the second, of which the zinc communicates to the plate that one silvers.

With this small battery I achieve a very beautiful silvering, which begins to be a bluish color, and after three quarters of an hour turns a beautiful creamy white, which lets show through the burnish that I gave the plate before putting it into the bath.

Here again is a very simple battery. Take any glass, faience, clay or porcelain vase, and which will be about 14 centimeters in height and 8 or 9 in diameter, and fill it $\frac{3}{4}$ full with this pulverized sandstone that one uses in kitchens to clean copper utensils.

Push into this sand perpendicular and to the bottom of the vase, two slats of the same size, one of red copper, the other zinc, 16 centimeters long, 8 centimeters wide and 3 or 4 millimeters thick. Place them parallel to each other 3 centimeters apart and pour on the sand water saturated with ammoniac salt that has been filtered, but in a way so that the water does not rise above the sand and so that it only becomes saturated/soaked. As usual attach to the two copper and zinc elements of this battery the red copper wires, and [p. 22 connect the conductor attached to the zinc to the plate to be silvered, and that of the copper pole to the soluble anode immersing in the vat à décomposition. Figure 22 represents this small apparatus.

This battery is energized and its action lasts for several days; but it is unpleasant, because the two metal plates oxidize and are destroyed quickly. Especially the copper is soon covered with a greenish-blue film, which is very poisonous and needs to be handled with caution.

One also can obtain excellent results by soaking the sandstone of these small batteries with water acidulated by sulfuric acid and marquant 5 degrees acidimeter. I use them now with success, and of all of the ones I have tried, they are certainly the most economical, the easiest to make, to use and to keep clean.

A small battery of three elements is enough to silver large plates; its action lasts for several days, but I prefer to clean them at the end of the day and refresh the sandstone and acidulous water every morning.

The sandstone does not alter and it can be used indefinitely, by washing it and draying it every time it is used. As for the zinc, it should be carefully amalgamated.

CARE OF THE BATTERY WHEN IT IS NO LONGER IN USE

p. 23:

Detach the two wires from the rods that are attached to the zinc battery apparatus.

Remove the zinc stick and wash it with a hard brush or a large sponge to take off the oxyde which will have formed on its surface in a more or less large quantity.

Remove the diaphragm in the sulfate solution, throw out the acidulated water in it, rinse it out thoroughly, replace it with fresh water and let it soak like that during the night; you can empty it and wipe it the next day.

The copper sheet and the small crystal gallery can remain in place for eight or fifteen days; but at the end of this time, it is advised to clean the interior surface of the cylinder formed by the rolled sheet with sandstone. The small gallery demands less care.

As for the battery that is set in motion by the water saturated with ammoniac salt, it is sufficient to moisten again the stoneware when it gets too dry, and one must replace the elements, copper and zinc, when they will have been completely destroyed.

COPPER SULFATE SOLUTION

P. 24:

Nothing is simpler than to prepare in advance the solution saturated with copper sulfate: place seven or eight hundred grams of these blue crystals in a stoneware pitcher, and pour into it four or five liters of water. After several hours, the water will contain all the salt that it was able to dissolve, and there will remain at the bottom of the pitcher a large enough quantity of crystals to replace for a long time the losses that the liquid will make.

METHOD OF AMALGAMATION

p. 25:

The amalgamation of zinc has as its goal to preserve the zinc from a rapid destruction by the sulfuric acid in the acidulated water. It also has this advantage that it makes the action of the battery less vigorous, and that it because of this results in a more regular and more adherent deposit of silver. One must understand that the electric current almost always has too much action, and that most accidents that happen in galvanizing are due to this excess.

The simplest method of covering the zinc with mercury is this: Take two ordinary saucers. In one of them, place two or three spoonfuls of pure water, ten to a dozen drops of sulfuric acid and a drop of mercury the size of a small pea. Dampen a piece of an old sponge by lightly touching the acidulated water, and rub the entire zinc stick that you want to amalgamate. This operation scrapes it clean so as to receive the mercury. Then place the zinc stick perpendicular in the other saucer and slowly pour against p. 26: against it all that was in the first saucer. One part of the mercury, which will have slide across the zinc, will attach there, and the rest will fall into the empty saucer. Then with the sponge, spread the mercury that adheres to the zinc, and repeat this same operation until all of its surface has taken on a very bright sheen. Next wash it in lots of water and dry it with a large cloth. I amalgam the zinc again when it has been used two or three times.

DIAPHRAGMS

p. 27:

Porous tubes of half-fired white earth seem to me, until now, the best to use and they last the longest. Several manuals show how to do it in plaster. They are also very good; but they go soft quickly and become too permeable. However, here is how one can mould them, because if you don't have the first kind, they can be very useful:

Turn a ring of lead, (figure 8) 3 centimeters high and 8 centimeters in diameter (exterior), and $6\frac{1}{2}$ interior diameter. It should be, as a result, 7 (typo error; should be $1\frac{1}{2}$) millimeters thick, and it will be this thickness that determines that of the diaphragm. Have two sheets of very thin and very flexible tin plate cut, perfectly square, one 25 centimeters high and 32 wide, and the other 24 by 23 centimeters. Roll these two sheets

lengthwise, so that the edges overlap a bit and so that you can diminish the diameter; again, have a tin plate rod 23 centimeters wide (figure 9) and, at one of the ends, solder perpendicular to the rod a circular piece of tin plate, [p. 28 whose edge will be a bit folded over on the rod side, and whose diameter will be equal to that of the interior of the ring, less however than the thickness of the tin plate that would be placed around between it and the lead.

These pieces, put into place the way I have said, will form the whole mould.

If you wish to set it up, oil well the lead ring on all sides, the small tin plate cylinder on its exterior surface, the large on the inside, and the round piece at the end of the rod on the side opposite it. Put the ring on a flat surface, on a marble fireplace mantel, for example, and put into the ring the small tin cylinder, in a way so that its lower side touches the marble exactly the same all over. The 3 centimeters of height of the ring will allow the tin cylinder to remain perpendicular and to form a tube of parallel sides. Then place in this tube, and the rod from below, the small round piece of tin, and place it so that it closes it at the top, as well as possible, on the inside and at the level of its edge.

Then wrap the lead ring with the large cylinder, and keep it in this position with a string that is tightly tied, and which spirals the length of the tube in a way that maintains the same diameter throughout, and so that the distance that separates the two cylinders on the inside is the same throughout their circumferences. The interior cylinder will be a centimeter lower than the outer one, and it is this difference, levelled out by the liquid plaster, that will form the bottom of the diaphragm. Figure 10 represents the mould completely set up.

[p. 29

Then take some building plaster freshly prepared and well sifted. Mix it as tightly as possible, that is to say, only adding as much water as is strictly necessary and pour it between the two cylinders until it reaches the edge of the larger cylinder; but do not mix more than necessary to make a diaphragm, because you will have to throw out the rest.

Let it dry at least for 15 minutes without touching anything, and when the plaster has hardened, turn the apparatus upside down, and carefully pull out the tin rod with the round top which has formed the bottom. Untie the string that holds together the exterior of the tin plate. It will loosen itself from the plaster; remove it carefully. Detach the lead ring, which you will see whole, from the diaphragm then by pressing with your hand the interior cylinder you can pull it out easily. The diaphragm is removed from its mould. Let it dry at least for 15 days before using it, or if you want to shorten this time, dry it before a fire. It is good to make twelve or fifteen at a time.

I make these diaphragms from fine plaster, rough moulding plaster and building plaster; these latter are the best, lasting four times longer than the others and hardly costing anything. I am trying, moreover, at this moment, diaphragms made from very thin red copper, which was pointed out in a recently published English scientific journal. Until now they have given

me the same results as the best tubes made of porous clay, and it seems to me impossible that they will not make the others obsolete once they are made to be submerged in [p. 30 in excited liquids that do not damage them. In the Daniell battery, which I use, they are perfect up until now. With them, there cannot be the endosmosis or touching of the two liquids, and the material they are made of allows an easy passage of the electric current. It is only indispensable to isolate them completely from the copper and zinc elements of the battery. In my bottle, they sink into the copper sulfate through the small gallery, and remain at the bottom without touching either the partition/wall or the gallery, or the rolled sheet that supports it. The zinc that is immersed in the acidulated water by which they are filled is suspended by a glass rod as opposed to a copper rod, and thus there is no contact with the metal of the diaphragm. The wires stabilize as usual.

Finishing the discussion about the battery, I could not recommend too strongly to clean often the ends of the rods and the wires with sand paper, as well as to revive the holes of the plates or the appendages, all the places where contact takes place, with a triangular stylus. The metal oxides are not good conductors, and the more the metals are live at the point where they touch, the more electricity will be easily transmitted.

ZINC BATTERY APPARATUSES

p. 31

Zinc battery apparatuses are rather difficult to set up when one wants to silver several large plates in it at one time. The wood troughs, which one can give the form one wants, would be perfect if they could be lined with a varnish that resisted the action of cyanides. That which several authors suggest and which is made of wax, rosin, red ochre and plaster, is worthless; because after several hours, it is dissolved by the silver bath.

The varnish that is used to protect the backs of plates would not, I believe, resist for too long immersed in the bath. As for small oak vats, they are never tied to each other well enough to prevent the liquid from seeping through their joints, and the wood absorbs a rather large quantity of dissolved metal. Perhaps one could line them on the inside with gutta-percha. This is something I am trying now and which has worked wonderfully for 25 days.

The oak vats color the metallic bath a deep Madeira red, but without damaging its properties.

p. 32

Meanwhile, I use crystal bottles that I have made for me and which are 27 centimeters high on the inside and 27 centimeters in diameter..

They each can hold from 12 to 14 liters. The edge is ground so that a piece of glass placed on top will prevent any evaporation. If I need the apparatus, I remove the mirror/glass and I replace it with a wood frame (figure 11) that is 4 centimeters wide and tall, and 31 centimeters long, from end to end. The crystal bottle fits into a circular notch cut beneath the frame so that it cannot slide. In two of the sides, which are parallel

to each other, I cut five holes 4 to 5 millimeters in diameter, and lined up so that I can suspend a copper rod which will hang a bit above the liquid when the frame is placed over the vat. Then I place two brass wires, at the same ends as the holes, on the wood. The ends of these wires are bent at a right angle that goes into two holes almost at the edges of the wood. These two rods then will be at a right angle to the rod I will have placed in one of the five positions intended for the anode. Figure 11, already referred to, will help to better understand this placement which is very convenient.

The wire going from the copper pole of the battery is attached firmly to a rod on a hook, which will horizontally cross the two opposed sides of the frame. The wire coming from the zinc pole will go to one of the two brass wires that lie on the wood surface.

I plunge into the liquid the soluble anode and suspend it from two small silver hooks [p. 33 that are attached to the brass rod connected to the copper pole. These hooks are arranged in a way so that I can remove the anode without moving the rod. I hang from another single rod, and in the same way as the copper hooks (figure 13), the plate to be silvered that I want to immerse and which has just been polished, as I explained above.

If I immersed the plate in the metallic bath in this position, the battery's action would only be established at the moment when the rod came in contact with the two rods fixed to the wood, and so after the complete immersion of the plate; which is what should be avoided. It is essential that the electric current be set up by the plate's contact with the bath, and nothing is easier to do: attach to the rod (a in figure 11), from which is hung the plate, a long enough fine copper wire. With one hand, touch the end of this wire to the zinc wire, or turn it into a spiral, and with the other, immerse plate b in the bath so that it hangs parallel to the anode c, the side to be silvered turned towards it, and about 5 to 6 centimeters away from it. It goes without saying that you must calculate ahead of time the length of the small copper hooks, so that whole plate is immersed.

I had recommended quickly placing the plate in the bath; now I think it is better, on the contrary, to put it in slowly, but without stopping. It seems to me that in this way the plates that I silver are less likely to have a watered effect or be streaked.

PRECAUTIONS TO TAKE WHILE THE SILVER SETTLES ON THE PLATE

p. 34:

Two or three minutes after having plunged a plate in the bath, you have to remove it, which always can be done without negative consequences, and examine its surface.

If it takes on a bluish tint and is milky, even throughout, this is proof that the operation is working well; put the plate back in the vat, without letting it dry, and take care to change its perpendicular position from time to time, by detaching one of the small hooks and putting it in the third hole, which has not yet been used.

If stains, streaks, a pattern of small white dots, a distinct

iridescence, black lines running perpendicular from top to bottom, a mass of long white ovals running perpendicularly, or like undulating ribbons, or a dirty yellow layer, passing to violet, or finally a deposit of greyish dust, etc., form on the plate, remove it immediately

p. 35 from the bath, wash it in a lot of water carefully re-polish it, and do not put it back into the vat until you have remedied the causes of these phenomena which are sometimes so discouraging and are well known to those who are engaged in electro-chemistry. Almost always they are due the fact that the metallic solution is too strong, or the electric current has too much energy. So, one must put the plate further away from the soluble anode, or replace this anode with another that is smaller and thinner, or use finer wires, use zinc rods whose surface is less spread out, or letting only a small part of it plunge in the acidulated water, throw out this water, and if it contained forty drops of sulfuric acid, only put twenty in the new one; separating as much as possible the elements, copper and zinc, from the battery, or diminish the force of the bath by adding distilled water. Doing one of these, or several, or all of them at the same time, almost always works.

If the soluble anode is covered with a brown oxide or with streaks, or round points, and sometimes crackles formed by a thick black or gray mud, not sticking but leaving a stain that is difficult to remove, it is because there is a lack of potassium cyanide in the bath. There is not the desired surplus needed to dissolve the silver that forms on the cyanide anode; so add some of it little by little so that this phenomenon doesn't re-occur.

If, on the other hand, the silver solution or the electric current was too weak, you must remedy it by doing the inverse of what has just been said, and it will be easy to recognize this defect by the slowness by which the layer settles on the plate.

p. 36

Under good conditions and with a medium temperature a large plate takes about 8 decigrams of silver in one hour, and that is more than is needed to obtain a completed plate.

I can only silver two plates at a time in one of my vats, using thus two surfaces of the anode.

When the plate is covered with the layer of silver that seems adequate to me, I remove it from the metal bath, I wash it with a lot of water, I remove one of the hooks and I hang it by the other so that it will dry before putting it away . It appears a beautiful, cream-white tint, lightly sky-blue. If the water is perfectly pure, it will leave yellowish traces on the silver, but these will disappear with polishing.

It is good to place the plates that have just been silvered in a closed box.

Exposed to air, dust, or humidity, they will alter at several points and the burnishing will be longer and more difficult.

THE SOLUBLE ANODE

p.37

This is what we call the plate that is of the same metal as that which is invisibly contained in the metal bath. Here, however, it will be pure silver, and it will serve to replace the silver in the bath that the clad plate removes from it. The anode should have a surface about equal to half of the plate that one is silvering. One adds or lessens its active surface by more or less plunging it in the liquid, because the action will only occur on the immersed part.

Its thickness has to be not too thick, about 1 millimeter, so that the electric current doesn't have too much energy. Finally the anode, dissolving little by little in the bath, ends up disappearing entirely, if it is not replaced at the moment when its volume has become too small compared to that of the plate one is silvering.

As for the bath, it can be used indefinitely, because the anodes always maintain it at the same degree of saturation; but it is good to filter it when dust or the plates's impurities have dirtied it and form a deposit at the bottom of the vat.

Pure silver, as plate, wire or granulated, takes [p. 38 about 25 cent. a gram. 8 decigrams is sufficient for each plate for a large plate, 4 for a 1/2, and 2 for a 1/4. But I am speaking only of clad plates; you need much more, three times as much at least, if you want to directly silver a copper plate: however, once this first layer is put on, this plate becomes as good as a clad plate, and after three or four images have been erased, you only need to put on as much silver as I have just indicated for each new operation.

ACCELERATING SUBSTANCE

p.39:

A long experience has led me to believe that iodide chlorure was the substance that gave daguerrein images the warmest and most brilliant tones, and I used it constantly despite the difficulties I had using rather complicated apparatuses. But I believe I have succeeded in making it play an important role in the preparation of the sensitive layer/coat, without changing the method used by everyone else. I make the bromide lime absorb some chlorine which, by combining in part with the excess of the iodide of the preparation, forms evenly on the plate itself this chloride which gives me such good results. For a long time I have done many experiments with this substance which seem to me decisive.

I prepare in the usual manner what is called lime bromide, that is, I make the brome [bromide?] evaporate in a capsule placed at the bottom of a jar that is tightly closed, containing hydrated lime reduced to powder and sifted. When the lime, which is best used when a bit damp, has taken on a beautiful red color, a bit like that of the wax used to seal letters, I remove the brome which [p. 40 the capsule may still contain and I replace it, in this same capsule, with a certain amount of chloride de brome. With the action of the vapors that it gives off, the surface of the lime bromée lightens and takes on a very pronounced yellow-sulphur color. One then stirs the mixture with a glass stirrer, and one notices already that on top of this discolored tone, there is a layer that is a very vivid blood red color..

Again one stirs and one continues to absorb the chloride vapors, until the whole mass has taken on the same color and there remains red-yellow vapors in the empty part of the jar, vapors with which the saturated lime cannot mix. One closes the chloro-bromide lime in a bottle with a large opening, closed with emery, and one shakes it vigorously from time to time and during a day or two so as to mix the parts well. One uses it then and absolutely like the bromide lime, either in basins, or in boxes with porous diaphragm, of which I will soon speak. One has only to give to the second iodage almost the same intensity as the first; and it is perhaps to this excess of iodide, combining with an exposed part of chlore, that is responsible for the vigorous and warm tones that the chloro-bromide lime gives, and is just as good as the pure chlorure iodide gave me in the past. This is only a conjecture because I have no pretention of putting forward here the least theory.

Be that as it may, I have had two container boxes, one for eight months, and the other for fourteen, of the lime thus prepared. I made hundreds of images with them, and I always obtained not only remarkable tones, but a rapid, clear impression that I never had before. [p. 41 I always work with large plates, I use long focus lenses, I correct views or monuments with a prism or a parallel mirror, I use a very small opening, and under these conditions, which demand a prolonged action of light on the sensitive layer, I get very beautiful images in eight and five seconds in the sun, and fifteen or twenty if it is cloudy.

As to the proportions that must exist between the lime, the brome and the chlorure de brome, it is impossible for me to give them because I do not know them. They depend, I think, on the more or less large quantity of water contained in the lime. If this substance is too dry, it has trouble mixing with the bromide vapors; if it is too wet, it will absorb a large amount of it and end up combining with them, which is not good. Therefore one must proceed by trial and error and be guided above all by the color,

39

the red wax color for the chaux brome, passing to the blood red by the vapors of chloride de brome. The smell can also give good indications. The substance should give off a strong odor of chlorure de brome, which one cannot breathe in if one is close without impunity.

If, despite of the intensity of the color, the substance only smells of bromoforme or iodoforme, without bothering the organs, there would be a combination and the substance would be bad. One could fix it by mixing little by little a certain quantity of very dry hydrated lime, and after adding, if necessary, chlorure de brome reduced in vapors/fumes.

IODINE AND CHLORO-BROMIDE OF LIME BOX

p. 42:

I noticed some time ago while experimenting with bromoforme that the half-fired clay not only absorbs easily iodide and bromide fumes, but even acts as a sieve in some way by letting them pass consistently and with great regularity through it. I have thought since then that if I would hermetically seal an even layer of iodide or bromide of lime under a plate

made out of this porous clay with a piece of well ground glass, covering the surface of the clay opposite to that which is in contact with the above

40

named substances, I would have extremely flat basins and would have the best possible conditions, especially for an apparatus destined to be carried from one place to another. In fact, whatever jolts given to the box, whatever its position, on its side, slanted, horizontal or overturned, the iodide and the lime should always retain even surfaces, on one of which I could also still put (parallel to it) [p. 43 the clad plate that must receive the fumes from it. Thus, these boxes would be at the same time hermetically sealed containers for iodine and bromine, and the double apparatus destined to be used when desired. I immediately made two of these boxes and they more than met my expectations.

It seems to me that even traversing this porous clay, the two substances are modified in a way that is favorable to the photographic process.

After many attempts and some changes that came from experience, this is how I make the boxes:

I take some of these white, half-fired, earthen plates that one finds everywhere and which porcelain painters use to put their decorated pieces into the fire; these pieces are placed directly on these plates in the oven. They are about 27cm by 19 cm and 5 or 6 millimeters thick. They absorb water with such avidity that a glassful of water could be absorbed without traversing them.

I cut the very squarely, and of a desired size, this plate that I will call bisque so as to avoid confusion, and this size will be the same as the largest of the clad plates that I want to use, however, 1 centimeter larger on all four sides. It goes without saying that one box is used for all smaller plates using small boards of different sizes.

The large standard plate, which I use almost exclusively, being 217 millimeters by 162 millimeters [p. 44 the bisque has to be 237 millimeters by 182 millimeters and only 3-4 millimeters thick, which I obtain by carefully grinding/filing down the two sides.

The bisque thus prepared, and especially being of equal thickness, I trace in ink one centimeter from the edge on both sides, a line that forms a kind of frame, and which marks the space to be covered with glass strips, in order to make a flat double basin, whose interior surface will necessarily be equal to that of the clad plate which provided the first measurement. Then I cut a piece of glass 3 millimeters thick, in strips that are 1 cm wide and as long as the sides of the bisque plate. There must be 8 for each surface. I grind them on all 4 sides, so that they will take the glue that has to fix the first four to the biscuit itself and the second 4 on the first 4 to raise the level of the edges of the basin.

Glueing these strips requires much care and some precautions. It is essential to heat the bisque and the glass strips; enough glue has to be put on so that there are no air bubbles between the strips; but one has to avoid too much glue because if it touches the porous clay, or a spreads across it, permanent stains will result where the iodide and bromide will

gather in a very unfortunate way. Finally, the seams of the upper strips should cross at right angles to those of the lower strips, that is to say, if in the first the strips on the longer side go from one end to the other of the bisque, those of the short sides must go there on the second.

p. 45:

When this operation is finished on the two sides, I have two very flat small basins built back to back on the half-fired plate which then serves as the bottom to both. Their sides are formed by the double thickness of the glass strips. Figure 14 shows a cross section of this still incomplete small apparatus.

After a few hours everything is dry enough so that it is possible to grind down the 4 sides of the double basin, then to glue there a strip of glass 3 millimeters thick so as to prevent the evaporation of the substances through the edge of the bisque itself. This grinding/filing has to be done dry because if water is used, it would penetrate into the porous earthen plate and then would come into contact with the glue that holds the glass strips, and would weaken it enough to break down the adherence of the strips to the bisque. These strips, which will go around the double basin, will be as wide as the double basin is thick, and will complete the framing of the porous clay. Fig. 15 will help to better understand this arrangement.

When this new glue is dry, one must perfectly grind the protruding edges which are formed by the glass strips. They are intended to receive on one side a glued piece of glass that will enclose as tightly as possible, the iodine or the chloro-bromide of lime, and on the other side, a smooth piece of glass that slides over the bands to hide the surface of the bisque when desired, or uncover it when one wants to use the fumes it filters. These edges will be now formed by the upper surface of the glass bands and the perpendicular glass that wraps around them.

It goes without saying that by increasing the number of bands, or by cutting them from a thicker kind of glass, one can make the basin, which p. 46: holds these substances, the depth one wishes. For the iodine a thin layer, 5 or 6 millimeters is enough, but for the chloro-bromide of lime, it is better to have a rather considerable thickness, for example, 9 millimeters since this substance weakens considerably by evaporation and it has to be saturated again after a certain period of time.

Under the conditions I have just described, and if the glue and the grinding are perfect, the lime has to be changed or made to absorb again bromine or chloride only after a year, even longer.

The boxes that I took on my last trip were prepared 15 or 18 months ago. When I returned to Paris they were in as good condition as when I left. Therefore, they can be used for about 2 years without doing anything to them.

The edges being perfectly ground, one can enclose the iodine in one and the chloro-bromide of lime in the other. What I will say about one is necessarily applicable to the other.

Have a piece of glass cut beforehand which is 3 millimeters thick (f in Fig. 16) and large enough so that when laid down flat on the basin, it covers it entirely, but without extending further than the

exterior edge with which it must line up. Don't frost it so that you can always see the color of the substances within. This precaution is especially necessary for the red colored lime which changes color as it weakens. One spreads out the iodine or the chloro-bromide of lime in one of the holes of the double basin, (e in Fig. 16) but without filling it up entirely p. 47 so as to be able to agitate these substances and move around the molecules which, by equalizing their all over color, makes the chloro-bromide homogenous; for if there is a defect in the glueing of the strips the glass will let some fumes escape. One would soon see a noticeable discoloration close to where the evaporation took place.

The amount of empty space to be left in the basins can be calculated as about 1/12 of their capacity. One puts the glass exactly on the ground strips, one keeps it in place with a rather heavy weight, and by means of a ribbon of string about 2 centimeters wide, and with a very warm and thick glue, one adheres the glass to the edges that it covers without being glued there; the string, as indicated in figure 16, letter d, holds all straight by envelopping under the glue of which it is coated a part of the exterior surface of the glass f, its area, and a part of the exterior edge of the basin c. It is good again, to be sure, to recover the junction line of the glass with the edge with a strip of gutta percha or very strong and carefully glued paper. It is necessary, in a word, to neglect nothing to close off all areas from which fumes could escape except that of the surface of the biscuit.

This arrangement allows the opening the basin when one wants, without requiring the breaking of the large glass because the strong glue gives to the strips and the porous clay such an adherence that it is impossible to separate them without breaking them. One could also glue the glass that covers the iodine or the lime along the edges of the basin itself; but one must then treat beforehand on one of the sides and absolutely at an angle an opening p. 48 about 2 centimeters long, and as wide as the strips of glass superimposed. It is through this opening, and by means of a small, flat funnel made with a cone of well glazed paper. that one introduces the substance into the empty space, between the glass and the bisque. Then one closes the opening with a piece of glass which fits there and which is beveled like it, so that it cannot slide into the interior, and one glues the whole, as I already said. The conditions obtained thus are no doubt better than the preceding ones to prevent any evaporation, but one has to break the glass if one had to open the box.

The upper basin, by which pass the fumes filtered through the bisque, is covered by a ground piece of glass (h, figure 16) which hermetically encloses it and which one removes or which one slides to substitute the small board that holds the clad plate. Everything is placed in a wood box, the same as those that serve as common basins. Also, in order to prevent as much as possible any release of fumes when the box is at rest, one must fit, in the interior of the upper basin a ground piece of glass (g figure 16), which will lie flat directly on the bisque. One removes it, of course, when one wishes to use the box, and one puts it back when one has finished.

This apparatus gives really remarkable results, and after seven or eight days, when the bisque is well saturated with the fumes, the clad plate that receives them passes successively by all known nuances with a conformity and a constancy which leaves nothing to desire.

The warmed up clay that covers the iodine soon turns a dark rust color, the one under which is the bromide of lime or chloro-bromide always remains white.

p. 49. It is good but not indispensable to blacken the bisque by crushing carbon black in ether cut by wine spirits, and by applying it on the porous clay with a flat brush. The next day one must remove with care the excess of the carbon black that has not penetrated into the porous clay with a hard brush.

I had to blacken the bisque of my boxes because, being sometimes obliged to use it in daylight, I noticed that the white reflections at the bottom of the basin, whatever precautions I took, altered enough the sensitive layer of my plates so as to veil the images.

One can blacken the bisque, on one side only, either before constructing the basin, or when it is already filled with iodine or chloro-bromide of lime.

My two basins are contiguous, back to back, without a divider, in a box, each of which has an opening made to receive in turn the small board which holds the clad plate. When this one is iodized, I turn the box over, and I pass over the chloro-bromide, then I turn it over again to add the second iodage.

The basins go into and out of the box by a door that is on the side opposite that which has the two volets through which one pulls out the two ground pieces of glass by sliding them. This box is 6 centimeters thick, 21 centimeters wide and 27 centimeters long.

I can, when I want, remove the two double basins from the shared box and place each of them into a separate box, which is more convenient when one works at a fixed station.

p. 50:

Figure 17 represents a cross section of the length of my double box.

The temperature of the place where one works, the thickness of the bisque, its greater or lesser porosity, the more or less considerable quantity of bromide or chloride de brome contained in the lime, the thickness of the layer of iodine or chaux brome contained in the basins, necessarily affects the rapidity with which the fumes are released in the boxes and color more or less quickly the plate undergoing their action. However, because it is by the color the plates take on that one judges the degree of their sensibility, there is no real inconvenience in using boxes that are too slow except a loss of time, which is often precious. I also noticed that during the same day the same box became slower the more it was used and so I concluded that during the time off the fumes slowly filtered by the bisque deposit on its upper surface a light layer of iode or brome, which evaporates more quickly than if it had not formed. Therefore one has to have at least two types of double basins if one wants to work quickly and make several images in a short time. In particular one must use in the

construction of these basins a half-fired clay whose porosity permits easy passage of the iodine and bromide fumes.

I cannot recommend so strongly that those who prepare the accelerating substances themselves take all the precautions possible to prevent unfortunate accidents. The brome, chlorure de l'iode, especially the chlorure de brome, are very strong corrosives. It would not be prudent to breathe the lime impregnated with these substances if it entered as dust into the apartment. Therefore, one must always p. 51 be next to a window where there is an air current when one prepares the lime or one wants to decant it. Ammoniaque and the concentrated solution of hyposulfite of soda have the good property of destroying almost instantly their deleterious qualities; it would thus be wise to have them next to one when one removes the tops of the flasks containing these substances so as to pour them into capsules. One must above all never let them fall from a too high distance for fear of having some drops splash into the eyes; which would unfortunately be without a remedy. If some of it falls on the hands or the face, immediately wash the stains with the solution saturated with hyposulfite of soda; they will disappear instantly, leaving no trace. If the odor they emit is too strong in the apartment, spread about some drops of ammoniaque. The invisible fumes of brome and alcali combine to neutralize each other, and will create white fumes that are not harmful. If, in wanting to smell a flask, you breathe in too strongly and in a way that irritates the mucous, immediately breathe the ammoniaque. Moreover, all of these accidents can easily be prevented, by working next to a source of air current.

BUFFING BOARD

p. 52:

This board is a small wood tool whose surface is a bit smaller than the clad plate for which it is intended; one covers it with a thick and soft flannel, and one fits a removeable copper button which can be fixed by a small screw. The screw holds it there by means of a copper shaft that passes through the wood by an opening lengthwise and this arrangement allows for moving the button further away or closer to the angle of the board. The button should be round, flat, and hollowed in a way so as to cover the flattened angle of the clad plate that one slides underneath. At the same time it serves to hold the plate, and prevent the angles from tearing the animal skin or velvet of the buffers.

The board is fixed to the edges of a table, or on a corner of a marble top of a chest or chimney using a small wood or iron press which fits to an appendage placed in the center and underneath the board.

An improvement that I have found useful consists of rotating this tool horizontally at its center once it is fixed by the presse, so as to expose the plate to the action of the polisher without disturbing it.

Figure 18 gives an exact idea of what I am describing.

p. 54:

Buffers are very long, light boards about 70 centimeters long, 15 centimeters wide and 2 1/2 centimeters thick. They are equipped on one side with a handle similar to that of a planer. The opposite side is covered

with a large piece of soft flannel upon which is placed a very thin (1/2 millimeter thick) piece of cardboard, which covers it completely, and over the whole one tightly stretches chamois or white cotton velvet, so that the nails are imbedded on the edge. It is a good thing to have three: one covered with very thick velvet, and the other two covered with chamois.

If the chamois buffers scratch the plate, one can soften them with a piece of very fine pumice stone, one side of which will have been made flat by rubbing it on a grinding plate with a bit of sand or emery. One would carefully and evenly sand the whole surface of the plane, and afterwards one would clean it well with a hard brush to take off the particles of the pumice stone which might have attached themselves to it.

p. 55:

I also use small wood pads (fig. 19) finished with a layer of very smooth rubber to which I add small square pieces of velvet cotton that I replace as necessary. One places these pieces, which are about 8 centimeters square, in such a way so that two of its opposite angles fold over the narrowest part of the pad and thus the operator holds them in place by pressing down.

POLISHING POWDER

p. 56:

Pumice stone and rotten stone, both perfectly porphyzied (made into a paste) and dried after washing, are, I believe, the best powders one could use. Photogine is also very good. As for tripoli (another word for rottenstone), its molecules sometimes aggregate and often scratch plates.

The fine rouge, prepared like rotten stone, is indispensable for giving the silvered plate this deep, black burnish without which you cannot have beautiful images. It is difficult to find very good fine rouge ; that which I use, which is high quality, was purchased in London.

Often, however, it sticks to the plate and harms the beauty of the image. Therefore, one must use it carefully, and not hesitate to re-buff the plate with a bit of rotten stone, alcohol and cotton, if, when viewed in the sun, it has a reddish brown cast even with the most perfect burnish. One would then give the plate a final stroke with the chamois buffer.

LIQUIDS USED IN THE POLISHING OF PLATES

p. 57:

If I have to polish a new plate or a silvered plate which is thick, or again if I have to erase an image treated with gold chloride, I use, with pumice stone or rotten stone, rectified oil, into which was poured beforehand 3 or 4 grams of pure nitric acid for every 100 grams of oil one wants to acidify. One strongly shakes from time to time these two liquids, which do not mix, because the acid being much heavier than the oil, it forms a very distinct layer at the bottom of the bottle. However, after several days, the oil that was clear takes on a yellow-gold color that is rather dark, and deposits reddish mucuses that often stick to the walls of the bottle. Fifteen or twenty days after one filters it with paper, through which the oil and the acid pass easily; one uses the oil that floats and which is acidulated since it reddens the paper.

For the plates that I do not have to treat so strongly as those I have just spoken about p. 58 I use the same powders, moistened with alcohol into which I mix about a fifteenth in volume of liquid ammonia, and a bit less of sulfuric ether, or better yet, of distilled water saturated with cream of tartar. Moreover, every process that will expose a silver surface as pure as possible, without scratching it, will always be excellent.

ABOUT THE LENS

p. 59:

No one ignores the fact that the lens is the most essential factor for the photographer, and that one would make only bad images if one did not have a perfect lens, that is, one that brings together as much as possible, two qualities that seem mutually exclusive: a great light intensity and a faultless sharpness in even the parts furthest from the center of the image. Strictly speaking, this maximum cannot be attained, and one must always accept a slight compromise, according to the use to which the lens that one wants to have will be put. If it is to make portraits, the intensity of light has to take precedence because the picture has to be made quickly; if one wants to reproduce monuments, it is sharpness that is preferred. Moreover, the day will come when we will arrive at making the layer silver bromide of iodine, or to another substance, perhaps yet to be discovered, so exquisitely sensitive, that only a light that is a bit bright will be enough to produce an impression in an instant. Then we will abandon all of these too short focal glasses, really magnifying glasses which, bringing together the greatest amount of luminous rays at a single point, [p. 60: necessarily deform everything that is a bit away from it.

Until now I have been seriously occupied with taking pictures only of sites, engravings or buildings. I always use a large plate and the lenses with a long focal point, which were sent to me from America or supplied by M. Charles Chevalier in Paris, have always given me images with a very striking sharpness; it is a recognition that I hasten to give him. We have also seen above that these images, rectified with a prism or a parallel mirror, were often made in eight and in five seconds, and this rapidity I would not have had in similar conditions.

Therefore, one must ignore nothing in the choice of a lens, and every sacrifice should be made to purchase the most perfect lens one can find.

THE CAMERA BOX

P. 61:

My camera box, similar to all of those one generally uses, but of a rather large size, since it is intended for normal plates, is lined on the inside with black cotton velvet, glued in a way that the small pleats formed by the material are parallel to the axis of the rays of light that go from the lens to the ground glass. Absorption of the light is more complete.

The metal ring that surrounds the part of the lens in the camera is masked by a round piece of cardboard covered with the same cloth. The interior of the copper tubes in it are also lined. All of these precautions, which are not indispensable, nevertheless contribute to the success of the

operation since they prevent light reflections, even the weakest, from affecting the sensitive layer.

The sliding frame intended to enclose the small board that holds the metal plate, and which is substituted for the ground glass after the focusing, is also lined with black velvet; not only to do away with the light reflections, but also to fix the dust particles that, attaching themselves [p. 62 to the pieces of velvet arranged perpendicularly one next to the other like bristles of a brush, can no longer fall on the plate.

The foot of the camera box is made of three rods with two branches which are bent into threes, and a strong ball top that moves, which is absolutely necessary in some places to have the apparatus in a good position to take the picture.

MERCURY BOX

p. 63:

I use the mercury box that has been generally used until now, that one whose feet, fixed to copper springs, slide by pulling along the lateral sides of this box when one has to transport it, and thus reduce its volume to the most indispensable dimensions. It suits me because in my portable apparatus it holds several of the pieces that make up the apparatus.

When it comes out of the camera the exposed plate is put into the box at a 45 degree angle which at first was said to be absolutely necessary, but has been abandoned for a long time by several people. M. Claudet, the skilled operator who is an authority on photography, puts his plates in perpendicular one next to the other, in a mercury box of cast iron, like we put our new plates in a grooved box. Some amateurs use a flat basin made of sheet metal, upon which they put the plate that must be exposed parallel to the mercury surface and very close to it, about 2 or 3 centimeters. These three different positions,

p. 64: perpendicular, parallel or diagonal to the surface of the liquid metal, all give good results. One therefore can use whatever form for the mercury box that best fits the rest of the apparatus.

In my apparatus I make a small opening 4 millimeters in diameter next to the thermometer and the closest to the mercury surface. It is in this hole that I place a glass tube containing two or three drops of sulfuric ether when the plate is exposed to the mercury fumes.

Figure 20 will give an exact idea of this tube. At one of its ends one fits a piece of cork that is flush with the outside edge of the box when the tube is put into place. A small bit of shaped wood will close the opening from the same side, so that the ether fumes can only spread into the box itself.

In place of the glass tube one could use a piece of rolled paper large enough to slide into the hole made in the mercury box. One thrusts the end of the rolled paper into the sulfuric ether, and one pushes it into the box in a way so that its end is in the center of the basin. It goes without saying that this paper must fill the opening through which it is introduced, and close it off completely so that no air or light can enter the box.

PROCESSES USED TO MAKE AN IMAGE

p. 65:

Polishing

A new plate silvered by means of the battery has to be polished and given the most perfect burnish that is possible to give it. Two essential conditions are necessary: the surface of the silver has to be as pure as possible, speaking chemically and materially, and the burnishing that it receives has to have the appearance of the clearest silvered mirror..

A daguerreotype image should be thought of as a drawing that would be made with a white pencil on a black background; because, unlike a regular drawing, where the lights and halftones are left untouched by the pencil that, on the contrary, blackens the shadows and the half tones according to their intensity, it is the burnish, or if one wants the black of the metal plate [p. 66 , that the white drops of mercury fumes will avoid in the shadows and halftones of the image to whiten, by attachment to them, the luminous or reflected parts according to their value. Such is, at least until the present, the simplest account of this mysterious and interesting phenomenon, despite M. Ed. Becquerel's experiments on the action of glass continuators.

Be that as it may, the clarity and depth of the black of the plate depends upon the polishing it received, and like I just said, the rigorous perfection of this polishing is one of the essential conditions of a successful image.

The first thing to do it to turn down the sharp edge of the plate from the copper side, so as to facilitate the action of the polishes on the silvered surface. For this one uses a burnisher or a small, rather ingenious machine which one finds at opticians or the manufacturers of daguerreotype plates. It is good for small plates; but because the pressure it exerts is not instantaneous on all the points of the edge at the same time, on the contrary is gradual going from one angle to the other, large plates become warped and become deformed so that it is almost impossible to make them straight again, which is so important to preserve. To remedy this drawback I had a press made, one made with a perpendicular cast iron slat that a beam/rocker arm lowers at will to the edge of a plate, which is also cast iron, and that is horizontally arranged and forms the base of the device . It is on this latter that one puts the plate whose edge one wants to reduce. One of the plate's edges extends beyond the cast iron edge by a millimeter and a half [p. 67 along its side, and it is on this edge, which supports nothing, that the perpendicular slat works with force and bends the plate all at once as it is lowered. Each of the four sides of the plate is submitted to the action of the beam/rocker, and it is in a cut groove on the horizontal plate and perpendicular to its diameter (width) that the silvered side that has just been cut down sinks into. Several grooves, spaced proportionally to the plate's dimensions, half, third, fourth and sixth, are made on the base of the press. The skilful engineer M. Poirier, on Faubourg Saint-Denis street, is the one who has made this excellent little machine.

The edges of the plate being turned down, the corners flattened with pliers, and the plate itself placed on the polishing board in such a way that its corners are under the copper buttons, one sprinkles heavily pumice or porphyzied rotten stone on it. These substances are stored in small bottles with a large opening closed by a metal cloth. One takes a very clean cotton pad which one dips into a bit of acidulated oil of petroleum, placing it on the bottle's neck that contains the oil and turning it upside down, and one rubs the plate in all directions making small circles that are as close together as possible. Soon the surface of the plate is covered with a rather thick black coating that one removes little by little with the same cotton pad, however doubled with a new, clean pad: one continues like this until the plate is almost dry, one sprinkles powder on it once more and then one polishes with one of the velvet squares I spoke about, which one attaches to the rubber of the small wood stamps. One lightly rubs [p. 68] in all directions until the silver has taken on a beautiful bluish black hue, and so that breathing on the plate does not make any stain appear, proof that the acidulated oil has been completely removed.

If, on the contrary, one noticed some traces of grease spots one would start over, using the same powders, a new pad and alcohol mixed with ammonia and sulfuric ether. The plate being dry, one takes the large buffer covered in white cotton velvet, one again puts powder on the plate, rubs the length of the plate as if one were using a plane, but not applying too much pressure, and one polishes in all directions, that is to say, diagonally from corner to corner, or parallel to two sides. At this level of polishing, breathing on the plate would result in a marbled white fog, with no impurities showing. One then takes one of the chamois buffers, well soaked with fine rouge, and under the moving pressure of this plane the plate will be quickly burnished. One always rubs the length of the plate and in all directions, and when one sees objects clearly reflected on the whole surface, one finishes the buffing with a third plane which is also covered with chamois but without any powder, and one finishes by buffing in the direction that cuts at a right angle the perpendicular of the image one wants to make.

One could equally, and I often do this, submit the plate to the action of large, light wooden discs covered with chamois cloth and mounted perpendicularly on a stand or made to move by a single large wheel. One thus obtains a perfect polishing and this method [p. 69] is generally used by the large establishments in London and the United States.

The little board, which moves horizontally on its axis, and which figure 18 represents, facilitates primarily the buffing of plates, and I would very much recommend it to amateurs of photography. They all know that the polishing of the surface of silver is made by an innumerable mass of curved or straight lines, crossing each other in thousands of ways in every direction, and that when the burnish obtained by means of buffers is as perfect as possible, these lines are still visible as a kind of bluish haze if one looks at the plate from a given angle. They are invisible if the light falls parallel to them, and on the other hand appear if the light hits them at a certain angle; this is what we call the direction of the

plate, and it is to make sure that the haze is not apparent that we always advise finishing the polishing with several strokes made perpendicular to the top of the plate. The haze no longer exists using the small, mobile board, and with it one easily obtains a perfect burnish. Here is how it should be done:

Strongly fix the iron press at the corner of a table or a marble mantel or chest, but in a way that it is between the operator and a window.

The operator, always in the same place, guides the direction of the polishers perpendicular to the window, and, in this position, he doesn't make a move with the plane without being able to see immediately the effect it will have on the plate.

I take up here the buffing at the point when one uses the white cotton velvet polisher and one of the dry powders; the surface of the plate will be burnished as a result of this action, and the [p. 70 curved or crossed lines disappear little by little underneath those that are formed at this instant, and, being parallel to the light rays that come from the window, are not visible from this position. So, one loosens a bit the small screw that holds the small wood board and one turns the board on its axis until the lines reappear and create the bluish haze; once again one fixes it and restarts the same process, continuing until this blue haze becomes equal in tone and homogenous; but one must not think about getting rid of it with the velvet buffer; it will always exist if looked at from a more or less wide angle.

Then one takes the chamois buffer, dipped into fine rouge, and one again starts the same operation in the same way, always bringing back the blue haze on the plate after making it disappear completely; but here, from the first strokes, one obtains a burnish that is a beautiful, clear black, and, when turning the wood board, one brings back the blue haze, it has already changed and become almost transparent. However, it is not still under the action of the fine rouge that it will disappear completely, it is only with the plane covered with very pure chamois that the burnish will acquire its full beauty and neither the haze nor lines will be visible whatever the position of the mobile plate.

The buffing is then perfect; but, as always and in everything, it depends on the care, the skill, and habits that will be brought to this delicate operation.

PREPARATION OF THE SENSITIVE COATING

P. 71:

The plate thus being perfectly cleaned and burnished, one fits it to one of the wood boards of the frame that is intended to replace the ground glass after focusing. One removes with care, by means of a pinch of cotton, all the dust particles that are on the surface, one removes the glass that covers the bisque of the iodine bottle, and one replaces it with the wood board that holds the plate. One turns over the board end to end, every 25 seconds. The plate successively takes on all of the tones that are well known: straw yellow, yellow gold, yellow orange, brick red, red passing to pink, violet red, violet, steel blue, and finally clear green, then

taking on almost its first tone of burnished silver and starting again another series, straw yellow, yellow gold, etc.

It is at the red passing to pink tone in the first series that one must stop, but rather going past it a bit rather than [p. 72 staying under it. One has counted the number of seconds needed to arrive at this color. This time varies according to the temperature, the perfection of the polish or the relative quantity of the fumes combined with the silver. Furthermore, it is the color one should rely on and it is the best guide to follow.

The plate being thus iodided, one removes the glass that covers the bisque of the chloro-bromide of lime; one replaces it, as was done for the iodine, with the wood board to which is fixed the plate which is red turning to pink. It changes tone over this new substance, and when it has taken on a violent tint, preserving however a light pink color, one must put it over the iodine and leave it there for about two-thirds of the time it was there the first time. It will become then steel blue, almost colorless, and presenting sometimes a slight greenish color, which is good to avoid.

Here are some numbers taken as averages to which one should only attach a relative importance. First iodage, 90 seconds; over the chloro-bromide of lime, 30; second iodage, 1 minute.

These different operations have to be done, as much as possible, in the dark. Therefore one must only examine the color that the plate takes on by the least bright reflections a single piece of paper or the ceiling of the room could project on it, and it is above all essential to shield the plate from light, even the slightest amount, once it passes through the second iodage. One should not look at it again.

TRIAL TEST TO PREPARE THE SENSITIVE COATING WITHOUT LOOKING AT THE COLOR OF THE PLATE

p. 73:

The sensitivity of the coating that forms on the plate, as one knows, depends on the balance that exists between the silver, the iodine, and the accelerating substances that combine together; but no information is certain in this respect. Moreover, how to measure or calculate at least the relative quantity of each of these substances, since the color the plate takes on because of them, and which is the only indication possible to consult, is often changed by causes completely independent of them as, for example, the polish of the plate, the purity of the silver, the atmosphere, the fumes or the exhalations in the air where one works, etc., etc. and nevertheless a bit more or a bit less of iodine or bromine can mean results quite different and can produce a beautiful image, or prevent any trace of the image to appear on the plate. Regarding this I have conducted numerous experiments [p. 74 and here is a means I use often and almost always with success, although it is still inadequate and does not in any way resolve the problem I have posed for myself.

When the plate is well polished and ready to receive the fumes, I put it on the iodine box, whose sliding glass I have already replaced with

a small hardwood device that entirely covers over the bisque, but which I can open partially by pulling, one after the other, three strips that are each the same length as the box and only a third of the width on its small side.

I pull one of these strips and thus establish a direct communication between the third of the silvered plate and the third of the biscuit from which the fumes are emitted. The third of the plate, on the length soon changes to straw yellow, etc., whereas the rest of the surface does not change color, and, to give numbers, I will cite those of the last experiment done in the first days of December 1849.

Fifty seconds after having removed the first strip, I take away the second; I wait again fifty more seconds, I pull along the third strip, and after fifty seconds again, I remove the plate and its small board and I put it in their frame.

If in the state that it is, I looked at this plate in the daylight, it would show three strips of the same dimensions, but of different colors, because the first was exposed to the iodine fumes for 150 seconds, the second for 100, and the third only 50.

Thus prepared, one must have the plate absorb [p. 75] chloro-bromide of lime, and for this the ordinary box suffices. When the small wood board is put into place, I pull the smooth glass so as to only open one third of the box, and I leave it partially opened for 20 seconds; then I pull the glass to expose another third; I again count 20 seconds, then I remove it completely, and after 20 seconds I put the plate and the wood board in the frame.

During this operation there will form three new colored strips on the plate; but they will be perpendicular to the first ones, and like them also equal in dimension and having different colors because the first will have been exposed to the chloro-bromide of lime for 60 seconds, the second for 40, and the third only 20. Finally, for the second iodage, I leave the plate exposed in the ordinary way to the iodine fumes for 80 seconds. It is then ready to receive the impression of light.

At this moment the plate has a surface divided into nine parts of different hues, each of whose sensitive coating was formed by different combinations of silver, iodine, chlorine, and bromine; but, it is evident that if I make an image with this plate, and this image is more beautiful in one of the areas than the others, it will be the combination which will be

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the most favorable for the photographic operation. One must then try to obtain this surface on all of the plates one intends to make images with. It goes without saying that a trial of this type has to be done under identical conditions, and one must use as the subject a monument of the same tone, for example, [p. 76: and evenly lit, or an engraving or a printed page, a newspaper. The experiment of which I speak was done with a pretty lithograph representing a fantastic ronde by Willis. These are the results obtained:

First area, at the top and to the left of the plate looking at the image: first iodage, 150 seconds; exposure to the chloro-bromide of lime, 60; second iodage, 80 seconds. This second iodage being the same for

each area, I would not repeat it. Bad image, black, without details, and hazy in the shadows.

Second: iodage, 100 seconds; bromine, 60; image completely solarized.

Third: iodage 50 seconds; bromine, 60; image better than the one before, but over exposed also.

Fourth, underneath the first: iodage, 150 seconds; bromine 40, magnificent image, with a remarkable vigour, brilliant whites.

Fifth, in the center of the plate: iodage, 100 seconds, bromine, 40; beautiful image, but light fogginess.

Sixth: iodage, 50; bromine, 40; better than the preceding, but not as good as the fourth.

Seventh: iodage 150; bromine, 20; black, incomplete, very bad.

Eighth: iodage 100; bromine 20; passable, but a bit black.

Ninth: iodage, 50; bromine, 20; second iodage, 80 seconds, like the eight other areas; bad, but a bit less than the seventh.

There was thus a very pronounced difference between the image produced on the fourth area and [p. 77 those on all the other areas. I then prepared several plates by exposing them like the fourth to the iodine fumes for 150 seconds, to the chloro-bromide of lime for 40, and the second iodage for 80, and I thus obtained eight images just as beautiful as the fourth area of the plate proof.

These experiments are of great interest; one could modify them in a thousand ways and perhaps arrive at some certainty as to the combination of substances that form the sensitive coating. What is remarkable is that the best combination found in the morning varies very little throughout the day; but the next day, for example, it is not longer determinant; it seems that another light, a different wind, a change in temperature, demand other proportions in the mixture of substances; thus the fourth square, so remarkable only a few days ago, the next day only gave me an almost foggy image although I worked with the same dosages.

Again one must state that the four worst images were in the four corners of the plate, the first, third, seventh, and ninth compartments; and that in the center, the fifth, was beautiful but a bit foggy; perhaps it would have been perfect if the exposure in the camera had been shorter. One finds there the effect of the lenses, necessarily more luminous in the center than at the edges. Thus one has to combine these tests under different lighting conditions, and there is perhaps still a field open to its successes, its deceptions, its unexpected results, its emotions in short, and this word will be understood as that which makes photography one of the most attractive occupations that can be found.

THE MEANS OF EASILY JUDGING THE COLOR OF THE PLATE

p. 78:

A very simple modification made to one of my frames allows me to examine the color of the plates during all phases of their transformation,

whether in full light, or even in the sun, if I want, and without any drawback. It goes without saying that to achieve this a point on the plate has to be sacrificed; but this point will only be the size of a lentil, and will be in a corner of the plate that will be covered over when the image is framed.

When I take out the plate from the mercury box, it always has at one of its corners, close to the edge, a small mark about 5 millimeters in diameter, very white and solarized, according to whether I examined the color of the plate in a more or less bright light. It is easy to conclude from it that it is through a small hole in the runner of the frame that I judge the hues produced by the iodine and the [p. 79: bromine; but the hole must be made in a way that presents the least disadvantages. One pierces in the runner of the frame, which is intended exclusively for the examination of plates (figure 21), a hole about 12 to 14 millimeters in diameter and in a place that matches exactly one of the angles of the plate. There, on the inside, one glues a small hollow cone, made from wood or cardboard, whose large opening will be about 10 millimeters in diameter, and whose small opening will only be 4 or 5. It is essential that the interior sides of the cone or the edge touch the plate, so that light cannot come between them and thus form with the mercury a halo that more or less spreads across the plate. The upper edge of the cone will be level with the surface of the runner, which is screwed to the frame so that it is no longer mobile. The interior of the small funnel will be painted white so that it can reflect as much light as possible on the small exposed piece of metal. This part of the plate exposed which, by its position, will form the bottom of the hollow cone, can be looked at easily next to a window or outside. By placing the runner between the light and a piece of white paper which will reflect the light in the cone itself, one will judge the hues of this small area as if one were looking at the entire plate; because one must not forget that with the bisque boxes the different hues a well polished plate takes on are perfectly even throughout and the small corner of the plate will be identical to the color of the entire surface.

All the operators know how difficult it is to judge well the value of the tones produced by the iodine or the accelerating substances when one looks at them in a room or [p. 80] a place other than where one usually prepares the sensitive coating. This disadvantage, very serious especially for people who take pictures of sites and monuments, no longer exists when using this frame with the small opening, because looking at the color of the plate in broad daylight, one is always in the same conditions.

It goes without saying that one has to have a frame for every size of plate..

PLACEMENT FOR THE CAMERA WHEN REPRODUCING A SITE OR MONUMENT

P. 81:

A recent experiment, well observed for me, has led me to call the attention of the amateurs in particular to the placement of the camera when they want to reproduce a site or monument, a placement that is

dependent upon the local conditions, but which one must come as close as possible.

The best condition for obtaining a clear and vigorous image is to align the sun with the camera and the monument, the camera necessarily is placed between the sun and the building; but if this placement is the best for the photographic process, it is not the best in terms of light effects since the building, being lost in the sunlight that passes directly from the viewer to the monument, its range of shadows will not be visible, and there cannot be in the drawing any of [p. 82 of these contrasts, these lively effects that give charm to even the least picturesque sites. One therefore must choose an in-between position and stand, if one can, in such a way so that the sun is at a 50 or 60 degree angle on either side of the straight line or axis. I cannot stress too much, as always, to turn the camera so that the parallel glass or the prism present their reflective surfaces to the side opposite the point of the horizon where the sun is. If the sun is in the East, for example, it is towards the East that one must point the lens, so that the surface of the prism is turned to the West.

One will not have studied the way in which a monument is lit at every hour of the day so as to take a picture when the light strikes in the most favorable manner the most picturesque or the most characteristic aspect. Unfortunately, there are some aspects that can never result in a satisfactory image because of their position. This is easily understood.

Here, furthermore, is a general rule one must never forget. Every time the reflective surface of the prism is positioned in such a way as to receive, even at an angle, the sun's rays, visible or not, the image will be blurred and more or less hazy because of the intensity of the sun. Therefore, as much as possible, the back or the silvered side of the prism should be turned towards the sun, either shining or clouded over, even if the camera is in the shade or even in an apartment.

EXPOSURE IN THE CAMERA

p. 83:

The plate having been coated with a sensitive layer and well enclosed in its frame, will be placed, as early as possible, in the camera. It could, without doubt, wait for several hours, from one day to the next even, without losing its intensity; but it is always worthwhile to use it immediately because it is almost impossible to prevent dust from clinging to its surface or air from producing stains that appear under the influence of the mercury.

Here one must take precautions, especially those like me who use small boards with a small opening lined with strips silvered copper [double] to iodize or bromidate plates smaller than the box or the basin, a quarter or sixth plate, for example, on a box intended for a full plate; this is to never expose the plate in the camera on the same small board that has just been exposed to coloring fumes. In the deepest darkness one has to remove the plate from [p. 84 this small board and put it on another small board that has been perfectly cleaned with ethanol or hyposulfate of soda and thoroughly dried. Without this precaution one will only get a dreadful

image, if one even gets an image because often not even the smallest trace of an image appears after the plate comes out of the mercury box. It is likely that the iodine or bromine fumes which have soaked into the wood, spread in the camera around the sensitive plate and create new combinations contrary to the photographic phenomena.

It goes without saying that this is not addressed to those who iodize their bare plates.

The precaution I have just pointed out is useless to take when using a full plate because in that case the small board only has the surface of the silvered strips upon which the plate rests and these strips stop the iodine and bromine fumes that have colored them. They only form, as it were, an appendage of the same type all around the plate.

The length of time during which the sensitized plate should be exposed in the camera to the action of light cannot be determined beforehand; every operator must rely upon his own experience.

However, here are some rigorously exact numbers from my recent attempts, but which can only be approximate for attempts undertaken under other conditions.

A view of the church of Saint-Germain-en-Laye and a part of the chateau was taken in 7 seconds, [p. 85 the average time for 5 images. I use M. Chevalier's lens with a long focal point at 3 pm in the sun and during the first days of October. The image, rectified by a prism, fills an entire full plate.

The same view made under the same conditions but in a more somber light and during a fine rain, takes 25 seconds, as witnessed by M. de Valicourt and Charles Chevalier.

A view of Notre Dame taken last September from the Tournelle quay in the sun at 3 pm was made 6 times with a rare clarity in 7 and 12 seconds.

Attempts to take pictures of people and dress, made in one of the best lit glass gazebos in Paris, and with a Viennese full plate lens, but in a thick mist, and without rectifying the image, gave me passable images on half-plates, in 7 seconds at noon, 12 at 2 pm and 25 at 4, in the first days of November.

In Athens, under a bright sun, one needed 4 to 6 seconds to make a rectified view on a full plate by placing in front of a normal lens a cap with a 1 centimeter opening.

EXPOSURE TO MERCURY

p. 86:

When one judges the plate sufficiently exposed in the camera, one closes the runner of the frame, and one pulls it out with all the necessary precautions to protect it from the light. One places it immediately in the mercury box where the image, of which no trace is apparent, will come up and develop under the action of the mercury fumes; one lights the ethanol/spirit lamp, placed under the metal basin that forms the bottom of the box, and one allows the thermometer to reach 60 degrees celsius. One extinguishes the lamp, plunges the open end of the small glass

tube (figure 20) or a rolled piece of paper, in a bottle of sulfuric ether, allowing two or three drops of it to enter into the tube, and one stops up

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the other end with a small piece of wood and one places it in the mercury box through the hole there in a way so that the evaporation takes place just above the ball of the thermometer. One allows the thermometer to drop to 25 degrees and one takes out the plate, which should be well developed. It is

better not to look at it under candlelight [p. 87 while the image is forming. Some people keep a lamp lit beneath their mercury box all day long, which maintains the alcohol of the thermometer at 55 degrees. The plate can be removed then at the end of six or eight minutes.

Few operators use the sulfuric ether advised by M. Laborde, physics professor at Corbigny, nevertheless an ethereal image is much warmer, bolder, and whiter in tone than one that is not and which was made under the same conditions as the first. If one wants to convince oneself that ether produced some effect or other on the plate, one can look at it when it is fixed by gold chloride; by holding it in a certain way and looking at it at close range, one would perceive a rather thick layer of gray ash, but clear when looked at perpendicularly (straight on). It seems that under the influence of ether fumes the mercury molecules are deposited on the plate in new ways, and, without a doubt for me, this is completely favorable as to the beauty of the image.

It was also M. Laborde who was the first to point out the double iodage as a way of getting rid of the bromide hazes that came from its excess; but it is right to say that it was Mr. W. Thompson, one of the most skilled operators I know, who popularized this method, which remained only theoretical until he made known the practical advantages of it. Moreover it was not the only service he has rendered to persons who are involved [p. 88 in photography because he has given the art of portraiture a remarkable impulsion and contributed more than anyone else to the progress made lately.

The mercury should from time to time be filtered through a fine cloth to get rid of the layer of oxide that covers it and which harms the release of the fumes.

RINSING WITH HYPOSULFATE OF SODA

p. 89:

Coming out of the mercury box the image, which is judged beautiful enough to keep, and consequently fixed by gold chloride, first has to be cleaned of the bluish or greenish violet layer that the accelerating substances has given it, and which has resisted, at least apparently, the light and the mercury fumes.

Hyposulfate of soda is the salt used for this. Dissolve 60 or 80 grams in a liter of filtered water and pass this solution through paper.

Have two flat basins made of glazed earthenware or porcelain. They are better than metal ones; one could also use those of gutta-percha, which would be neither heavy nor fragile. In one put enough filtered water so that the plate would be well covered; in the other pour the same quantity

of hyposulfate solution. 7 or 8 millimeters high of these liquids will suffice. Plunge the plate into the cold water of the first basin, leaving it there for [p. 90 several seconds, 25 or 30, then take it out flat by two of its corners, and place it in the same position at the bottom of the other basin containing the hyposulfate solution. The blue or violet layer grows dim and then soon disappears, especially if you give the basis a little impulsion, which constantly changes the relationship of the plate with the molecules in the liquid. When the plate no longer has the slightest yellow hue and the iodine has disappeared, take it out by one of its corners, plunge it again into the first basin, rinse it with lots of water, and place it on M. Ch. Chevalier's double return spring grill or other devices used to hold images. But take care not to let any part of its surface dry or risk seeing there a brown stain that will spoil your image.

One could still use another process that works perfectly well, especially for small plates. Holding them in the hand or with flat pliers and at a 40 to 45 degree angle expose them to a spurt of hyposulfate of soda solution flowing from a crystal pitcher or carafe held in the other hand, and move them under this spurt so that the iodine is dissolved and swept away by the current of hyposulfate; then wash the plate with much water before fixing it with gold chloride. The hyposulfate solution can be saved, filtered, and reused several times again.

FIXING WITH GOLD CHLORIDE

p. 91

I have little to say about this operation, which is so well known by everyone. Cover the plate that is on the grill with as much gold chloride solution that its surface can hold. Even out the thickness of this liquid layer with two screws ; heat this plate with a strong ethanol lamp that heats it evenly throughout until the moment when the plate, which darkens at first, ends up whitening and having a tonal vigor. Once it is good don't go trying to make it better or you will most certainly ruin it.

Stop the heat, wash the plate in a lot of water, cover it with distilled water and dry it with the lamp by holding it by means of pliers if it is small or with the excellent fork invented by M. de Brebisson and frame it as soon as you can. It is unnecessary, as I already said, to take off the varnish that covers the back of the plate beforehand. The heat of the spirit lamp, which is strong enough to almost boil the layer of gold chloride on the plate, will not alter the resin thickened by the [p. 92 lead chromate, and this operation can be done again without the least drawback.

One has to fill the holes in the corners of the plate with small pieces of soft wood for risk of seeing the silver film become detached from the plate in small webs so that in some parts, and particularly in the shadows, the plate takes on a milky haze that cannot be removed.

I do not know if the silver deposited by battery jumps like the clad-plate that is heated too much. It is an experiment to do.

The gold salt known by the name of its inventors, Fordos and Gelis, is extremely convenient, especially when traveling because it can be preserved indefinitely and it is easy to prepare in a few seconds the

quantity one needs. It suffices to dissolve it in distilled water and in the proportion of one gram for every 800 grams of water.

As for the excellent preparation that we owe to M. Fizeau, it is for me the best of all, and seems to me to give the whitest and warmest tones to the plates. Moreover, these two chlorides each have their advantages, and one has to be abundantly provided with one and the elements that are used to make the other. Their solutions will be carefully filtered before being used.

The image fixed in gold salt should be immediately put under glass, and as much as possible protected from the air, [p. 93 dust and humidity, which will hasten to alter it. As for the light, it has not the least effect on the plate. One must never enclose a plate in a frame or a mat that is not perfectly dry; for if it is still a bit wet under the glue it will form permanent white stains on the plate which cannot be removed even by potassium cyanide.

Finally, I recommend to those amateur photographers who will read these notes the silvering of plates repeated with every image; bisque boxes for iodine and the accelerating substance, the preparation of chloro-bromide of lime, the drops of sulfuric ether, the small reversed and hollow cone, so that one can follow the hues of the sensitive coating; the test plate with the different combinations of silver, iodine and bromide made on different parts of the plate; and the horizontal buffing board that moves at its center.

I also ask them a bit of indulgence for these notes quickly written; finally, I would like to get them to follow my example, and to make known the results of their research if it is to science they are addressing themselves, as I inform them with pleasure, for my part, about what chance has given me, it would only be, perhaps, to answer the numerous questions that I constantly ask.

Saint-Germain-en-Laye, le 15

juillet 1850

EXPLANATION OF FIGURES

p. 94

The proportions observed in the drawing of the figures are not exact. Some details and some measurements were exaggerated so as to make the forms better understood. It's not the same in the text; these were rigorously calculated.

Figure 1 is a glass or crystal bottle, known commercially under the name of conserve. The interior surface of the bottom of this bottle being domed in the center, it is rather difficult to have tubes or caps with small diameters whose base is not ordinarily indented or concave stand up. One remedies this inconvenience by putting at the bottom of this bottle a wood ring whose opening, cut at an angle, is calculated so that the wood and the highest part of the glass create a level surface. The weight of the rolled sheet of copper and the diaphragm are sufficient to keep it at the bottom of the solution of copper sulfate.

Figure 2 is the rolled copper sheet with its extension and the conductor wire twisted into a spiral. [p. 95 The cylinder shape that it

forms can be made smaller by pressing with a hand. It could even almost touch the diaphragm, which would be a way to increase the action of the battery since the two metals, zinc and copper, would be closer to one another.

Figure 3 represents the small gallery that serves as the head of the cylinder formed with the copper sheet. It contains the sulfate crystals, which are intended to replace in their solution the metallic copper that is revitalized on the rolled sheet, whereas the silver of the cyanide bath attaches itself to the plate that is being silvered.

To better understand this I drew it from two different perspectives, horizontally to show how the sulfate of copper crystals are placed, and from below so as to show the series of small holes that allow the water saturated with sulfate to come into contact with the crystals. These holes should be no larger than 3 millimeters in diameter, so that small pieces of the sulfate cannot pass through them.

All of the parts that make up the small gallery will be soldered with an alloy and not with tin.

Figure 4 represents the amalgamated zinc stick with its extension, the copper rod that passes through it and the spiral or conductor wire fixed to the extension with a small pressure screw (fig. 6). The red or rose copper wire that I use to form the conductor spirals weigh 1 1/2 grams the meter; this is, I think, the best way to communicate its thickness.

Figure 5 is the diaphragm or porous tube made of baked clay.
p. 96:

The diaphragms made of plaster or copper do not differ from this tube except in thickness of their walls. The thickness of those in red copper are 1/2 millimeter, those of earthenware 4 millimeters and 7 1/2 for those made of plaster. It is always good to have the same interior diameter for all these diaphragms, that is, 6 centimeters.

Figure 6 is a small copper or brass screw; those that are found at the corners of the polishing boards could be used to fix the conductors.

Figure 7 represents the whole battery ready to receive the liquid stimulators, or already containing them.

Figure 8 is the lead ring upon which sits the mold that will make the plaster diaphragms.

Figure 9 is the tin rod that ends in a roundel which is intended to close the upper opening of the interior cylinder. It is on this that one pours the liquid plaster which fills up the space between the two cylinders..

Figure 10 represents all of the parts of the mold arranged in a way so that it is ready to receive the plaster by the opening at the top. a is the lead ring, b is the small tin cylinder, c the stem and the roundel, d the large cylinder, and e the string wrapped around the whole that keeps it together.

Figure 11 is the wood frame that one places on the decomposition vat, so as to easily bring into contact the galvanic battery with the bath and the plates that one submerges into it.

A is the copper rod from which is suspended the plate b that one

wants to silver.

E is another brass rod to which is attached by two pure silver hooks the soluble anode c . It passes through one [p. 97 of the five double holes, bored horizontally in the wood, and so could be placed further or closer to the plate b.

F are the small brass rods whose ends, bent into right angles, enter into the frame perpendicularly. These rods lay flat on the wood itself.

G is the very fine red copper wire made into a spiral that is attached to the copper pole of the battery.

H is the other conductor that goes from the zinc pole to the plate to be silvered.

D is the thin copper wire that serves to establish the electrical communication by the immersion of the plate in the bath.

Figure 12 represents one of the small pure silver hooks that are used to suspend the anode in the bath.

Figure 13 is one of the copper hooks intended for the plate that one is silvering.

Figure 14 is a cross-section of the double basin for iodine or chloro-bromide of lime, when the glass strips bb have been glued to the edges of the bisque.

Figure 15 represents the same cross-section as in figure 14, however with the perpendicular strip of glass c glued all around the double basin so as to prevent evaporation of the substances through the edges of the bisque itself a.

Figure 16 is the cross section of the completed double basin holding liquid and ready to be placed in a simple box or the double box that I use.

A is the eathenware plate; bb are the small glass strips that are glued to it; c the strips of glass glued perpendicular [p. 98 on the edge of the bisque and the small strips; d the ribbon of wire or gutta-percha well glued so as to adhere the lower glass f to the surface of the strips b and to the area of the glass c, without itself being glued there; e is the iodine or the chloro-bromide of lime; g the ground glass below that rests flat on the bisque when the box is dormant; finally h is the well ground glass that slides on the top of the basin where the fumes are emitted.

Figure 17 is a section of one of the large sides of the double box that was part of my portable equipment.

A is the box open on both sides to receive the board that holds the plate; b the ground glass sliding over the basin; c the empty space where the fumes are discharged; d the bisque resting on the chloro-bromide of lime e; f the glass that encloses the basin that contains it; g the open space between the two double basins that only touch back to back by the ribbon of wire or gutta-percha p; h the glass the encloses the basin containing the iodine I; k the bisque that covers it; l the empty space where the fumes are exhaled; m the ground glass that slides over this basin; n the perpendicular glass band glued to the edge of the bisque to prevent

the fumes from escaping; finally, on the small strips of glass glued to the bisque and to themselves, to form the height of the sides of the double basins.

I omitted, to be less confusing, two ground glasses that should be placed in the empty spaces c and l, and that one can find in figure 16, letter g.

Figure 18 is the small device that allows the polishing board to move horizontally at its center and to be stopped and fixed at the position one desires.

A is the small polishing board; b a bolt that holds it with 4 screws; p. 99

c, an iron press intended to secure the whole on the edge of a table or a piece of marble

d; e the steel pressure screw whose point should enter the neck of the bolt b, which will turn and fit snugly in the opening f.

Figure 19 is the small wood stamp that is used to buff the plates. A is a velvet or skin covering that makes it softer for the hand; b is the piece of rubber glued to the stamp with sealing wax; c is a square piece of white cotton velvet, arranged in such a way so that the two opposite points fold over the neck of the stamp and so are held in place by the operator's fingers. Figure 20 is the glass tube used to spread ether fumes in the mercury box; a is the tube; b a round piece of cork, c a small peg made of soft wood that closes off the tube, and d the ether used for a full plate. Figure 21 represents the frame with the small hollow reversed cone through which one can—in daylight, survey the successive hues the plate takes on when exposed to iodine or accelerating substances.

a is the frame into which is built the runner in b; it is a section of a side of this frame; d the screw that holds the runner; e the small cone that extends to the surface of the plate f, which rests on the board g.

Finally, the last figure, 22, is one of these small sand batteries that are to me preferable to all others; a is the glass bottle, b the moist sandstone, c a zinc plate, d a copper plate, and ee the pressure screws and the conductor wires.

PORTABLE APPARATUS

p. 100

In these notes I talked about my portable apparatus for full plate and as the combination of all the parts that make it is the result of much research in an attempt to make them occupy the least possible space, perhaps it will be useful to describe it.

The camera is made up of two boxes: one that the lenses screw onto; the other holds the ground glass and slides into the first like a drawer. By means of this pulling out the length of the camera can vary from 28 to 52 centimeters.

The camera, reduced to its smallest volume, is 28 centimeters high when it is in place, 23 when it is screwed widthwise onto the wood platform, which fixes it to the mobile top of the foot, and 29 centimeters wide.

The metal rings are calculated so that it is possible to adjust the lens on the inside of the camera or on the exterior to move it further away from the opening where it is attached. Thus one obtains all the focal distances in between 17 and 60 centimeters.

p. 101

I had a case made in the form of a trunk, very solidly built, covered with water resistant leather and with iron on all its edges. It was made to travel on the back of a mule in mountains that are almost inaccessible.

The interior, which is well lined with red chamois, is 29 centimeters wide, 41 centimeters long, and 32 centimeters deep.

At the bottom of the box are three rods with two parts that form the foot of the apparatus and that fold into three parts.

All of the bolts, the top and the nuts from it are removed. Next to the three rods, and in a double box made of cardboard, are two large buffers whose handles are removable and stored elsewhere.

On the five objects that cover the bottom of the trunk a piece of cardboard, 4 millimeters thick and covered in leather on both sides, is placed. It serves to level the whole surface and prevent any rubbing. Its corners rest on small wood pieces that are fastened at the four corners.

Here I have to resume in another order.

A box made of thin wood and closed with a sliding panel, which has small compartments that are well arranged and covered with chamois, contains the following objects:

The whole head of the tripod, minus the pressure screw that fixes the mobile ball.

Four lenses with their metal rings and their extensions.

Three diaphragms or caps.

A prism to rectify objects.

Its metal ring that has a continuous rotation.

p. 102

The three large bolts and their nuts used to mount the head on the foot.

The six small bolts and their nuts to fix the six hinges of this head when it is opened up.

The pressure screw of the large mobile ball.

A jar made of boxwood containing the mercury.

A small boxwood funnel to put it back into the jar.

An ethanol lamp that is filled up.

A box of matches.

A packet of string.

A knife with several blades and a screwdriver.

A box of pins, two gimlets (t-shaped tools), several nails without heads, nails and a hook screw.

Lastly, the small glass tube with the drops of ether.

This box once closed is placed into the mercury box into which it fits perfectly.

The mercury box, once it is closed, fits into the part of the

camera where the ground glass forms the bottom. It does not take up all of the room inside, but the space leftover is meant for two frames with their wood board and their plates, and a cardboard tube containing a candle and forming a stand upon which it is set.

Thus filled up this whole part of the camera slides into the other.

The camera, thus reduced to its smallest volume, is fixed to the platform with screws, horizontally held to the mobile head of the tripod.

One puts the whole, with the platform under it, on the bottom that covers the dismantled foot and the buffers, taking care to press the side closed by the ground glass against one of the side walls of the trunk. [p. 103 There is still room left in the trunk where one puts the following:

The double box with the double basin containing the iodine and the chloro-bromide of lime and a board that covers each of these.

The frame with a hollow cone together with a small board and a plate.

A box containing six plates which makes it nine plates because there are already three in the frame and this is more than one needs when one wants to take a picture.

The polishing board and the press that serves to hold it.

The two handles of the polishers.

The screwdriver of the camera.

Three small boxwood bottles containing the pumice, rotten stone and the fine rouge.

A small bottle of alcohol and another of ether.

Three or four cards of cotton.

Several meters of black fabric.

Two towels.

And finally a small, hard brush to clean the buffers.

The lid for the small trunk presses against the whole when closed and the apparatus, as complete as possible, can travel without danger. There is no empty space on the inside.

It takes 20 minutes to open up and put into place everything it contains, and as much time to disassemble and put every object into its compartment after one has made the images one wanted to make.

One will find in this long inventory objects that seem a bit odd; but one must think about the fact that [p. 104 in high mountains, in an Indian hut, and more often in the attics of Paris, one does not always have what it takes to shade a small area.

I would often have paid dearly for a nail, a hook, and a bit of black cloth or a piece of rope.

SUPPLEMENT TO THE NOTES THAT ARE RELATED TO THE GALVANIC DEPOSIT OF SILVER

While the preceding notes were being printed, I was asked to give information on the processes I described and the difficulties in obtaining good results when attempting to deposit a layer of silver on a clad plate by galvanizing. Therefore I think it useful to add here some words and to speak again of the method I use and the way I work without fearing the least disappointment. It is so simple and easy that it seems to me almost impossible not to succeed on the first try if one wants to stick to rigorously following the steps I have indicated and which until now seem to me the best and the least complicated. I emphasize this word rigorously owing to the experience that I have just had and that proved to me that the most essential precautions [p. 106] are often ignored, or that arrangements totally contrary to the development of electrical phenomena were adopted which had no relation to what I indicated. Thus, for example, four people who are total strangers, and certainly skilled in photography, consulted me about their batteries, set up according to my directions, and which were impossible to use... And so! three of these operators had connected together, and by a copper wire, the copper and zinc elements contained in the same bottle, and the fourth, who did not make this same mistake, made up for it by suspending the soluble anode and the plate to be silvered in the decomposition vat, by two metal rods that were connected to the two copper and zinc poles of the battery!... It was enough to restore these apparatuses to their normal state so that the batteries function beautifully and the four persons perhaps will smile when reading these lines if they see them, and will silver with greater ease.

The silver bath is prepared as I have already indicated, but one must dilute it with distilled water until the acidometer, which one floats on top, shows five degrees, weak rather than strong.

Into a small bottle or in a bottle with a wide opening full of ordinary water, slowly pour pure sulfuric acid until the acidometer, which will float to the surface of the water, measures 6 degrees.

Take two small glass conserves already described in figure 22, or better yet two jelly jars the same size as these conserves, and pierce a very small hole in the [p. 107] bottom of each of these vases so that the acidulated water that moistens the sand they will contain, can run out, exactly like the water when one waters flowers that decorate a balcony or a window.

The glass is pierced rather easily using a triangular file, broken at its upper end and whose point has been sharpened into the shape of a small pyramid that is very sharp. One plunges this point into the essence of turpentine, one pushes against the glass where one wants to make a hole, and by moving this tool in the same way as a punch with which one wants to pierce wood, one soon breaks through the glass which falls into small white chips. One again plunges the steel point into the turpentine, and in five or six minutes at the most, one has drilled the glass right through. In order to succeed there must necessarily be a bit of skill and some care; above all one should not try to go too fast.

Take very dry and pulverized sandstone, that which all the cooks

use to scour pans. Sift it and slowly fill up the two bottles that have been pierced.

Place perpendicularly into the sand a copper plate and a zinc plate so that they are parallel and are 2 to 3 centimeters apart. Look at figure 22 to see their form and their position.

The zinc will be amalgamated.

Put the two bottles thus prepared into a small flat basin so that the acidulated water that will seep through the small hole at the bottom will not leak into the apartment, and p. 108 put this device, this small battery, next to the decomposition vat containing the silver bath.

Into this bath suspend by means of a red copper rod that rests on the edges of the basin, the soluble anode held by two silver hooks.

Attach a red copper wire to this same rod and fix the other end of this wire to the copper element in the first bottle; it should end there..

Do not establish any connection, any contact, between this copper plate and the zinc plate which are next to each other in the same vase, but attach another copper wire to this zinc and make it go to the copper plate that is in the sand of the second bottle where it will stay and not go further.

Do not establish any connection, any contact between the copper of the second bottle and the zinc that is next to it in the same vase, but attach a third red copper wire to this zinc and fix the other end of this wire to a second copper rod that will rest on the edges of the basin, parallel to that which holds the soluble anode in the bath. It will be to this second rod that one will later suspend the plates one wants to silver.

The complete device having been set up, pour onto the sand of each bottle the water that you will have acidulated by sulfuric acid until the sand, well moistened, allows the excess to run out the small opening.

At this point and immediately after having moistened the sand, the battery is ready to be used and one can try immediately, here is how:

Take a copper rod that is as thick as a quill of a raven's feather, make it touch the rod [p. 109] that is to hold the plate to be silvered in the bath, and, continuing to maintain contact, plunge the end of this rod into the bath. Not only the emerged part will be silvered, but it will produce a rather strong effervescence, and numerous gaseous bubbles coming from the decomposition of the water will release from the rod to burst the surface of the liquid. If this phenomenon takes place, the battery is working and every plate that has been carefully polished will be

perfectly silvered.

If the gas is not released from the emerged part of this copper rod, which should be exactly 3 millimeters in diameter, there is some error to correct. Perhaps the conductors are not well set up or fixed, the points of contact are not sharp enough, a layer of oxide perhaps has formed between the hooks of the anode and the rod from which it hangs, the acidulated water is not strong enough; if the elements are too close together, a layer of zinc will have covered the copper plate and will have whitened it, etc, etc., etc.

One must then remedy these faults that one recognizes and try again the very simple and conclusive experiment that I have just indicated.

A very thin copper wire, connecting to the zinc pole, and submerged into the basin when the anode is there and when the conductors are well set up, will result in a pronounced effervescence. But the more the diameter of this wire is, the less the bubbles will form at its end, and they will no longer be apparent once it gets beyond a certain thickness. Therefore, there is a direct connection between the volume of the copper immersed in the bath and the production of gaseous bubbles that form on it; but a long experience has proven to me that [p. 110 when the gas is released copiously around a copper wire that is 3 millimeters thick and is immersed about 3 centimeters in the bath, the best conditions for the battery exist to silver the plates one uses regularly, quarter, half, and full.

A single battery, set up following the proportions indicated above, is too weak, one has to at least have two, or else one can double the active surfaces of a single bottle as I will show later.

After twenty minutes of immersion, during which the position of a large plate would have been changed two or three times, there will be deposited on it two and a half decigrams of silver, and that is all that is needed to get a beautiful image. The deposited layer will have a bluish white look that is perfectly even when it emerges from the bath.

The plate that one wants to silver is immersed in the bath as has been pointed out in the preceding notes; but right away I put a small copper hook into each of the three holes made in three of the corners of this plate. It thus becomes easier to change its position in the bath. The plate should be hung parallel to the anode directly opposite it and at a distance of about seven to eight centimeters.

One was able to see in one of the notes already published that the silver anode is covered in a layer of black or gray oxide that is difficult to remove and which is often harmful to the perfection of the metal deposit. The remedy that I pointed out, based on the theory that I found in several works, does not always work and on the contrary, in some

circumstances, increases the harm rather than reduces it. This deposit, it was said, was only a union of silver cyanide insoluble in water and [p. 111 which can only disappear with an excess of potassium cyanide. It is probable that this theory is not justified and the experiments done in Russia by M. the Duke of Leuchtenberge seems to prove that the oxide formed on the anodes comes from foreign substances that are often found in metal, in cyanides, or in acids that are used, and which, through some still unknown action, are deposited, perhaps in combination, on one of the elements of the battery.

Until we have better information, one must very simply remove

from time to time the anode from the bath and remove the black oxide from it by washing with a lot of water after having scraped it with a hard brush and soap.

The cleaning of these excellent small batteries is as simple as it is easy: each evening one removes the copper and zinc plates that compose it and one washes them with a hard brush, or one rubs them with a piece of pumice or sandstone, if the oxide that covers them is too strong, and especially if the copper has become white by the action of the zinc that is acted upon it. One can change the sand of the batteries every 5 or 6 days without throwing it out; washed and dried, the sand can be used indefinitely. As for the zinc it is good to amalgamate it every 8 or 10 days.

One last word: one can increase the action of each of these small batteries by doubling their active surfaces, that is to say, by using for example, the two sides of the copper plate and that is what I always do..

The bottle being full of sand, I sink the copper plate into it so that it is well positioned and centered, and I place on each side and two centimeters away an amalgamated zinc plate. No contact is established among these three elements in the same bottle, but a red copper wire fixed to the copper plate will be attached to the rod to which [p. 112 is hung the soluble anode in the bath, and another copper wire comes from each zinc plate to be attached

to the rod from which the plate to be silvered will be hung. I use only a single battery thus prepared.

Two of these bottles form a small battery that is powerful enough, but often too strong to silver full plates.

The copper of the first bottle connects to the anode, whereas the two zincs of this same bottle are connected to the copper of the second, whose two zincs are attached to the rod to which will be hung the plates to be silvered.

The same arrangement will always be followed, whatever the number of batteries with which one wants to make a battery; but the copper

and zinc elements in the same bottle must never touch or be connected to one another by a conductor wire.

It goes without saying that the sandstone in the batteries has to be continuously saturated with acidulated water, and that consequently one must pour a small quantity of this water on it every four or five hours; a half of glass, for example, will suffice for each time and for each bottle.

END