TONING WITH GOLD AND PLATINUM.

Introduction.

When a silver print has been removed from the printing frame, it is found to be of a reddish brown or violet colour, and, of course, still sensitive to actinic light. To remove the sensitive salts which have not been acted upon by the light, it is necessary to use one of the various fixing agents, which will be considered later. If the print is merely fixed, however, the result is unsatisfactory, the colour being some shade of brown or yellow. To change this deposit, which consists of metallic silver, the usual method is the substitution of gold or platinum for the original silver. Gelatino- and collodio-chloride papers are coated with gelatine or collodion emulsion, which is chiefly composed of silver chloride, free silver nitrate, and citrate ; and the chemical change produced by the action of light differs in degree according to the varying intensity of the light, the reduced silver chloride being in a suitable physical state for the deposition of another metal.

Toning Action of Gold and Platinum.

The chemistry of toning this class of paper is comparatively simple, the important part of the action of gold chloride being expressed by the equation

$$Ag + \underline{Au\,Cl} = Ag\,Cl + \underline{Au}$$

(Silver and gold chloride form silver chloride and gold.)

Other metals might be used, but gold and platinum are at the present time universally employed for P.O.P., collodion, and albumen papers. The bath should be either neutral or alkaline; if acid, the image will be attacked, and unsatisfactory tones produced. The neutral bath gives splendid purple tones, but is slower in action than one with a slight excess of alkali. In this latter bath, the gold chloride is first reduced from auric chloride ($Au\,Cl_3$) to aurous chloride (Au Cl). This is a slow process, so that the bath is best left standing a short time before use. An atom of gold is then deposited, taking the place of one atom of silver, as in the equation previously stated. In the same manner, platinum is deposited in the place of the silver.

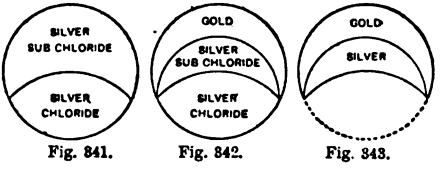

Fig. 341. Fig. 342. Fig. 343.

Fig. 341.—Silver Image After Printing.
Fig. 342.—Silver Image After Toning.
Fig. 343.—Silver Image After Fixing.

The Theory of Toning

is not yet wholly understood, nor is it certainly known what exact physical change takes place when the silver image is replaced by the gold. It is almost generally accepted that the particles of silver chloride and free silver are acted on by the gold upon the top surface only, which it replaces ; the lower portion of the particles remaining unaltered. A certain proportion of the chloride of silver is also left. Fig. 342 gives an idea of how the gold is deposited (see also Figs. 341 and 343). Gold trichloride is the commercial form of the toning metal now in general use.

If used alone, the gold trichloride would give a blue image, which, on being fixed, would be excessively weak. This is accounted for by the fact that one atom of gold would take the place of three atoms of silver. The image would therefore be less vigorous, as shown by the equation

$$3\,Ag_2\,Cl + Au\,Cl_3 = 6\,Ag\,Cl + Au$$

(Silver Sub-Chloride) (Gold Chloride) (Silver Chloride) (Gold)

Fortunately, gold chloride exists in two states, the auric and the aurous; the latter differs from the former in possessing only one atom of chlorine instead of three, and therefore does not effect such a great reduction of the image. Thus

$$Ag_2\,Cl + Au\,Cl = 2\,Ag\,Cl + Au$$

This chlorine must be removed, and sulphocyanide of ammonium, which is a chlorine absorbent, is largely used in conjunction with the gold trichloride. For this purpose, instead of sulphocyanide of ammonium, the acetate, bicarbonate, phosphate, or tungstate of soda, and other neutral or alkaline salts, are employed.

Colours or Tones Available.

Neutral and slightly alkaline baths tone very quickly, if used immediately they are made; heavy, dark tones being produced. After standing a short time, the baths work slower, and lose their activity gradually; the tones are, however, bright and most permanent. The permanent colour is produced gradually, from shades of pink and rose, to copper-red, purple, chocolate, and in some cases black. The platinum bath is especially suitable for shades of sepia-brown. The colour will vary with most of the numerous toning formulæ, and also with the different brands of paper. The quantity of gold and platinum in the bath, and, perhaps of more importance, the readiness of the metal (or, more correctly, its chloride or other salt) to replace the original silver, influence the ultimate tone. It will thus be seen that special precautions are necessary for special effects; and that a variety of results are obtainable from the same formula by adopting different methods.

Influence of the Negative on Tone.

The negative from which the print is taken exercises much influence; and it has been said that the quality of the negative determines the quality of the tone. This is so far true, that strong, plucky negatives, inclined to be hard, give most readily purple and black tones; and, on the other hand, weak negatives, those showing little contrast, can rarely be toned satisfactorily to the purple stage, and are at their best when they reach red-brown.

Influence of Method of Printing on Tone.

Then, again, as previously stated, the intensity of the light when printing is an important factor. It is found, and no doubt has been generally noticed, that in some instances the unfinished prints from the same negative vary considerably in colour. Those exposed to intense light, when the action is sudden, are distinctly red in appearance; and those printed slowly, by well diffused light, are inclined to the violet shades. The difference is a physical one, and caused by the more gradual, and complete, reduction of the silver. The colour is not so important, in this case, as the effect of the more gradual reduction. In the case of the red image, there is a certain want of proper rendering of the tone values of the negative, *i.e.*, the intense light destroys the half-tones, and does not correctly reproduce the harmonious gradations. This refers, of course, to prints taken from good average negatives. Slow printing is therefore essential for bright and strong prints, those which can be satisfactorily toned. Slow printing should, however, not be carried to extremes; as, if prolonged unnecessarily, delicate half-tones will not be reproduced, and the resulting print will show more violent contrast than the negative. This fact should be remembered when the negative is not perfect; but the principal idea must be kept in mind, that from plucky negatives, brightly toned purple prints are most readily obtained, the tone varying according to the negative.

1. PLAIN PRINT. HAIR, FACE, AND BACKGROUND TOO DARK. INSUFFICIENT DETAIL IN DRESS.

2. PRINTING FRAME FITTED WITH TISSUE PAPER AND COTTON WOOL.

3. DODGED PRINT. NOTE LIGHTER HAIR FACE, AND BACKGROUND, AND PERFECT DETAIL IN DRESS.

EXAMPLES OF DODGING.

Careful Working Essential.

Many more or less explicit explanations have been written on the subject of gold and platinum toning, but the tyro will do well to study this more elementary treatment of the subject. A great deal of time and trouble will be saved if, before proceeding to print, an examination is made of the materials which are to be used. As will be seen later, failures and difficulties are very often the result of bad tools, and of these, surely a bad negative is a tool to be despised and cast aside. The theoretical side of the toning action of gold and platinum must be studied, and its elementary practice at any rate understood thoroughly. The practical is, of course, the main point. Every effort will be made in this section to include all necessary formulæ, with explanatory notes, but the toning methods are so various that the novice is advised to take up one well-tried brand of paper, with one particular toning bath, and study them well. In this way, success should be ensured, but the constant changing of papers and baths is strongly deprecated. Excellent effects can be obtained with all processes if carefully worked, and although the tyro may not succeed at once in getting perfectly toned pictures, yet if he will consider the process thoughtfully, the difficulties will soon disappear.

Preservation of Untoned Prints.

Great care must be taken to prevent light or moisture getting to the prints before toning; but they will keep untoned for some time if proper precautions are taken. Untoned albumen prints are not so stable as P.O.P. and collodio-chloride. The latter have been kept for more than two months after printing, between the leaves of a clean blotting book, without showing any sign of deterioration, either in appearance when finished, or in comparison with other prints toned immediately after printing. Albumenised paper, however, should be finished at once. Untoned prints of this description must not be kept for more than a day or two, as it is found that the high lights of the prints rapidly become yellow, and when transferred to the toning bath the action is uneven, and the resulting fixed print disagreeable in colour. In fact, some albumenised prints kept with the P.O.P. prints for two months refused to tone at all, although the same care had been taken to preserve them.

Preliminary Washing.

It is advisable, however, when possible, to tone silver prints immediately after printing. Some workers trim their prints before toning. This is a mistake, as the edges are pretty certain to be abraded during the various operations, thus necessitating a second trimming. The edges, however, should not be rough, as they are apt to scratch the surfaces of other prints. The first stage is the thorough elimination of all free silver salts and free acid by washing in water. Upon this washing depends the quality and evenness of the toning action, also, to a large extent, the permanency of the print. The presence of this free silver tends to yellowness of the high lights, and generally to the gradual deterioration of the image. This part of the process is very liable to be hurried over by the photographer, but its importance is so great that too much emphasis cannot be laid upon the necessity of thoroughly removing any free acids, or silver salts. Citric acid and silver nitrate will contaminate the toning bath, causing slow toning with most baths, besides being a constant source of double toning.

Light for Toning.

This washing is best done in well diffused daylight; the weaker the light the better, but it should be sufficient for the operator to see the colour of the print easily. The ordinary lamp or gas light is not good, as it is difficult to judge colour properly by these means. Where daylight cannot be used, incandescent gas is far preferable to most other sources of light. The whiter the light the better; and of course a minimum quantity only must be allowed to fall on the prints.

Method of Washing.

There are several excellent washing machines on the market, but at this stage the prints must not be left unattended, and washing by hand is preferable. For twelve prints, half-plate size, take two porcelain dishes, which must be chemically cleaned, filling each with clean water. There is a distinction between ordinary cleanliness and chemical cleanliness. To ensure the latter, it is a good plan to make up a solution of potassium bichromate 1 part, sulphuric acid 1 part, and water 20 parts. This may be used repeatedly. Pour it into the dish or measure, and rinse round. Then wash freely in water. This mixture must not be allowed to get on the clothes or fingers. The dishes should be deep, and at least a size or two larger than the prints, say 8½ in. by 6½ in. Place six prints, one at a time, in the first dish, keeping the water steadily moving. The latter will speedily become like milk, in consequence of the rapid formation of silver chloride by the combination of the soluble chlorides and silver nitrate. After a minute, transfer the six prints, separately, into the second dish, pour off the milky water, and refill. When another two minutes have elapsed, transfer the prints back to the first bath. Pour off the second milky water, and refill, placing the second six prints in the clean water. The water in the first dish will be now found to be much less affected than before, which shows that most of the soluble salts have been eliminated. These first prints must be removed to another dish, and the whole so interchanged that they have each at least six separate changes of water. The prints should be left in the last three changes for a longer time than in the early ones, as while the free chemicals are liberated quickly at first, the action is not thorough, and the final removal takes place gradually. The prints should be placed in the water face upwards, although if they are constantly moved about, and care taken that they do not touch one another, this is not very important. The last water should remain quite clear. The time taken with the six washings is about ten to fifteen minutes. Some workers prefer to use rain-water in which has been dissolved a small quantity of common salt. This certainly has the advantage that the printer knows exactly what he is using—a state of things not existing when ordinary water is used, in which a variety of earthy salts are dissolved. It is, however, an unnecessary refinement.

Alum Bath.

The following bath is one which is often omitted by some of the most particular workers, and yet others consider that it is almost indispensable for several reasons. It is known as the hardening bath, and is best made up as follows:—Chrome alum, 20 grains; common salt, 1 oz.; water, 20 oz. Instead of chrome alum, the ordinary variety of powdered alum may be used, in which case take 1½ oz. The prints, after aluming, are much more easily and safely handled in the subsequent stages; which is a strong point when time and clean work are considerations. It is best to alum the prints before toning, as the slightest contact with the fixing agent will be fatal, and cause yellow stains. For enamelled prints, or those to be hot rolled and burnished, this bath is absolutely necessary, since the film is toughened, and therefore better able to bear the heat and pressure. On the other hand, those which are to be mounted in optical contact should not be so treated. The salt is added to the bath, not only for the purpose of converting any free silver salts in the paper into chloride, as before explained, but because it is also a great preventive of black spots, due to water charged with metallic impurities. Rust from iron pipes through which the water flows is a constant source of such troubles in old houses, or where the water is allowed to stand in the pipes for long periods. The prints must be kept constantly on the move, and should remain soaking in the alum for five to ten minutes (of course, in winter the time may be much shorter than in the warmer season), care being taken that they do not stick to one

another. On removal from this bath, again well wash in three or four changes, or, better still, in gently running water, for ten minutes, by which time they will be ready for the toning bath.

Gold Toning for P.O.P. and Collodio-Chloride Papers.

In the following various formulæ for making up the toning bath, the quantities of the chemicals given are such as have been proved to give the best results on well-known brands of P.O.P. and collodio-chloride paper now in use. The colour produced is largely dependent upon the amount of gold deposited by the bath. Most of the formulæ produce the warm tones readily, while some are more suitable than others for giving purple tones.

Fig. 344.—The Operation of Toning Prints.

Time of Toning.

Emulsion papers toned in sulphocyanide or such baths assume the desired colour in a far shorter time than the older albumenised paper, and it is probably this point, more than any other, which has made the paper so popular among amateurs. Toning prints from average negatives should be completed in six to ten minutes; and it is advisable that it should not take less. In warmer weather, toning will appear to be finished in less time, but it will be merely a surface tone. This surface tone will be found to be soluble in the fixing bath, and therefore of no practical effect. The prints should remain in the bath until the colour, when viewed by transmitted light, has reached the desired tint. The toning must be allowed to proceed until there is only just a trace of warmth in the shadows of the print when viewed by transmitted light, that is to say, when held up to the light and looked through (see Fig. 344). The exact time to stop toning, or the exact amount of tone, must, as in the case of

developing, depend upon the subject and the taste of the operator.

Sulphocyanide Bath.

The following formula is recommended by Ilford, Limited—who may be looked upon, commercially, as the pioneers of the process—for use with their well-known P.O.P., but it is an excellent all-round toning bath with all gelatino-chloride papers:

Ammonium Sulphocyanide . .	20 grs.
Water	20 oz.
Gold Chloride	2 grs.

This is a sufficient quantity to tone a sheet of paper 24½ in. by 17 in., or twenty-eight pieces quarter-plate size, to a cold purple colour in ten minutes. For warmer tones, the bath may be diluted with half as much more water; but the proportions of gold and sulphocyanide should not be altered. The diluted bath would tone 1½ sheets of P.O.P. Cold water may be used for making up this bath, but for best results the sulphocyanide should be dissolved in 10 oz. of boiling water; and the gold chloride, after having been also dissolved in the other 10 oz. of boiling water, is added very slowly to the sulphocyanide solution, well stirring. If this latter method of mixing is adopted, the bath may be used when cooled to 60°, otherwise the mixture should stand for about twelve hours before use. This is a point to which the amateur seldom pays proper attention, the bath often being made up with cold water and used immediately. The only serious result to be feared is a reduction of the image through the aurous salt not being formed. This is very evident on placing it in the fixing bath.

Chemical Reactions of the Sulphocyanide Bath.

The exact method of compounding the bath is considerably more important than might at first appear. There are certain points to consider, which must be carried out with equal care in various baths. The first of these is that the gold must be added last, as noted in each of the formulæ given. Secondly, that within certain well defined limits, a slight alteration in the amount of sulphocyanide is not important. When gold solution is added to the solution of sulphocyanide, it first of all changes to a bright red, and afterwards becomes clear again. The changes are almost instantaneous, or should be if the bath has been properly made; but they are sufficiently marked to be observable by every printer. This indicates that some new compound is formed on the addition of the gold, which is afterwards redissolved, and such is found to be the case, as shown in the formula

$$Au\,Cl_3 + 3\,Am\,Cy\,S = Au\,(Cy\,S)_3 + 3\,Am\,Cl$$

(Gold trichloride and ammonium sulphocyanide give gold sulphocyanide and ammonium chloride.) Now, gold sulphocyanide is a bright red compound, so that this is what has been formed in the solution. It is redissolved in excess of ammonium sulphocyanide, giving a double salt of gold-ammonium sulphocyanide, having the abbreviated formula Au (Cy S) Am Cy S. (In all these remarks it may be taken that the potassium salt may be substituted for the ammonium, wherever preferred, and used in exact proportion to its chemical equivalents.) Fuller information on the chemistry of the process is given in the theoretic section. This is the substance which it is desirable to form. It follows, then, that sufficient of the salt must be used to accomplish the purpose of redissolving the precipitate. The exact quantity required is easily estimated by the molecular or combining weights, and will be found to work out as 3 is to 4. That is to say, 3 grains of gold require 4 grains of sulphocyanide. Now, many formulæ give a much greater quantity, and it has been found by experiment that practically no difference occurs between the use of 5 grains to 10 grains to each grain of gold. Above this, however, there is, with certain papers, a danger, but this depends on (*a*) the temperature, and (*b*) the melting point of the gelatine used for the paper. When the solution contains too much sulphocyanide it attacks the gelatine, softening it, and making it peculiarly liable to abrasion and finger marks. With some brands of paper, 15 to

20 times the amount of gold may be used, even in warm weather; but with others it is not advisable to go above 10 times. The necessary modifications of the formula may be easily determined from the information already given.

Effect of Varying the Amount of Gold.

The effect of varying the amount of gold, on the other hand, is very marked, and the greater the proportion of gold the bluer and colder is the tone, and the shorter the time of toning. An excess of gold over that given in the formula cannot be recommended. To make this still clearer the following experiment has been suggested. Take a small quantity of phosphorus about the size of a pea, and dissolve it in ether. Add this to water in the proportion of about 1 drop to 5 oz. Now pour into this 8 drops of gold solution (1 grain in ½ oz.). The gold will very slowly be reduced, and will come down a bright red colour, the reason for this being that the particles are in such an extremely fine state of division. In the case of adding to the gold solution anything which produces immediate or rapid reduction, the gold will be found to be of a deep blue, almost purple. From this it will be seen that reduced gold is of two colours, dependent upon the rate of reduction. If, now, the toning goes on slowly, either on account of deficiency of gold or other causes, the deposit will be reddish, and depositing red upon red can never make much difference to the colour. What is required, then, generally speaking, is to deposit the blue particles, which shall combine with the red to form a pleasing purple tone, and this can only be effected by having the bath of proper strength.

Temperature.

It may, however, happen that the bath is of correct strength, yet will not give the desired tone. This is usually to be explained by the temperature. A cold toning bath causes the gold to be deposited very slowly, and there is therefore a tendency towards a red tone in such circumstances. (This is a practical point for those workers to remember who complain that certain baths act too quickly to give a warm sepia tone.) The proper temperature of the bath is 60° F., but there are occasions when it is quite permissible to allow it to be slightly above this; all will depend on the result desired.

Dilution.

The dilution of the bath does not appear to have any effect, and the water may therefore be looked upon as merely a medium for the action. The best method in toning either on a large or small scale is undoubtedly that of calculating the exact amount of gold required for the given area of silver chloride, adding the amount of sulphocyanide or its equivalent in proper proportion, and diluting with sufficient water to handle the prints conveniently. It must be noticed, however, that it is the area of silver chloride which is to be borne in mind, not the area of the paper; for, in some cases, in two sheets of paper of the same size, one may have more than double the quantity of reduction product possessed by the other. Therefore, the darker the prints the more gold will be required.

Methods of Preparing the Bath.

There are two methods of preparing the bath. In one, it is mixed with cold water and ripened for twenty-four hours or so; and in the other hot water is used for mixing, and the bath used when cold. Both these methods lead to the same

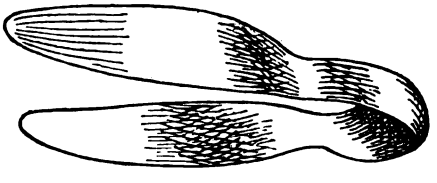

Fig. 345.—Clip For Lifting Prints.

result, and ensure the formation of the aurous salt. The prints must all be put together into the bath, or the tone will vary; the majority of the gold being used

up on those first put in. In toning the prints, it is essential that they should be handled as little as possible. This is especially the case where the printer does any other work with chemicals. For handling the prints a vulcanite clip, as shown in Fig. 345, is a convenience. It is tipped with cork, and holds the print very lightly. Some printers will gather the prints all together on the left hand, and peel them off one by one, plunging them face down in the toning bath. This method is employed at one of the finest establishments in the trade, which is noted for the beautiful tones of its productions. Many printers, however, attempting the same method, have only succeeded in producing blotchy, uneven tones with a fine crop of finger marks. This fact is mentioned to show that the actual system is very much a personal matter. It may be safely said, however, that the less handling the prints have, the cleaner and purer the chemicals and dishes employed, and the more accurately the bath is prepared, both as regards strength and temperature, the better are the chances of success. The fact that some expert workers are able to do things which seem to contradict all elementary rules is of no importance.

Concentrated Sulphocyanide Bath.

This bath will not keep, as a rule, the gold being precipitated, but we are indebted to Buhler for the following concentrated sulphocyanide bath:

Distilled Water	1 oz.
Gold Chloride	8½ grs.
Strontium Chloride	85 grs.

Heat the water to 200° F., add the gold and then the strontium. Next add:

Potassium Sulphocyanide	25 grs.
Distilled Water	7 drams.

Heat the solution to 200° F., cool and filter, and make up total quantity to 2½ oz. For use, take 1 part stock to 19 parts of water. This bath keeps indefinitely in the dark.

Bicarbonate of Soda Bath.

Soda Bicarbonate	30 grs.
Water	10 oz.
Gold Chloride	1 gr.

This bath is especially suitable for purple black and blue tones. It has the advantage of being ready for use immediately it is mixed, but it will not keep for any length of time. After use, it must be thrown away, since it is not suitable for diluting a new bath.

Acetate of Soda Bath.

Sodium Acetate	30 grs.
Water	10 oz.
Gold Chloride	1 gr.

Good purplish-brown tones can be obtained by using the sodium acetate bath. It will be found to work better if mixed forty-eight hours before use. Hot water is most satisfactory; the gold chloride being added after the acetate has been dissolved. Before adding, however, it is advisable to neutralise the gold solution by the addition of a few grains of common chalk. After having been used, the bath should be stored in ruby coloured bottles, or in the dark, and may be used, after filtering, to dilute a new toning bath.

Bicarbonate and Acetate of Soda Bath.

Sodium Bicarbonate	20 grs.
Sodium Acetate	240 grs.
Water	10 oz.
Gold Chloride	10 grs.

This is a concentrated bath; for use, take 1 oz. solution, and make up to 10 oz. with water. It should be mixed with hot water, the gold and bicarbonate being first dissolved in two or three ounces, and left standing for an hour or so. The acetate being dissolved in the remainder of water, the two are slowly mixed. This compound bath can be used at once, but for best results it should stand for forty-eight hours. After use, store in ruby bottles, or in the dark. Filter before adding to a fresh bath instead of water. If care be taken in the preparation, this toning mixture gives delightful purple-black results, rich in quality and very pleasing. It works easily, and is not liable to double tones. On this account various modifications of this bath are in general use by professionals. It is especially

suitable where large batches of prints are toned.

THIOCARBAMIDE BATH.

Thiocarbamide	5 grs.
Distilled Water	½ oz.

Now make up a solution of chloride of gold, 1 gr. in 1 dr. of distilled water, and add sufficient of it, drop by drop, until the precipitate first formed is redissolved. Then add:—

Citric Acid	2·5 grs.
Distilled Water to	10 oz.

and finally put in about 50 grains of salt. This bath is recommended by Hélain as an improvement on the sulphocyanide bath; and results from it are certainly very beautiful. The tones are very bright, and the high lights delightfully clean, with no trace of pinkiness. In using the bath, the greatest care must be taken to wash the prints thoroughly, both before and after toning, and particularly before fixing. Warm tones are produced by diluting the bath.

PHOSPHATE OF SODA BATH.

Sodium Phosphate	12 grs.
Water	10 oz.
Gold Chloride	·5 gr.

This is an old bath, and used largely by workers of albumenised paper, but with an increase of phosphate. It can be used when mixed, and gives purple results, particularly free from double tones. Must be thrown away after use, as it will not keep. The phosphate should be used in dry crystals. Toning should be complete in five or six minutes. When used on P.O.P. paper, it gives a tone very closely resembling albumen—that is to say, good pure shadows not in any way clogged.

FORMATE OF SODA BATH.

Sodium Formate	30 grs.
Sodium Carbonate	4 grs.
Water	10 oz.
Gold Chloride	2 grs.

This bath can be used when mixed, care being taken to wash the prints well. It is customary to immerse the prints before toning in common salt 1 part, water 10 parts. It tones quickly, giving very good browns. Fine warm tones are produced with a diluted bath.

TUNGSTATE OF SODA BATH.

Sodium Tungstate	20 grs.
Water	10 oz.
Gold Chloride	1 gr.

This bath is excellent for warm tones of good quality. Mixing should be done with boiling water. The bath is ready for use when cooled to 60°. It keeps well, and may be used repeatedly, adding 1 oz. of new solution for every sheet of paper toned. Some workers greatly dislike this bath, as in their hands it gives good tones only from the very best negatives.

CHLORIDE OF LIME AND CHALK BATH.

Chloride of Lime	2 grs.
Chalk	20 grs.
Water	10 oz.
Gold Chloride	2 grs.

This bath gives brilliant results, of good purple tones. It should stand for forty-eight hours before using, unless boiling water is used for mixing. It is then ready for use when cooled to 60°. This bath has one serious disadvantage; namely, that it necessitates considerable over-printing, as the colouring matter deposited does not consist entirely of gold, and is dissolved in the hypo. bath. Also, the image suffers considerable loss in vigour. By increasing the proportion of chloride of lime there is less need of over-printing.

COMPOUND CONCENTRATED BATH.

Chloride of Lime	15 grs.
Chalk	15 grs.
Sodium Acetate	60 grs.
Gold Chloride	15 grs.
Water	5 oz.

Dissolve thoroughly, adding the gold chloride in a thin stream, and stirring well. This concentrated bath should be left at least ten days before using, when 1 oz. of solution should be filtered and added to 11 oz. of water. It gives good purple tones with ease from all fairly good negatives, and seems to work better than the acetate.

Making-up the Bath.

When working on a small scale, the best plan is to make up just sufficient bath to tone the prints in hand. Thus, if 2 grains will tone one sheet of paper to a purple, then for every three half-plates or six quarter-plates it will be necessary to take $\frac{3}{8}$ grains of gold and a proportionate quantity of sulphocyanide. For measuring extremely small quantities of gold, make up the gold into a 1-per-cent. solution by dissolving the 15-gr. tube in 3 oz. 1 dr. of distilled water; every 100 minims will then contain 1 grain. The sulphocyanide may be in a 10-per-cent. solution. Suppose now one half-plate or its equivalent is to be toned. Take 25 minims of sulphocyanide solution, and add to it sufficient water to deal conveniently with the print. Then add 12 minims of the 1-per-cent. solution of gold chloride. Any larger number of prints will require quantities of each in the same proportion, the amount being easily ascertained by multiplying the numbers just given.

Proportion of Gold for Different Tones.

It has already been stated that the proportion of gold to the area of the paper governs the final tone. The following table shows the exact proportion necessary for toning one quarter-plate print:

Gold Chloride.		Tone.
8 minims or $\frac{1}{4}\frac{1}{0}$ths of a grain.		Purple black
4 ,, $\frac{3}{8}\frac{3}{0}$	,,	Purple
3 ,, $\frac{3}{1}\frac{3}{0}\frac{3}{0}$	,,	Brown
2 ,, $\frac{1}{8}\frac{1}{0}$	,,	Warm brown
1 minim or $\frac{1}{1}\frac{1}{0}\frac{1}{0}$th	,,	Red

It is assumed that a 1-per-cent. solution of gold chloride is in use. If also a 10-per-cent. solution of ammonium sulphocyanide is employed, the same number of minims of this may be taken, and the solution made up with sufficient water for the number of prints in hand.

Platinum Toning for P.O.P. and Collodio-Chloride Papers.

This metal is very little used for the glossy varieties, the tones given being more suitable for matt surface papers. Some really fine results can be produced, the tones being quite peculiar to platinum, and, generally speaking, cannot be given by baths made up of other metals. It must not be supposed that platinum is especially suitable for good black tones. The quality of a black tone produced with gelatino-chloride prints is, generally speaking, not to be compared to the rich velvet black of platinum papers, or even gelatino-bromide papers. In fact, platinum gives warm brown and sepia tones, the latter tints being very useful, and showing to great advantage for some subjects. The prints should, except for the difference of the bath, be treated exactly as for gold toning; save that the prints, after leaving the platinum bath, should be immediately transferred to a 5-per-cent. solution of common salt. Otherwise, toning continues while washing, and uniform results cannot be relied upon.

The Platinum Bath.

Chloro-platinite of potassium is the salt employed; it may be procured in 15 grain tubes like gold chloride. Several formulæ for platinum baths have been suggested, those given below having been tested and found to work well with the matt papers in general use.

Sodium Chloride (Common Salt)	50 grs.
Alum	100 grs.
Chloro-platinite of Potassium	2 grs.
Water	10 oz.

With this bath, brown tones will be produced in about five minutes, sepia tones in ten minutes. It is not advisable to take the prints further than sepia, as the colour becomes unsatisfactory. If removed from the bath after two minutes only, the finished prints will be red-brown, and will be found an artistic shade for portraiture and special effects. It is not necessary that prints toned in this bath should be alumed after the first washing. The free salts, however, must be thoroughly eliminated. The prints will dry decidedly colder in tone than they appear when wet, and this must be allowed for.

Another Formula.

Potassium Chloro-platinite	8 grs.
Dilute Phosphoric Acid	2 drams.
Water	10 oz.

Proceed with this bath as usual, not neglecting the salt and alum bath before toning. A diluted bath will give warm sepia tones more easily.

Haddon's Formula.

Platinum perchloride is not especially suitable for toning, although the following formula yields very pleasing prints:—

Platinum Perchloride	3 grs.
Sodium Formate	100 grs.
Formic Acid	30 min.
Water	35 oz.

A formula sometimes given for black tones is:—

Sodium Chloride (Salt)	100 grs.
Sodium Bicarborate	40 grs.
Water	10 oz.

The prints are placed direct into this bath. After washing, they are toned to purple red in:—

Borax	40 grs.
Gold Chloride	1 gr.
Water	15 oz.

and, finally, washed and toned to black in the phosphoric platinum bath. This method cannot be recommended for black tones, although some workers find it answers remarkably well. Careful washing is very essential between each stage. The prints must be kept moving, and well separated when toning. The final tone must be judged by transmitted light.

Another Method

which is now employed with matt paper in a large printing factory is as follows: Dissolve 4 oz. of borax in 8 oz. of water, and for use take 1 part of this and dilute with 5 parts of water. The tone should be governed by the amount of gold per area treated. Thus, for a blue-black tone, use 3 grains per sheet, or for a red tone the minimum quantity of ½ grain per sheet. The prints are then toned in the platinum bath as given above, except that it is the rule to use it slightly more diluted and to strengthen it as required.

Albumenised Paper.

A particular feature of this paper is that it is not nearly so liable to double toning as gelatino-chloride paper. Toning, as a rule, is more even, and purple colours are very readily obtained. The paper should be quite fresh, and no time should be lost after printing before finishing. Keep the prints well protected in a box, or between the leaves of a blotting book. In no case should the time between printing and toning exceed two or three days.

Permanency.

Much blame is laid to the charge of this paper on account of the vast number of albumen prints which are liable to rapid fading; but if the paper is well made, and precautions taken, especially in the washing between the different stages of toning and fixing, there seems to be no reason why albumen prints should not be at least as permanent as any print-out silver prints. The proper elimination of all free soluble salts is the important point to be remembered. Most of the P.O.P. toning formulæ give good results on albumen paper, and the general instructions are the same.

Toning Baths for Albumenised Paper.

Acetate of Soda	30 grs.
Water	10 oz.
Gold Chloride	1 gr.

Mix with hot water, and use twenty-four hours after. The bath acts regularly, and produces warm, rich tones. It will keep, and if stored carefully the old bath may be used to dilute fresh solutions. Good tones should be procured in about seven minutes. The above formula is the one commonly used by professional workers who sensitise their own paper. The following bath was for many years a great favourite with professional users of albumen paper.

Bicarbonate of Soda	4 grs.
Water	10 oz.
Gold Chloride	1 gr.

It is suitable for warm tones, and may be used immediately it is mixed, but must be thrown away after use, as it will not keep.

Phosphate of Soda	20 grs.
Water	10 oz.
Gold Chloride	1 gr.

Suitable for rich purple tones. Must be used immediately it is mixed, as it rapidly deteriorates. Old solutions cannot be used to dilute new baths.

Concentrated Bath.

Chloride of Gold	15 grs.
Water	20 oz.
Chloride of Calcium	2 drams.

To mix this bath, the gold should be first dissolved in 4 or 5 oz. of water; and, if acid, the solution should be neutralised by the addition of a little lime water. The remaining water is then added, and after this the calcium. For use, take 1 oz. of solution to 10 oz. of water. This stock bath will keep well.

Acetate Bath.

The acetate bath is also very suitable for making up a concentrated solution.

Acetate of Soda	480 grs.
Water	15 oz.
Gold Chloride	15 grs.

1 oz. of this solution added to 20 oz. of water will tone a full sheet of paper, or 30 prints ¼-plate size. This concentrated acetate bath will keep splendidly, and may be used repeatedly, adding fresh solution as required. Large batches of prints can, perhaps, be toned more reliably in this bath than in any other. After toning, the prints simply require rinsing in clean water before placing in the fixing bath.

Paper to be Used.

The above baths are specially suitable for use with paper prepared as described in the section on "Printing-out Processes and Papers" (p. 170); but for those prepared upon an acid sensitising bath, such as what are called "ready sensitised" papers, the borax bath should be employed.

Bath for Plain Salted Paper.

This paper has had to give place to the more reliable commercial papers, gelatino-chloride, collodio-chloride and albumenised; and, except by those who prefer to make it themselves, is very little used. The enthusiastic worker, however, will find that some beautiful results can be obtained, especially with rough paper, for broad effects. Borax and acetate are the two chief toning baths.

Borax	100 grs.
Hot Water	5 oz.
Gold Chloride	1 gr.
Water	5 oz.

Use this bath immediately after mixing the two solutions, as it will not keep.

Alternative Bath for Plain Salted Paper.

Sodium Acetate	30 grs.
Water	10 oz.
Gold Chloride	1 gr.

Make up with hot water, and use when cool. It keeps well, but the old bath should be strengthened from time to time with fresh solution. This bath is not, however, so good as the last named, as there is a tendency towards greyness with it.

Fixing without Toning.

As plain salted paper fixes out a very pleasing sepia colour, if not too heavily sized, it may even be better not to tone it at all. This may be explained in the following manner. If paper prepared only with silver chloride is fixed, it comes from the hypo. bath a blue, whilst if the organic silver salt is chiefly used, a foxy red results. Compare an ordinary P.O.P. print with a piece of filter paper sensitised as described in the section on "Printing-out Processes and Papers" (p. 164). It is the combination of these two colours in right proportion which results in a pleasing tone on fixing. Such papers are sometimes termed "self-toning" papers. To produce a satisfactory result, it is essential that all the free silver is removed from the print before fixing.

Importance of Thorough Washing.

Too much emphasis cannot be laid on the fact that thorough removal of all free silver and free platinum salts is essential before passing into the toning or the hypo. bath. It has been proved that chloroplatinite of potassium and silver

citrate form certain insoluble compounds which remain in the paper and are liable to discolour under the action of light; while the same remark applies to the combination of chloroplatinite and hyposulphite. Before any and every toning bath, therefore, washing is necessary to ensure complete removal of the free silver; while, after toning, the prints must pass through an alkaline bath, for platinum toning baths are invariably acid.

Formula for Black Tones.

For toning plain salted proofs to a black or brown black, the formula given by Lionel Clark is excellent, being exceedingly simple and reliable.

Chloroplatinite of potassium . .	4 grs.
Water	2 oz.
Nitric Acid	2 drops.

(Almost any of the acids may be substituted without apparent difference if in same proportion.) Owing to the costly nature of the solution, he suggests using the reverse side of a wooden dish levelled by three screws to contain the solution (or three wedges may be employed for the same purpose). The print, on coming from the washing water, is floated in this and instantly assumes a brown black. It is then passed into a bath of carbonate of soda, and is ready for fixing. By making use of the above plan the solution may be made to cover an 18 in. by 15 in. dish. This bath does not keep, but may be used to tone several sheets in succession. For warm brown tones it is made up much weaker, diluting even to one quarter the above strength, or ½ grain per oz. Such a bath may, of course, be used in the ordinary manner.

Combined Toning and Fixing Bath.

Much has been written with reference to this method of finishing prints, particularly regarding permanency. It has been urged in its favour that the bringing of the print in contact with the salts contained in ordinary water is liable to cause the precipitation of compounds within the print which will subsequently react upon it; and that, as the combined bath allows of toning without the preliminary removal of the free silver nitrate, such a bath possesses the advantage of giving greater permanency to the print. On the other hand, it has been proved that if a solution of alum is added to a solution of sodium thiosulphate, sulphur is liberated, and this sulphur is bound to attack the image, with consequent fading. Moreover, the toning is usually complete before the print is properly fixed, so that even if the injurious compounds, alum and lead nitrate, are omitted, a second fixing is required. The abolition of one operation is the strong inducement that the combined bath offers, but if a second fixing is needed, the advantage is not evident. On the one hand there is a certainty, and on the other hand there is merely a probability, of the formation of injurious compounds. The prints produced by both methods fade, especially if kept in a strong light and in an impure atmosphere.

Points to be Considered.

These are especially the proper elimination of the free salts of silver and acid, and also the complete fixation of the image. Several formulæ have been proposed, in using which no washing before toning is required; that is to say, the dry prints are placed direct into the toning and fixing bath. This, however, is liable to cause intricate chemical combinations, sulphate of aluminium, acid sulphite of soda, pentathionate of soda, sulphuretted hydrogen, besides the free silver and gold salts, being present. It is not difficult to see that deposits of sulphur would very likely affect the permanency of the toned image.

Stability of the Prints.

This is much greater, when the combined bath is used, if the washings are done carefully, and the proper fixing of the image is assured. On the other hand, Mr. Otto Schölzig considers the dangers of fading are increased by the preliminary washing owing to the complex reactions liable to occur when free silver nitrate is brought into contact with the soluble salts present in ordinary tap water. He based these conclusions upon the following ex-

periments. An unexposed piece of albumenised paper was taken and cut into two pieces. Both pieces were washed for ten minutes, and then one piece was soaked for a further ten minutes in a new toning bath, and finally both were fixed in the usual hypo. bath, washed, and dried. A few drops of ammonium sulphide were then added to a little water, and both papers soaked in it, when it was found that the piece which was untoned was unaffected, but the piece which had been through the toning bath showed a decided yellowing of the whites through the formation of silver sulphide. From this it was assumed that the deposition of the gold imprisoned certain compounds formed by the washing water, which were not so readily removed as a consequence. This, however, does not appear to be the case with all samples of water; but the experiment is certainly worth repeating. Mr. Schölzig has also suggested that the exact amount of gold required to tone each print should be taken, and applied with a brush. This method is, of course, far too slow for commercial work.

Rinsing and Finishing.

With all combined baths, the tendency is for the toning to be completed before fixing is finished. The prints should, therefore, be rinsed and fixed for five minutes in a fresh solution of hypo. or other fixing agent. In some respects, if the prints are placed direct into the toning and fixing baths given, the results appear to be superior. This cannot, however, be recommended on account of the danger of sulphur toning, as previously stated. Wash the prints in several changes, both before and after toning.

Gold Combined Bath.

Ammonium Sulphocyanide	200 grs.
Sodium Chloride (Common Salt)	200 grs.
Alum (Powdered)	100 grs.
Hyposulphite of Soda	1½ oz.
Water (Distilled)	10 oz.

When mixed, allow to stand for two or three days. Pour off the clear solution, and add

Gold Chloride	4 grs.
Water	½ oz.

The following bath is more complicated, but gives pleasing tones.

Lead Acetate	30 grs.
Sodium Acetate	10 grs.
Hyposulphite of Soda	1 oz.
Sodium Carbonate	10 grs.
Alum (Powdered)	30 grs.
Gold Chloride	1 gr.
Water up to	10 oz.

Add each ingredient to the water, in the order given; and allow to stand at least twenty-four hours before use. Filter the solution.

Platinum Combined Bath.

Hypo	1 oz.
Lead Nitrate	60 grs.
Alum	60 grs.
Sodium Formate	20 grs.
Formic Acid	30 grs.
Water	10 oz.

Dissolve the lead and sodium formate in 2 oz. of water; then add to this the hypo. and alum, which should have been dissolved in the remaining 8 oz. of water (hot). Leave the mixture standing in an open vessel for twenty-four hours, and then add

Platinum Bichloride	2 grs.

Preliminary Washing.

Before toning, wash the prints well and soak in

Sodium Chloride	½ oz.
Water	10 oz.

The washing of prints after toning should be thorough, and generally ten minutes in several changes will suffice. It is important that all trace of toning solution be removed, as it would cause the fixing bath to become acid, which is most certainly undesirable. See that the prints are kept free during washing. If they are allowed to cling together, stains will afterwards appear.

Fixing Silver Prints.

By fixing is meant the removal of any sensitive silver salts which have not been acted upon by light. Until this stage is reached, the prints must have been protected from actinic light as far as possible to avoid degraded tones. These salts are

removed by the solvent action of hypo-sulphite of soda, cyanide of potassium, and sulphite of soda. Of these, the first named is almost universally used. It is in the form of watery crystals, and must not be contaminated by acid. When hypo. is dissolved in water, it has a cooling action. It is advisable, therefore, to make up hypo. solutions with warm water, since, if the fixing bath is cold, the action is retarded and irregular. This, and all other baths used in the toning process, should be worked at about 60°.

Fig. 346.—Arrangement for Holding Stock Solutions.

Fixing Bath

Hypo.	3 oz.
Water	20 oz.

This bath is recommended as the best strength for most silver prints. In case the hypo. is not quite free from acid, a few drops of liquid ammonia or a few grains of sodium carbonate should be added to the baths, sufficient only to give an alkaline reaction with litmus paper. Acid fixing baths are sometimes used for bromide prints, but on no account should they be employed with printing-out paper. A mixture of hypo., alum, and citric acid works very cleanly and brightly, but it cannot be relied upon if permanence is a consideration. In the opinion of many, an alkaline fixing bath should be invariably used. The reactions which occur when silver chloride is placed in soda hyposulphite (or, more correctly, soda thiosulphate—$Na_2S_2O_3 + 5H_2O$—the real soda hyposulphite—Na_2HSO_2—being a substance containing less oxygen and sulphur, and useless for fixing) are first to form silver hyposulphite, and, at the same instant, the double salt of silver and soda hyposulphite, which is insoluble in water but soluble in excess of hypo., so that a further reaction goes on, provided the solution is strong enough. To ensure proper fixing, the bath must therefore be of sufficient strength. On the other hand, too strong a bath is liable to partially dissolve away the image. It has been

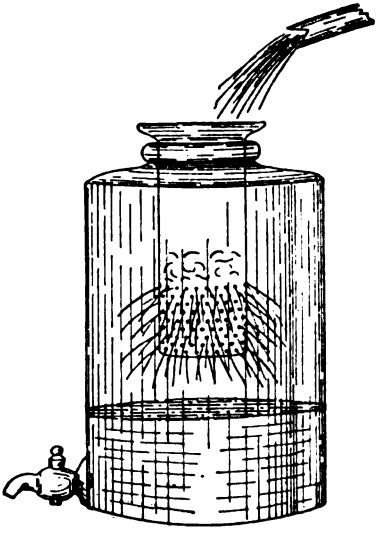

Fig. 347.—Making Stock Solution of Hypo.

stated that a 10 per cent. bath of hypo. can thoroughly fix a print in ten minutes; while, as to quantity, the minimum amount allowable would be 2 oz. of the above solution to each dozen half-plate prints. Freshly made hypo. solution must be used for papers; but the same fixing bath may be used repeatedly for plates without apparently much harm arising. Nevertheless, in all cases it is advisable to have fixing solutions as fresh as possible.

Preparation of Sodium Thiosulphate.

The quality and form of the salt used are matters requiring attention. Rough lumps covered with metallic and other impurities, such as are supplied by some

chemists, should never be used for fixing prints, or all kinds of spots and markings may be expected. The granulated form is the best, and the crystals must be clear and clean. Ordinary hypo. contains 5 molecules of water (see above; the anhydrous form is scarcely ever used for photography), and dissolves readily, but being heavier than the water it requires thorough mixing, or the hypo. will remain at the bottom of the vessel. It has already been pointed out that hot water must be used, so that the following will be the exact procedure. Place the crystals in a large stone jar, or barrel, and pour the hot water over. Stir well till dissolved, then add cold water to make a 1 in 3 solution (*i.e.*, 1 oz. in every 3 oz.). The amount needed is drawn off, as required,

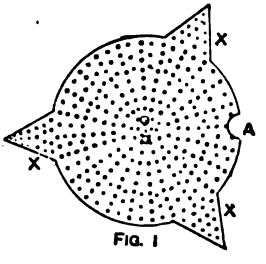

FIG. 1

Fig. 348.—PERFORATED ZINC FOR PRINT WASHER.
Fig. 349.—BARREL PRINT WASHER.

from this stock solution, and may be used as it is for plates, or diluted with an equal bulk of water for prints. Fig. 346 shows a good form of appliance. Some workers prefer to use a contrivance something like a colander, in which the crystals are placed, and the hot water poured over, as in Fig. 347. An arrangement for upward filtration, as described in the section on "Printing-out Processes and Papers" (p. 168), may be used; substituting, of course, a piece of canvas or netting for the muslin. The crystals, if preferred, may be suspended in a muslin bag. Do not make up the hypo. bath just before toning; in fact, it is better not to touch it at all if it can be avoided.

ADDITIONS TO THE BATH.

The principal additions to the bath which have been suggested are sodium sulphite and soda carbonate; both serve to keep the bath faintly alkaline. The following formula may be used:

Hypo.	3 oz.
Common Salt	½ oz.
Soda Sulphite	½ oz.
Water	20 oz.

Or, in the case of soda carbonate, use sufficient only to render faintly alkaline.

ADDITIONAL FIXING BATHS.

It is always a good plan to have two baths ready; so that when all the prints have been passed into No. 1 bath, those that were placed there first may be transferred to No. 2. This ensures proper fixation, and prevents overcrowding. In the case of the combined bath, it is also a

Fig. 350.—CIRCULAR WASHING TANK.

good plan to have an additional fixing bath, since it is seldom that the prints can be sure of proper fixation in the same time as that taken for toning. In the case of toning, the time of immersion may be varied according to the colour desired; but in fixing it must always continue until the effect is complete. If the solution is too weak, a salt of silver-hyposulphite is formed, insoluble in water. This is probably the most fruitful cause of fading and deterioration. A fresh bath should, therefore, be used for each batch of prints. Hypo. is extremely cheap, and it is poor economy to use old baths which are weakened by use and contain silver. If the bath has been used even once before there is always great danger of stained lights.

Method of Fixing.

To ensure perfect fixing, the prints must not be allowed simply to soak in the bath, but should be regularly moved about one by one; the best plan being to have two dishes and plenty of solution. The prints should be removed from one dish to the other constantly, pressing each one under the surface. If only one dish is used, the prints must be moved about in a systematic manner to ensure each one being properly exposed to the working of the bath. Ten minutes should suffice for complete fixation, when a fresh bath is used. Prolonged immersion tends to reduce the

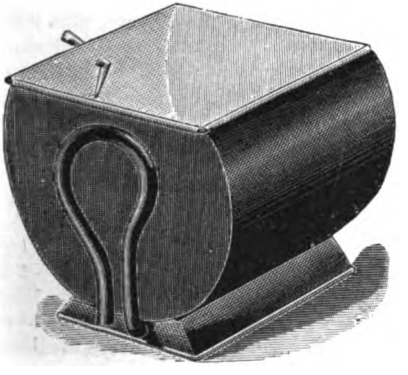

Fig. 351.—Washing Apparatus.

image and destroy brilliancy; but at least ten minutes should be given. It is at this point that the permanency of the picture is most likely to be affected.

Final Washing.

Nothing must be left in the print except the metallic particles which form the image; and the hypo. having removed all the soluble silver salts, it must, in its turn, be entirely eliminated. Prolonged washing and soaking is the best means of accomplishing this. The water and the prints should be kept constantly moving; while the fact that the hypo. is not simply on the surface, but embedded in the film and paper, makes a slow process of thorough soaking necessary. The slightest traces of hypo. left in the print will cause spots and stains, either when the picture is finished, or at some future time. The best method of hand washing is by using two dishes of clean water placed side by side. Laying the prints all in one dish, transfer one at a time, draining well, to dish No. 2. Pour away dish No. 1, and refill with clean water. This process, which must be continued for twenty minutes, is rendered still more effective if each print is laid on a glass and stroked lightly on the back with a squeegee. This somewhat tedious method of washing is, however, far from convenient to those who do a lot of

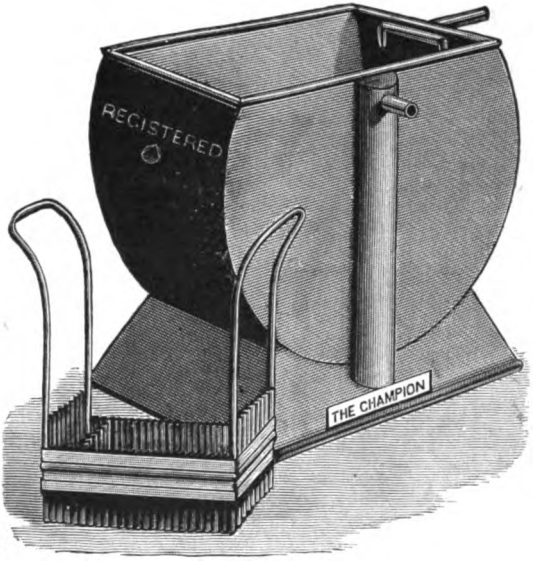

Fig. 352.—Washer for Prints or Negatives.

work, and several machines have been devised for the purpose.

Mechanical Washers.

It has been pointed out that, when possible, hand washing is preferable to machine washing; but it will easily be seen that hand washing can only be done when the quantity dealt with is small, as not more than about fifty prints can be washed properly by hand at one time, and if they have to be done in batches the waste of time increases. All washers are constructed on practically the same principle. They consist of two compartments, and are made of a substance that is not likely to

affect the print, such as wood, enamelled metal, or porcelain; the lower compartment receives the contaminated water, and is fitted with a syphon for emptying purposes, and the upper compartment allows the prints to soak, keeping them at the same time well separated. Any washer that does not meet these requirements is bad. A serviceable washer may be constructed with a small wooden cask, a sheet of perforated zinc, some compo piping, and some rubber tubing. Coat the cask well, inside and out, with paraffin wax. Next cut a sheet of perforated zinc, as shown in Fig. 348, bend at the parts marked x, and place the zinc in the bottom of the cask. The zinc can be removed when required by

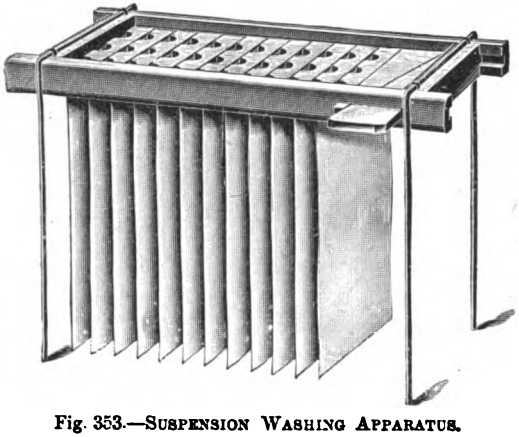

Fig. 353.—Suspension Washing Apparatus.

passing the fingers through the two holes. The compo piping must be fastened so as to pass through the cut A and over the side (see B, Fig. 349). At C fix another piece of piping and connect C with the tap by a piece of rubber tubing. A circular motion is given to the prints by the jet of water emitted by C. Fig. 350 shows an excellent form of washing apparatus. The fresh water is introduced from the side, and the contaminated water is drawn off from the bottom. The inventor claims that in all ordinary circumstances it is impossible for prints to clog together for a moment, and this claim seems to be substantiated. The prints do not appear to suffer ill usage in the process, as with some mechanical washers. Fig. 351 shows another form of washer which is very popular. The "Champion," suitable for either prints or negatives, is illustrated by Fig. 352. The "Suspension" washer for large prints is shown by Fig. 353. The prints are held in a wooden frame by means of wedges and the frame is supported in a large tub or tank by metal uprights, which fold out of the way when not in use. Another useful idea takes the form of wooden clips (Fig. 354) by means of which the prints may be floated in an upright position in any convenient vessel.

Other Substances Used in Toning.

Other substances have been suggested for toning, among which are uranium, palladium, lead, osmium, and iridium. Of these, uranium is dealt with in another section, and is not by any means suitable for toning print-out impressions. Prints may, however, sometimes be toned in a mixture of gold and uranium with some success. The formula used is:

Chloride of Gold	1 gr.
Uranium Nitrate	1 gr.
Sodium Acetate	15 grs.
Common Salt	15 grs.
Water	10 oz.

Pleasing dark tones are obtainable, but the image loses considerably in vigour. Palladium toning does not appear to offer any advantages over the usual and more accessible substances. The following formula has, however, been experimented with:

Chloro-palladinite of Potassium	2 grs.
Citric Acid	20 grs.
Water	10 oz.

20 grains of common salt may be added, if desired, but it does not appear to affect the result materially. The addition of common salt to platinum and other toning baths has been many times suggested. It certainly offers the advantage of ensuring the conversion of any free silver remaining in the paper, and preventing its combination with the platinum or other salt, but it appears to retard the toning action seriously, and, in fact, in some cases stops it altogether.

THREE-QUARTER FACE, TURNED TOWARDS LIGHT.

FULL FACE, ORDINARY ROUND LIGHTING.

EXAMPLES OF STUDIO LIGHTING.

Causes of Failure.

Great importance attaches to the thoroughness with which the different operations are carried out, especially when washing the prints between the alum and gold baths, and also before and after fixing. Most of the defects met with, such as stained or spotty prints, uneven and poor tones, etc., are generally traceable to faulty working and failure to carry out the instructions in their entirety. Of course, chemicals are sometimes impure, and the prepared paper is occasionally at fault, but as a rule both chemicals and paper are of excellent and reliable quality. Iron spots and markings sometimes appear on the paper, having escaped the vigilant eye of the factory examiner; but such faults are not common, and should be detected before printing. It is proposed, therefore, to consider the common causes of failure, with special reference to stains and poor quality of tone.

Stains.

Many photographic experts have made this the subject of research, and the experiments of Mr. C. H. Bothamley a few years ago did a very great deal towards clearing up some disputed points. Among other things, he pointed out the absolute necessity of excluding hypo. from all operations before fixing. Until this stage is reached, the hypo. should be placed entirely on one side. A certain part of the working room should be set apart for the hypo. dishes, and used for nothing else. Do not make up solutions of hypo. near the toning bench; in fact, no trace of solutions or crystals should be allowed where other work is done. See that the hands are well washed after manipulating the prints while fixing, and not merely dried with a towel. This is a frequent cause of bad stains; the towel appears clean, but is really affected sufficiently to contaminate the fingers instead of cleansing them. Even though great care is used to thoroughly wash down a bench that has been splashed with hypo., some part will probably be absorbed in the wood, and at some future time will work mischief.

How to Treat Hypo. Stains.

To the novice it is always a cause of considerable wonderment why a print may be placed entirely in a bath of hypo. without staining, and yet if touched by the hand which has been in contact with the merest trace of the salt a bad stain is produced. This is easily explained by a little experiment. Take a small quantity of silver chloride and divide it into two parts, placing each portion in a test tube. Pour over one a strong hypo. hath, say 3 in 20, and a weak one, 1 in 200, over the other. That in the strong hypo. bath will be immediately dissolved. but the other will form a dirty yellow metallic-looking precipitate. This is the insoluble silver thiosulphate, which rapidly decomposes into the dirty brown silver sulphide, constituting the stain on the paper. In most cases the stain is complicated by the silver organate present. Such stains

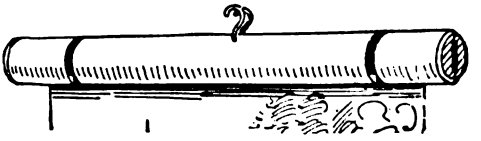

Fig. 354.—Floating Print Clip.

are to some extent soluble or removable by strong potassium cyanide, but it needs to be used with extreme care, and, generally speaking, it is easier and better to make a new print. The method adopted is to moisten the corner of a silk handkerchief and rub it on a lump of potassium cyanide, and then lightly touch the stain until it shows signs of disappearing, when it may be plunged into a bath of clean water.

Poor Tones

may usually be traced to prints from flat negatives with very little contrast. In the case of an average negative, however, should poor tones be produced, one of three things may have a bearing on the result: (*a*) Printing in too bright a light, and consequently destroying the proper contrast of light and shade; (*b*) toning in too strong a bath; (*c*) toning in an old or weak bath. The remedy for (*a*) is obvious. For (*b*) the time taken for toning should be

noted. This, under ordinary conditions, at a temperature of, say, 60° F., should take from 6 to 8 minutes. If the toning is completed in less time, the bath is too strong for the best work. In the case of (*c*), an old or weak bath will invariably affect the tone, for the reason that the gold is either used up in toning or has been precipitated by impurities in the water, action of light, etc. Great care should be taken that the proportions of gold and salt are maintained, or the toning will be irregular.

Double Toning

is generally the result of using a weak bath, which is strong enough to tone the lighter half-tones but fails to affect the stronger portions of the print. Especially is this the case with the sulphocyanide bath. Excess of this salt is liable to produce double tones and pinkiness. Therefore it is better, when working on a small scale, to make up a fresh bath for the exact number of prints—for instance, a 10 oz. bath for each dozen quarter-plates—than to strengthen a bath that has been used by the addition of sulphocyanide and gold.

Loss of Tone in Fixing

may be caused by (*a*) too strong a toning bath, or (*b*) too strong a fixing bath. If the bath is too strong, the tone is more or less superficial, giving consequently a thin image after removal of the free silver salts by the fixer. When the fixing bath is too strong, a similar result happens in a different way, the whole image being reduced. A bath of a certain strength should be invariably used for a certain number of prints. A 20 oz. bath of hypo. solution (3 in 20) is sufficient to fix safely about 50 cabinet prints, each remaining in the bath 10 minutes. Use a fresh bath for each batch of prints.

Concluding Hints.

General faults in toning may be found to be the result of the prints sticking together, or adhering to the sides of the dish. In all operations the prints must be kept moving, however slowly, so that the solutions shall have free access to the surface of the print. Very many difficulties may result from negligence in this respect, particularly stains and marks. Bleached spots on prints, which have a bluish tinge, and appear in the final washing, are usually due to allowing the prints to cling together in the washing tank. Loss of brilliancy is also caused by prolonged washing, which makes the film tender and the paper rotten. Prints which have been washed too long are almost as likely to fade as those which have not been washed long enough. Black spots are sometimes due to faults in manufacture; in this case they may be detected before printing, but will, of course, appear lighter and brighter. Generally, black spots are traceable to metallic impurities in the washing water. Iron rust from old pipes is a constant source of the trouble. Such operations as filing, cleaning up brasswork, etc., should not be done when the prints are about drying, and never in a printing room. If yellow whites appear during the operation they are due to (*a*) a trace of hypo. in the washing water, or (*b*) an old or stained fixing bath. If the defect does not show until after drying and exposure to light, insufficient fixing is the cause.