kind of print. Under the head of "Transparencies," we shall show how to make new and stronger negatives from such weak ones.

Slow printing always makes the richest prints. Half of the back of the printing frame can be raised so that the print can be examined from time to time; care, of course, being taken not to allow the paper to be moved from its first position, otherwise the print will be blurred. If you print against the glass on the inside of a window be sure that the glass is clean, with no spots on it. The printing is to be carried on until the picture is one or two shades darker than it is desired to have it after toning. After printing and toning one or two batches of prints there will be little difficulty in deciding how deep the printing should be carried. When examining the prints in the frame, care should be taken not to allow sun-light to fall upon the paper, and the frames should be opened, therefore, away from the strong light.

It sometimes occurs that a portion of a negative is thin, and prints very quickly, while the rest is intense and very slow in printing. To remedy this and get an even print, we can hold a sheet of rather thin, white paper over the thin part of the negative while printing in the sunlight, the paper being cut so as to shade only the parts which we wish to cover. The paper should be kept slowly moving so as not to let its outline show in the print. If this does not suffice, we can paint over the thin portions on the *back* of the plate with Gibon's opaque, and rub this off when the more intense parts are nearly done. Or, the thin portions can be retouched on the *back* of the plate with one or two coats of Prussian blue, applied with a fine water-color

brush. Previous to doing this the glass should be well cleaned with powdered pumice stone, rubbing it with the finger moistened with alcohol or water, and then carefully brushed off with a clean, soft cloth. This will allow the color to lie smooth.

TONING AND FIXING PRINTS.

The operation of toning should be carried on either in the evening by artificial light, or it can be safely done in the daytime, but not near a window admitting a strong light. As fast as the prints are finished they should be put in a dark box until they are ready for the next operation. It is better that the prints should be toned the same day they are printed, though it is not necessary to do this; they can be kept a week or more if desirable, but it is better to tone them before too large a number accumulates, as it is alway easier to tone a few prints at a time than to undertake a great many. Before toning, the prints should be trimmed carefully, and the trimmings saved in some box or drawer; they contain silver, and hereafter we shall explain how to get the silver out of them. To make the toning solution, we take a pint bottle and pour into it an ounce of powdered borax. We fill the bottle with hot water and shake it until the borax is entirely dissolved, then we set the bottle away to cool. Then we take a four ounce bottle which we know to be perfectly clean, and pour into it the contents of our thirty grain vial of chloride gold and sodium. The gold does not all run out, but we shall attend to that in a few minutes. Carefully cleaning our four ounce graduate we pour into it thirty drams distilled water; we pour a few drops of this into the gold vial, which dissolves the gold, which we then pour into the four ounce bottle. We continue this several times,

pouring a little water into the vial and then pouring that into the other bottle, until we are sure that all of the gold is out of the vial, when we pour the balance of the thirty drams into our bottle and cork it. This bottle now contains thirty drams water, and thirty grains gold and sodium, and we label it:

Chloride gold solution.
One dram equals one grain.

For the fixing bath we use one ounce hyposulphite soda dissolved in eight ounces water, and add, when ready to use, four or five drops of strong ammonia. By this time we will take it for granted that our solution of borax is cool, and we take of that two ounces and two ounces of water, to which we add one dram of our gold solution. This makes the toning bath, and we pour it into our toning tray. After using this toning bath, unless we have more prints to tone the same day, it should be thrown away. We now take a clean tray, large enough to hold our prints, and fill it nearly full of water. Into this we lay the prints one by one, face down, pressing them carefully under the water so that no air bubbles adhere to the paper. We stir them about in the tray and shake the tray for a few minutes, and then pour the water off, which we notice is slightly milky: we then fill the tray again and shake it well to let the water freely circulate among the prints, and again pour off the water. We repeat this operation half a dozen times, and the time before the last we add to the water about three drams of our stock solution of carbonate soda. In large photograph establishments the water from these first two or three washings is always saved as it is very rich in silver. But amateurs, unless they expect to do a good deal of printing, will not find it to pay to save these

wastes. We shall, however, in a subsequent chapter explain how all these wastes can be saved. When the prints are finally washed, which, it will be noticed has changed them to a somewhat reddish color, they can be placed in the toning bath. It is not desirable to have more than six or eight in the toning bath at one time, and, therefore, if we have a dozen in the washing-tray we will tone at first only six of them. We place them in the bath one by one, face down, pressing each one well into the solution to insure its being wholly covered. We now gently rock the tray to circulate the solution thoroughly through the prints and after a few minutes we raise them at one corner and carefully draw out the lower one, which we examine to see if it is sufficiently toned. If not toned, we replace it on the top of the others and again draw out the under one: this, we keep repeating until the toning is done, which will be when the prints have a rich purple tint, when examined by transmitted light. This tint should show rich and warm right through the paper. The peculiar tint can only be learned by experience. Do not slight the matter of turning the prints. If allowed to remain some time in the toning bath without this constant changing there are liable to occur small or large spots where air bubbles prevent the toner from acting, and such spots retain their reddish color. Should such spots be seen, they can usually be cured by turning them, print face up in the tray, and pouring some of the solution on the spots from a graduate. When toned sufficiently the prints should be placed in a tray of clean water, and the other batch of prints placed in the toning bath to go through the same operations. After all the prints are toned they should be thoroughly washed in the washing tray in five or six changes of

water; they are then ready for the fixing bath and are to be placed in the fixer one at a time, face down. The fixing tray should be rocked occasionally, and the prints changed once or twice, from the bottom to the top, as in toning. The prints should remain in it about fifteen minutes. The fixing bath should be used for only one batch of prints. While they are in the fixer the salt bath can be prepared, which is made by dissolving about one ounce common salt in four ounces of water. The object of the salt bath is to prevent blisters, which are very annoying when they occur in the prints. Blisters, however, in spite of all precautions, may occur, and it may be well to know how to manage them. Lay a clean piece of blotting paper on a smooth board, or on the top of your table, and upon this lay the wet print, face up. Then cover the blister with another sheet of blotting paper, and very gently rub the paper directly over the blister with a circular motion. This rubbing should be very light at first, the pressure being gradually increased, and after a few moments the blister will be found to have disappeared, or will leave but a slight trace, which cannot be seen after the print is dry. After the prints have been a sufficient time in the fixer they are transferred directly, one at a time, to the salt solution, in which they should remain five or six minutes, and then, after rinsing in fresh water, placed in the washing-box. Dealers in photographic materials generally have washing-boxes for sale, but we have always found the following the most serviceable for our own use. We take a large, clean earthen jar, the larger the better (our own holds about 10 gallons) which we stand in a sink or bath tub, the water being let into it by means of a rubber tube, running from the tap to the bottom of the jar. The prints are placed in

this when filled with water, which being fed from the bottom and overflowing the edges keeps up a continual circulation. The prints should remain in this at least an hour, and two if possible. One advantage of this jar for the washing-box is, that there are no sharp corners in it to tear the prints. After the washing is complete the prints can be taken out and laid face up on newspapers, or suspended on clean strings, to dry, or they can be immediately mounted on cards.

If only a few prints require washing it will not be necessary to place them in the jar with running water. They can be washed as well in a tray of water, which should be rocked to circulate the water well among the prints. After half a dozen changes of the water, the prints should be laid separately on a sheet of glass, first face down and then face up, letting a good, strong stream of water flow over them. This will effectively wash out all the hypo from them. And it is essential that prints should be thus thoroughly washed to prevent their afterward turning yellow and fading.

CHAPTER VIII.

MOUNTING AND BURNISHING THE PRINTS.

THE prints can be mounted as soon as they are washed, or the mounting may be deferred to some subsequent time. In the former case the prints should be taken directly from the water and laid one above the other, face down, on a sheet of glass, and all the surplus water should be squeezed out of them. The handiest thing for doing this is a small rubber roller, which can be procured of dealers in these materials. If the prints have been allowed to dry after washing them, they will, of course, need to be thoroughly moistened again by soaking in water.

A good paste for mounting prints can be made by soaking about one-half ounce of common laundry starch in one ounce of cold water for say half an hour, and then adding to this two ounces of boiling hot water, and immediately stirring the mixture. This paste will not keep, but should be used the same day that it is made. A paste that will keep, which will answer for mounting photographs and for various other purposes for which a paste is required, can be made in the following way: Take about two ounces of common laundry starch and two ounces of water, and stir these together in a saucepan until it is like a thick cream; add to this one pint of hot water and about seventy-five grains sheet gelatine, cut into small pieces, and stir these together well, and let them boil on the stove for six or eight minutes, and then

set it to cool. Now measure out one ounce of alcohol and about fifteen drops of ordinary diluted carbolic acid, which should be added to the paste before it has become entirely cold. If strong carbolic acid is used the quantity should only be about one-third of the above. This paste should be kept in a wide-mouth bottle well corked.

Now to return to our prints. With a bristle brush, a brush about one inch wide is a convenient size, we apply the paste to the back of the uppermost print, taking pains to distribute the paste evenly over the whole surface, especially at the edges and corners. If any pieces of grit or hard substances should be seen in the paste they may be removed with the blade of a penknife, Now, raise one edge of the print carefully with the knife blade, and, taking the print in both hands, lay it upon the cardboard as smoothly as possible at an equal distance from all sides. Upon this lay a sheet of clean blotting paper, and with a circular motion lightly go over this with the hand, pressing the print to its place, taking care that it adheres at the edges and corners. Then the card should be placed on edge to dry

After mounting albumen prints, and before burnishing them, any light or white spots caused by opaque spots in the negative should be "spotted out." To do this we prepare a solution of

Water, one ounce.
Alcohol, one dram.
Gum arabic, sixty grains.
Glycerine, fifteen drops.
Ox-gall, ten grains.

Dissolve these, and keep in a two ounce bottle.

Mix the colors on a paint slab or saucer to match exactly the tint of the print, using a few drops of the above solution to moisten the paints. With carmine, Prussian blue and neutral tint, any shade can be matched. Apply this very delicately and carefully with a fine-pointed brush.

When the prints are almost dry they can be burnished. The burnishing iron should be heated and kept hot during the burnishing, about the same heat as a flat iron in ironing clothes. Care must be taken to keep the polished surface of the burnisher bright and clean. When the iron is hot enough the prints should be lightly rubbed with a glacé polish, which is sold for this purpose, and is applied with a small wad of flannel. Then the prints should be passed through the burnisher two or three times, the burnisher being so adjusted that the pressure on the prints is rather light; the degree of pressure will be quickly learned by experience, more pressure being required if the prints have been allowed to become dry before being polished. White castile soap will do very well as a lubricator for the prints before burnishing, and is applied in the same manner as the above.

It may often happen that it is not convenient to burnish prints the same day they are mounted, in which case they can be subsequently moistened safely in the following way: Set a developing tray filled with water in the bottom of the fuming box previously described, and upon the perforated pasteboard lay the mounted prints, on edge, so that they do not touch each other, and close the door tight. In a few hours they will become sufficiently moist to burnish.

If it is desired to have the prints polished without mounting it can be done in the following way: Procure one or two sheets

of highly polished rubber and lay the wet prints face down on these, putting on as many at a time as the rubber will hold; then all the water should be squeezed out of the prints with a rubber roller, and after that the surplus moisture should be soaked up from the back of the prints with blotting paper, the prints being firmly and smoothly pressed into contact with the rubber. They will dry in half an hour or so, when they can be easily removed from the rubber, and will be found to come out perfectly flat and with a beautiful, brilliant polish.

Every amateur should have a large album for his workroom, and paste in it one print from each negative made. Above this should be marked the number of the negative, and below it something like the following:

Carbutt B.—6—f32—10 B. May 10, 1890.

This shows the kind of plate used, the number of seconds of exposure, the size of stop, the time of day, whether bright or cloudy, and the date.

This will be a reference book, showing at a glance whether the time and stop were correct for such a view—a helpful guide for future work.

To mount quite large photographs we dampen a piece of thick blotting paper, cut to the exact size of the print, and lay this upon the back of the card for about ten minutes previous to the mounting. When the print is pasted on the other side both sides of the card will dry at the same time and remain flat.

Albumen prints have a tendency to curl very much in drying, which can be prevented by soaking them, after the final washing, one by one for a few minutes in a solution of pure glycerine and distilled water, mixed in the proportion of one part glycerine to

five parts water. When removed from this the superfluous moisture should be absorbed by gentle pressure between sheets of clean, white blotting paper. After this they should be laid out flat to dry, when they will become soft and smooth. At any subsequent time they can be mounted dry, using paste or gelatine, and burnished.

Once more in regard to albums. The one used for a reference book need not be of an expensive kind; any old blank book, of sufficient size, with every other leaf cut out, will answer for this purpose, as the book is solely for the amateur's use. Against the prints in this book it will be well to keep a record of the toning, the kind of paper used, etc.

Another album should be used in which to preserve all the best views taken, and these are procurable of dealers in photographic supplies. The writer has his own albums made with extra heavy leaves, made by pasting together two thicknesses of "mounting board." Such leaves will not warp or curl.

CHAPTER IX.

BLUE PRINTS.

THERE are few processes in the art, which are as simple and easy to follow and capable of such beautiful results, as making prints on blue paper. As the paper is easy to prepare, every amateur should make his own, because it is always better for being perfectly fresh. Any good close-grain, hard-surface, wove paper is good for our purpose, and the heavier the better. The best paper that the writer ever used for this purpose, was some very heavy paper especially prepared by Crane. A so-called book paper will not answer, as it is too porous. But any paper that makes a good writing paper, will also make good blue paper. To prepare the paper, the amateur will need a very fine, soft sponge, one of those usually called a nursery sponge. For convenience in handling this, about half or two-thirds of the sponge should be inserted in the neck of a rather wide mouth bottle, which will serve as a handle. The part of the sponge outside the bottle should measure about one inch and a half in diameter, to be the proper size for applying the sensitizing solution. For the solution, procure several ounces each of citrate iron and ammonia and ferricyanide of potassium (red prussiate of potash) C. P. The chemically pure is very much to be preferred to the ordinary commercial article, because it produces a

much more brilliant blue. Take of the latter 256 grains and dissolve in a four ounce bottle of water; cover the bottle with an opaque paper and label it,

STOCK SOLUTION.

Red prussiate of potash.

1 dram equals 8 grains.

We make a stock solution of this because it will keep indefinitely. The other chemical used in sensitizing blue paper will not keep, and therefore should be prepared fresh every time.

Having previously prepared this potash so that it will be dissolved and ready to use when needed, we dissolve 50 grains citrate iron and ammonia in one-half ounce of water. This takes but a few minutes to dissolve. The citrate of iron and ammonia should be kept in a wide-mouth glass bottle and corked tight, so that no air or moisture can get to it. Having the two chemicals now dissolved and ready to use, we pour into a small graduate four drams of the potash solution, which is the same quantity as we are going to use of the iron and ammonia. We place our funnel in our four ounce graduate, having previously placed in the bottom of the funnel a small wad of wet cotton wool, and pour the potash into the funnel and immediately follow it with the half ounce of iron and ammonia. They will filter through the cotton in a few minutes, and to this solution we add about one grain of bromide of potassium from the stock solution which we have at hand. This bromide must be used judiciously. If all the paper is to be used within a week, do not add any bromide. It is only to be added where the paper is to be kept for some uncertain time. Too much bromide will make the paper

print slowly. The object of this bromide is to keep the sensitized paper fresh. Now take the paper which we wish to sensitize, and cut it to a convenient size, as it is much easier to sensitize smoothly a small sheet of paper than it is a large one. We pin this paper by the four corners to a smooth board on which has been placed a sheet of clean paper. Any drawing board will answer for this purpose, if it is soft enough to hold the pins. Now we take the sponge and moisten the end of it, so that it will take water freely, and then squeeze all the water out of it, and dip the sponge in the sensitizing solution that is in the graduate. The sponge will suck up more than we need, so we press it against the glass to squeeze out a part. The quantity can only be learned by experience.* With the sponge in hand, now swab the paper gently, smoothly and quickly, beginning at the upper left-hand corner and brushing lengthwise across the paper, continuing this, always working the sponge in the same direction, until the surface of the paper is covered with the solution; then immediately, without again dipping the sponge in the glass, swab the paper at right angles to the first direction, beginning at the lower left-hand corner and ending at the upper right-hand corner. This should be done quickly and smoothly. Hang the paper up to dry, by one or two of the pins, where no dust or dirt can get upon it, and proceed to sensitize another sheet in the same way. After sensitizing the quantity needed, the paper, which will dry in a few minutes, can be cut to different sizes. All of these operations, of course, should be done in the evening and not by daylight. If all of the solution is not used

* Use just enough in the sponge to brush over the paper without allowing the solution to *flow* or *spread*.

do not attempt to preserve it, but throw it away and carefully clean out the glass. So much for the paper.

Blue paper should be printed preferably in the sunlight, as it may take several hours to print in the shade, and the printing should be continued until the dark portions of the picture assume a kind of bronze color. A little experience will show just how far to carry the printing. When the printing is done, the print should be placed in a tray of water, face down for a few minutes, and left there until the whites in the picture come out clear, or till the white margin around the picture comes out white, when it can be hung up to dry. It is not necessary, of course, to put the prints in the water, as soon as they are printed, as they can be kept for a day or two, and a number of them washed at the same time.

We think it is a very good plan in making blue prints to have one or two large frames, so that the blue print can be printed in the center of a large sheet of paper, when it will show like an engraving, with a broad margin around it. Suppose we have a frame, the inside of which is 11 x 14 inches, for which we have a piece of glass cut the same size, as a support to the smaller negative from which we wish to print in this frame. If our negative is 5 x 8 inches for example, we cut out a sheet of thick opaque paper 11 x 14 inches and in the center of this, for a 5 x 8 negative, we cut an opening, say four and five-eighths inches one way and seven and a half inches the other way. Placing the negative in the center of our frame on the glass, we lay upon it this black mat, so that all the margin of the negative is entirely covered, and upon this we lay our sheet of blue paper, cut the same size, 11 x 14 inches. We make a print from this, and on

putting it in the washing-tray, we find that all of the blue solution on the margin washes off, leaving all of the paper except the picture pure white. After it is dried, it should be pressed smooth under a heavy weight.

Plate marks can be made on these prints in the same way as described in the following chapter.

Our normal solution for sensitizing paper for blue prints, as given on page 77 is:

No. 1.

Citrate iron and ammonia, 50 grains.
Water, 4 drams.

No. 2.

Red prussiate potash, 32 grains.
Water, 4 drams.

The proportions of these chemicals may be varied to suit different qualities of paper. In sensitizing a rough surface and rather soft paper we find a less quantity of the iron and ammonia more suitable, using thirty-two grains in place of the fifty. Too much of the iron and ammonia has a tendency to leave the whites of the print with a yellowish tinge after washing.

Again, for a very rough paper, when it is desirable to have the sensitizing solution entirely on the surface, we dissolve the given quantity of iron and ammonia in a half ounce of gelatine water (sheet gelatine ten grains, hot water one half ounce), or in a weak solution of gum arabic.

CHAPTER X.

PLAIN PAPER AND ALBUMEN PAPER.

TO our mind there is no process of printing that can compare in an artistic sense with prints on plain paper. The gloss and shine of albumen prints are not pleasing to the eye; they usually detract from the beauty of the picture. If albumen prints do not appear finished without a polish, it ought to be an objection to the use of that paper. We hardly think that a person who possesses a fine engraving would consent to have it polished. That would give it a cheap and tawdry appearance.

The plain paper is altogether easier to prepare than the albumen, and the process is so simple that anyone can make it, and make with it most beautiful pictures. Perhaps the simplicity of its preparation is one reason why amateurs are not encouraged to use it, as it would lessen the demand for other papers in which there is greater profit.

The same paper that is used for making blue prints will answer for this purpose. Care should be taken to select a paper that is smooth and not too hard, of pure linen stock. The paper first requires to be salted, for which purpose we prepare a solution as follows:

To 16 ounces of hot water add 16 grains sheet gelatine, and when this is dissolved add 50 grains chloride ammonium.

After this solution has become cool, it should be filtered. The

paper should be cut a little larger than it is intended to be when finished. That is to say, if we wish to make some 8x10 plain paper, it would be well to have our sheets for sensitizing $10\frac{1}{2}$ or $11x16\frac{1}{2}$ or 17 inches. Or, if we wish to make 5x8 paper, the paper should be cut either the size mentioned before, or about $8\frac{1}{2}x10\frac{1}{2}$ inches, as a large sheet can be prepared about as quickly as a small one. Having our paper ready, we pour the solution into a tray, a trifle larger than the paper, and either float the paper upon it or immerse the paper in it. In the first case only one side, the side which comes in contact with the salt solution would be salted. In the latter case both sides. If only one side of the paper is salted it will be necessary to mark the other side with a pencil to show the right side for sensitizing. The manner of floating the paper upon the solution is as follows: Take the paper by two opposite corners, one in each hand, and bring the two corners nearly together; lay the paper gently upon the solution, letting the two corners down in such a way as to drive out any air bubbles that might get beneath them. Then if the corners curl upward, either blow them down or press them down with the fingers till they lie smooth. The paper should remain on the solution about three minutes, when it should be removed by raising one corner, and then hung up to dry. All these operations, of course, are done by daylight. In place of floating the paper upon the solution, it can be wholly immersed, which is much the best way, as well as the easiest. This is done by placing one side of the paper in the solution at the edge, and shoving it along under the solution until the whole is in the tray. If any air bubbles are seen on the paper they should be immediately touched with the finger to remove them. The

paper should remain in the solution half a minute, and then be hung up to dry as before. Where both sides in this way are salted it is, of course, unnecessary to mark either, as the sensitizing can be done on either side. The paper will dry in twenty or thirty minutes, when it will be ready for sensitizing, or it may be kept for any length of time until needed. The time for leaving the paper *in* the solution will vary with different qualities of paper. From ten to fifteen seconds will be long enough for a soft, smooth paper. Hard papers, such as are used for ledgers, require longer time.

The above we should call a normal salting solution. If we decrease the quantity of chloride ammonium to thirty grains, we should have a weak bath, which would require a weak sensitizing solution, thirty to thirty-five grains of silver in the place of the sixty grain solution we describe hereafter.

Or we might make a very strong salt bath by increasing the quantity of ammonium to one hundred grains. Paper so strongly salted should be sensitized with a solution containing sixty-five to seventy-five grains of silver in place of the sixty grains mentioned.

The quality of the negative determines the strength of the sensitizing solution; for a weak, thin negative the paper should be strongly sensitized and printed in diffused light, or exposed to the sun with a sheet of white paper in front of the printing-frame; for an intense or slow printing negative, the paper should be sensitized with a weak silver solution, and printed in the sunshine.

For all ordinary negatives, however, it will be found that the salt bath we give first, and the sixty grain silver solution, will answer every requirement.

It must not be imagined, however, that fine prints on plain paper can be made from very thin or weak, or, in other words, poor negatives, by any manner of preparing the paper. The best negatives for these prints are what might be called "plucky," of good intensity, with plenty of contrast.

Another salting solution, which we have been using for some years, is the following:

Hot water, 16 ounces.
Sheet gelatine, 16 grains.

When the gelatine is entirely dissolved, add:

Common salt, 30 grains.
Chloride ammonium, 50 grains.
Citrate soda, 80 grains.

When all are dissolved, this should be filtered, and the paper immersed in it, one sheet at a time, for from one to two minutes. Paper salted with this solution possesses an advantage over that salted in the bath first described, that, when sensitized, it will keep for months in good condition, between the sheets of soda blotting paper, under some pressure, as mentioned later, (page 88). For economy, salt at one time all the paper likely to be used in a year or more, using a large tray. The writer uses a deep tray for this purpose, 22 x 26 in., for paper 17 x 21 or 18 x 23 in., and prepares a bath containing twelve times the water and chemicals above.

TO PREPARE THE SENSITIZING SOLUTION.

For this purpose we should have two glass graduates perfectly clean; into one pour one-half ounce of water and add to this sixty grains nitrate silver crystals. They will dissolve in a few

minutes by stirring them with a glass rod. When dissolved we add, drop by drop, concentrated ammonia; a dark brown precipitate will be formed. Keep adding the ammonia, drop by drop, and after about thirty drops begin stirring with the glass rod; after awhile, the dropping and stirring being continued, the ammonia will redissolve the dark precipitate, and the solution will begin to grow clear. When it is perfectly clear pour one-half of the solution into the other empty graduate; then, to either one of these solutions, add drop by drop strong nitric acid, stirring the solution with the glass rod. Continue adding the acid until the solution turns blue litmus paper red; then pour the acid solution into the solution in the other graduate and add water to make up to one ounce. This is the solution required for our sensitizing. If made in the day time these operations should be carried on in the dark-room, or it can be made in the evening by gas or lamp light. The solution should be poured into a bottle covered with dark paper, and will keep indefinitely in a dark place.

We will now proceed to sensitize the paper, which can be done in the evening by gas light. We lay a sheet of clean paper, larger than the paper we wish to sensitize, on a smooth board, and to this we pin a sheet of the salted paper with the salted side up. The pins should be placed in the four corners of the paper, and as near to the edge as possible.

We now have to describe how to make the brush for applying the solution. For this purpose we need a glass tube three or four inches long, and about one-half inch in diameter inside. In case we do not have this we can break a hole through the bottom of a four-ounce bottle, and use that in the place of the tube. We pass the loop of a doubled string—clean white cord is the best to use

for this purpose—we pass this loop through the tube and run through it, that is through the loop, a wad of fine cotton wool. We then, by pulling on the two ends of the string, pull a portion of this wad into the tube, the greater part of it forming a sort of

ball or brush at the end. The ends of the string are then fastened securely around the tube, and then the wad is trimmed neatly with scissors, cutting off all the loose ends. This sensitizing brush should be from one inch to one and a half inches in diameter, the size depending somewhat upon the size of the paper which we wish to sensitize. If we wish to prepare a sheet of 5 x 8 paper only, a very small brush will answer for that purpose. Everything being ready, we pour a few drams of the silver solution into a four-ounce graduate, and in this we place the brush, allowing it to soak up as much of the solution as it will. Then with the paper before us on the board as described, and inclined

towards us, we take the brush and swab the paper, beginning at the upper left hand corner and brushing across the paper to the right until all the paper has been covered. With the first sheet of paper, if it is a large sheet, it may be necessary once or twice to take up a little more solution on the brush. As soon as we have thus finished the paper we turn the board at right angles to its former position, so that one end will incline towards us, and immediately, without adding any more solution to the brush, swab the paper across, beginning at the top and working down to the bottom of the paper. This cross brushing prevents the formation of any streaks which might make their appearance if the paper were brushed one way only. Also, care must be taken, in laying on the solution, always to brush right to the edge of the paper.

The board should now be laid flat, and after a few minutes, or as soon as it becomes partly or surface dried, the paper should be hung up by two corners to dry. As this is done in the evening it is not necessary, of course, to hang the paper in the dark-room. When a sufficient quantity of paper has been sensitized and allowed to dry thoroughly, which it will do in fifteen minutes, it can be cut to the required size, and the clippings preserved with the clippings from ordinary silver paper. The sheet of paper on which the paper has been sensitized should also be kept for subsequent use. Any silver solution remaining in the graduate should be returned to the dark bottle, and the brush, when dry, can be added to the clippings of silver paper, as it is quite rich in silver. This brush should never be used a second time. This silver paper which we have now made should be printed on the next day or two after being made, or it can be preserved for

several weeks by keeping it in a dark box between sheets of blotting paper that have been saturated with a solution of carbonate soda and afterwards thoroughly dried. The solution of carbonate soda for this purpose should be in the proportion of two ounces carbonate soda to twelve ounces water.

In using this plain paper we print several shades deeper than in using ready sensitized paper: the prints are toned and fixed in the same manner as the other prints* and washed in the same way They will not need to be passed through any salt water bath after the fixing, as they do not blister. The borax bath is altogether the best that can be used for toning these prints. It is very essential that the washing before toning should be thorough. Please refer to our experiments at the end of this chapter.

An excellent way of using this plain paper is to sensitize an extra heavy paper, and then make the prints in the center so as to leave a broad margin of white outside; that is to say, suppose we have our sensitized paper 8x10, then we cut some sheets of thick, black paper 8x10 inches outside and cut in the center of these square openings which shall take in all of the 5x8 negative that we wish to use. A good size for these openings for 5x8 prints would be 6½ or 7 inches long and 4½ inches wide. Care must be taken, of course, to have the sides of the openings parallel to the outside of the paper. Others, with the same outside, might be cut to make prints from 4x5 or quarter size plates. In using these masks the negative is laid face up on the large plate of glass in one of the 8x10 printing-frames, then the mask is laid over the negative, care being taken to see that it covers the edges of the negative completely, and then the sensitized paper

*See page 66.

is placed upon this. When printing, care must be taken in setting the frame in the window or elsewhere, to handle it gently, as a jar might slightly move the negative and blur the print.

If one is so situated that he has the use of a copying press, he can very materially add to the elegance of these prints by pressing a plate mark upon them. To do this cut several sheets of thin mounting card so that they shall be about half an inch longer and wider than the prints, taking pains to have the edges smooth, straight and sharp. For instance, if the picture is $4\frac{1}{2}$x$6\frac{1}{2}$ inches, the card should be cut 5x7 inches, and the corners very slightly rounded. When the print, after the final washing, is almost dry, lay it upon two sheets of clean blotting paper, and, upon the picture, lay the prepared card so that it shall extend beyond the picture just a quarter of an inch each way, which can be done accurately by marking its position with a pencil; over this lay a sheet of clean paper, and cover this with another sheet of blotting paper. This is then laid carefully in the press, and given a moderate pressure, allowing it to remain in the press for five or ten minutes, till the print has become dry. If all this is neatly done, the result will be a beautiful picture, in finish equal to fine engravings or etchings which are so much admired.

All prints, especially of landscapes, whether in albumen, plain salted, or blue paper, can be trimmed fearlessly. It is seldom necessary to print the full size of the negative. Frequently there is something at each side or top or bottom that may be omitted, which will add to the finish of the picture. Therefore, make opaque masks of different sizes and shapes, oblong, oval, round, and shave down the

paper around the inside to make it very thin at the edge, and cover the mask with white tissue paper. This should then be laid in the printing frame under the negative, and the printing done in sunlight. Try this and see what beautiful pictures it will make.

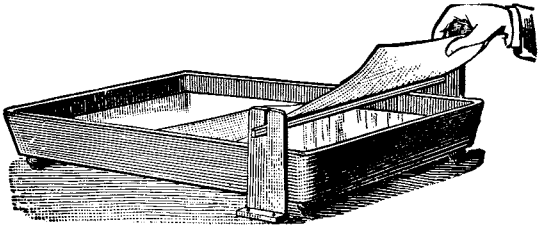
ALBUMEN PAPER.

Albumen paper, ready for sensitizing with silver, can be procured from dealers in such goods, of better quality than any one can make for himself. The usual size is 18 by 22 inches, and to sensitize a full sheet requires a tray somewhat larger to hold the silver solution. It will be more convenient, however, for the amateur to cut the paper to slightly more than double or quadruple the size required for his plate, which will allow the use of a smaller tray. The paper to be sensitized should be kept in a damp place for half a day before use, as it is more easily and smoothly floated on the silver bath if slightly damp. The silver solution should be prepared by dissolving in a glass bottle:

Nitrate silver, 600 grains.
Distilled water, 10 ounces.

When this is dissolved, it should be tested by laying in the bottle a small piece of litmus paper. If the litmus paper is not reddened slightly, showing its acidity, add drop by drop nitric acid, shaking the bottle after each drop, until the paper changes to a faint red. Paste a bit of paper on the bottle on a line with the surface of the solution. If it is desired to sensitize a full sheet of paper in a large tray, a proportionately larger amount of solution should be prepared.

When ready to sensitize the paper, this solution is poured into the tray, and the paper floated upon it in the same manner as described in the beginning of the chapter, raising the paper by each corner to remove with a glass rod any air bubbles that may adhere. The paper should float from a minute to a minute and a half, and then be removed by drawing it over a glass rod or tube laid across the tray near one end, to scrape off smoothly



a portion of the solution. Hold the paper by one corner over the tray to allow the solution to drip off, and then hang up to dry in the dark, using for this purpose the ordinary spring clothes pins.

After all the paper required has been sensitized the bath can be returned to the bottle. As the paper has taken up a portion of the water and silver, the solution should be restored to its original strength by adding water to bring it up to the marked place, and then adding twenty grains of nitrate silver for each half sheet (11x18) sensitized, or in that proportion. The bottle can be wrapped in black paper, and laid away in the dark room. The sensitized paper will dry in a short time, when it can be cut to the sizes required, and laid between sheets of soda paper, in which way it can be kept fresh for several days.

We have lately tried an interesting experiment in regard to washing and toning prints on plain salted paper.

We made two prints from a fine 5 x 8 negative. One of these prints was cut in three equal parts, and the other into four parts. The experiment was to determine the amount of washing required before toning, and the necessity of adding soda to the wash water. Each of the parts was numbered: Three of them were given a very short washing; one was about half washed; and the other three had an unusually long washing, being allowed to soak in several changes of water for nearly an hour. In the table below, the first figures are the numbers of the prints, and the last figures show the order in which the toning was completed, all being placed in the toning bath at the same time.

No. 1—	half washed, no soda used	2.
" 2—	short wash, soda in next to last wash	3.
" 3— "	" no soda	1.
" 4— "	" soda in last wash	4.
" 5—	long " no soda	6.
" 6— "	" soda in last wash	7.
" 7— "	" soda in next to last wash	5.

After toning (in the usual borax and gold bath) the prints received a thorough washing, and, after fixing, were placed in running water for two hours. The prints were then dried, and the proper parts were pasted on two cards, completing the two original pictures. Then a careful examination failed to show the slightest difference in tone or tint between any of the parts, and, excepting the lines where they were cut, they looked as if all had received precisely the same treatment.

CHAPTER XI.

STOPS AND SWING-BACKS.

IN some lenses, all of the stops or diaphragms are cut in one circular piece of brass, which revolves in the lens tube, each one of the holes stopping by turn exactly in the center. In other lenses the stops are inserted separately, and are of from three to seven or eight different sizes.

The smaller the stop used the more detail will be shown in the picture, and the longer time will be required for the exposure. It is not advisable in all photographs to have the detail as fine and exact as it can be made, but in taking a picture of a building, especially if it is a building containing much ornamentation, delicate carving or relief work, fine arches, etc., it is desirable to have the detail come out clear and distinct. So, too, with interiors. In such cases a small stop should be used. Small stops give a sharp focus, and tend to bring objects near and distant into the same focus, and with equal distinctness. Although this is not as the eye sees things, it is yet sometimes desirable.

With large stops, if we adjust the focus to a certain distance, objects nearer and beyond are out of focus and indistinct. Therefore, if we wish to take a picture of a house in the country, with a group of people sitting on the lawn in front, and show all clearly, we must use a small stop.

Large stops give more detail to the shadows, that is, the shaded

portions. Large stops give boldness; they make the more artistic pictures. They should be used when taking moving objects, because they require so much less exposure. In landscapes never use the smallest stop, nor in using the swing-back; but rather always use the largest stop that will give sufficient sharpness to the main object.

Stops are usually numbered with reference to the focal length of the lens, as f8, f11.3, f16, f22.6, f32, f45.2, f64, which means that f8 is one-eighth, f64, one-sixty-fourth, the focal length, etc. Therefore, if the focal length is eight inches, f8 will be one inch in diameter, f16, one-half inch; f32, one-quarter inch, etc.

The size of stop regulates the duration of the exposure, the smaller the stop the longer the exposure, inversely in proportion to the squares of their diameters. Therefore if a stop of one-half inch diameter required for a certain view two seconds exposure, a stop of one-quarter inch would need eight seconds, and one of one-eighth inch, thirty-two seconds, while another of one inch would need only one-half second. If, therefore, experience has taught us the proper exposure to give with an f16 stop, it will be a simple calculation to tell the necessary exposure for any other stop.

THE SWING-BACK

Is used to prevent distortion when tilting the camera to take in a tall building; also to bring a distant and near object into focus at same time.

We focus on a distant object and find the foreground out of focus, because the focus is shorter for distant views than for near objects. For distant objects, we draw the lens nearer the

ground-glass to get the focus; for near objects the lens needs to be further from the glass. To bring both in focus, we focus on a point in the center of the ground-glass; about half way between foreground and the distant object. In one case the focus falls a little behind the ground-glass, in the latter, it falls in front. So we use the swing-back, which we suppose to swing on its center, drawing back a little the upper part (the foreground), which pushes forward the lower part (distance), and this will bring both in focus, and at the same time it does not disturb the middle distance, as that falls in the center of the ground-glass, which practically remains in about the same place.

So with the side-swing. In taking a picture with some object, a tree for instance, near us on the right, to bring it into focus we swing back the left side of the ground-glass, on which the tree shows, till it comes in focus, swinging it back just enough to bring that side in focus without disarranging the focus of the more distant view. When making use of the side-swing or swing-back, we can employ a larger stop than usual, and still preserve the depth of focus to obtain which a small stop is ordinarily used. A picture is said to have depth of focus, when the foreground and distance are both in focus, details showing plainly in both. From the artist's stand-point, details everywhere are not admissible.

CHAPTER XII.

LANDSCAPES.

LANDSCAPE photography is the most healthful, instructive inspiring and delightful branch of the beautiful art. It leads one into the wholesome air of the country, to the lakes, sea-shore and the mountains, to quiet dales and laughing streams, to early morning tramps; teaches him to study nature and observe her varying moods; reveals to him visions of the picturesque and the beautiful, that without this incentive would have remained to him unseen.

There is no royal road for the landscape photographer; patient study and intelligent observation are constantly required. He must study pictures that attract him, to see wherein lies their charm. The finest camera and the highest priced lens are not the essential things, but the knowledge how to use them. A picture by one of our great painters, a modest, quiet man of rare insight, depicts a meeting of two hunters; one, a sportsman with his complete and elegant outfit, *with no game*, is showing his expensive breech-loader to the other, a lank, seedy countryman, with nothing about him to indicate a hunter, but an old, muzzle-loading, single-barrelled gun, and a score or more of ducks. And our fine sportsman seems to sigh as he says, "why can't I get them?"

The introduction of figures and of animals in landscape is

usually desirable, but they should never be made too prominent. There should be a fitness about the figures, they should look as if they belonged in the picture. Naturally therefore, it would be a defect to have them exactly in focus, or be rendered with fine details, unless the object is to take the picture of the group of people or of the animals; in which case the landscape is sacrificed to the portraiture. Many landscape views are failures, through the introduction of people in the immediate foreground, staring at the camera as if they had rushed in where they did not belong and were not wanted, to "get their pictures taken." Those who have tried to take views of charming bits of scenery in our public parks, know what a desire some people seem to have to get into the view; and stop where they are entirely out of place.

For pictorial effect all figures should appear unconscious of anything like posing.

The chief feature in the landscape should not be placed in the center of the plate, nor should the picture seem to divide itself into two equal parts. The point of view must therefore be carefully selected, setting up the camera in different places to try to get the best effect.

A small stream in the northern part of Illinois is often explored by those summering in its vicinity, who have heard of its varied and picturesque scenes. A young lad took his little skiff one July day, with a lunch and a twelve dollar camera, and spent the whole day on this stream, rowing back and forth sixteen or twenty miles. He had six plates with him, and when he returned at night, it was a matter of some surprise that he had only made three exposures. He set up his camera to take others, but something about the light or the shadow did not suit him, and he

seemed content with what he had secured. He did his own developing, and the result was three beautiful pictures, two a quarter size and one a 5 x 8. A week later, two older amateurs, of large experience, with fine cameras and Dallmeyer lenses, spent a forenoon on the the same stream and took a dozen or more views. But none of them were, as pictures, quite equal to those made by the lad with his cheap lens. They all saw the same scenes, but the younger had the more patience, and perhaps the faculty not given to all, of discovering the beautiful in common things. The larger of these pictures we have used as an illustration in the chapter on "Ornamental Photography."

In general, the sun should not be directly behind the camera, but rather at one side, not being allowed, of course, to shine into the lens. It is not necessary that the sun should be up at all—very charming views can be obtained in the early, bright mornings of spring, before sunrise.

Moonlight effects can be had, by pointing the camera directly toward the sun, with exposure somewhat longer than usual. If such a view is taken across the wavy surface of a lake, and carefully developed, it will give a very striking imitation of a moonlight scene.

Foliage taken during a light shower, produces a fine effect. Foliage generally shows to better advantage when taken in the spring before the leaves are fully developed, than later in the summer.

Waves and the surf on the sea and great lakes are best taken, when on bright days, the sun is concealed behind a cloud. In taking views of still water, the camera should not be turned

towards those portions which reflect the sky, or the water will look like the sky, white and harsh. Still water looks best when it has, in the near background, trees or high hills. There may be occasions, however, when it is necessary, in order to get a particular view, to have in the foreground water, which does reflect the sky, in which case the exposure can be lessened by holding the slide a moment in front of the lower half of the lens opening. So, too, to shorten a sky exposure, the slide can be held in front of the upper part of lens.

A view containing sharp shadows, dark foliage, as well as much light in other portions, or in other words, strong contrasts, should be given ample exposure. Long exposure tends to soften contrasts, to give harmony, and if carried too far, weakness. Short exposures, while apt to give some degree of hardness, will make more brilliant views, and give strength and character.

Winter views, in a bright light, with abundance of snow and sharp contrasts of light and deep shade, should usually be given long exposure, using a small stop.

If it is a bright day, with the sun obscured, which will have the effect of diminishing the contrast between light and shade, the exposure may be shortened.

In landscape work, after one has acquired some familiarity with development, the amateur should experiment freely. It would be well to take the same view on half a dozen plates, half of them slow, and half rapid, giving varying lengths of exposure and different stops, carefully noting the results.

For example, suppose you are using a lens of eight inches focus and a Carbutt B 16 plate. Take a favorite view,

and make nine exposures on a quarter plate, at noon on a bright day, with stops and times as follows:

$\frac{1}{8}$ inch stop (f64), 8, 12, 16 seconds,
$\frac{1}{4}$ " " (f32), 6, 8, 10 "
$\frac{1}{2}$ " " (f16), 4, 6, 8, "

Each plate before placing in the holder, should have a number marked with a pencil in one corner, to identify it afterwards. These marks will show plainly after development. Make one print from each plate and mount them all on one large card, marking under each the kind of plate, time and stop. From these, if the development has been successful, you can select one which will give you the standard stop and time, for such a subject in such a light, and from this in a short time, the correct exposure for any view will be judged instinctively. The proper exposure is the one most important point to be learned in photography, without which the highest excellence is impossible, and this can only be learned by careful, systematic experiment. After this everything is simple.

We advise a trial of orthochromatic plates in general landscape work. These should always be used when there are varied colors in the view, especially in autumn, when the leaves have changed to purple and red, and in photographing flowers. Colored screens are necessary to give value to different colors, directions for using which accompany the plates. The handiest way to use such screens, is to have them in the diaphragms. The thin discs of glass used for covering microscopic slides, which can be colored to the tint desired, can be attached with glue to the

center of the diaphragm, which should have enough of the metal cut or milled out around the opening, to allow the glass to lie flush with the surface.

Whoever wishes to produce landscape prints of a high order of excellence, will give them an artistic finish by adding clouds. It requires some patience to do this, but the result, if carefully and appropriately done, will amply repay all the trouble and extra time.

To do this well, a number of cloud negatives should be made on plates of different sizes, in the spring or early summer months. The horizon should be low, so as to take in as much of the clouds as possible, and the exposure short. The plates should be a little under-developed to print quickly. The exposures should be made at various times of the day, to secure a variety of negatives from which to make an appropriate selection to suit the different views in printing.

To use these, the landscape is printed as usual, the sky being masked by coating that part on the back of the plate with some opaque color, unless it is so intense as to print perfectly white. Remove the negative, and cover it with a sheet of thin, white paper, on which, when held to the light, the outline of the landscape can be traced with a pencil. With this as a guide, a mask of opaque can then be cut, which will cover as near as practicable the entire landscape. The cloud negative is then to be placed in the frame, with the print upon it, and while printing, the mask must cover the landscape, and be gently moved to and fro to avoid a harsh line. After one or two trials there will be no difficulty in this, and the picture will appear to be printed from a single negative.

CHAPTER XIII.

PORTRAITS.

GOOD portraits can be made in the house by the amateur, if he pays due attention to lighting the subject, and gives sufficient exposure. The sitter should be near a window, about three or four feet from it. If sunlight falls on the window, the light should be diffused by hanging over the window a thin, white sheet, or covering it with white tissue paper. The side of the sitter away from the light will be shaded, and this can be lightened by placing a white sheet, or anything that will reflect light, about three or four feet distant, and in such a position that it will reflect some light on the dark side of the face. If this is not sufficient, the operator can hold a mirror, about two feet square, in such a way during exposure, that it will throw some light on the shaded portion of the figure. Both sides of the face should not be equally lighted, as it will produce flatness. The camera should stand about the same distance from the window as the sitter, or a trifle nearer, and should be a little above the head, so that it may be inclined downwards. Arrange the sitter gracefully, avoiding all awkwardness or stiffness; pay attention to the position of the hands, that they are in focus and not too conspicuous, and, if the whole figure is to be taken, see that the feet are not out of proportion, by being thrust towards the

camera. Focus on the eyes, and see that they are looking in the direction the face is turned. A quick plate should be used, a medium size or large stop, and ample exposure. The exposure should be three or four times as long as an out-door, or even longer than that, according to the light.

The time required to take a portrait in the house, can only be learned by experiment. Let some obliging friend sit for you, and take his picture several times over, using different stops and exposures. Plates are comparatively cheap, and this will be a valuable lesson.

The background should not be so near the sitter, that shadows will fall upon it, and should be of a drab or pearl color. For flash-light portraits at night, we prefer a background of black velvet, as described in the following chapter. This also makes an admirable background for portraits taken out of doors; a black shawl will answer as well. Against such a background, profile views show finely. Out-door portraits should not be taken in the sunlight but in diffused light, in the shade, or the north side of a building.

Do not wastes plates trying to take portraits on a dark or cloudy day in the house, or in the fall or winter too late in the afternoon. Especially is this the case where you have to take a portrait of a very young child who can not keep still long enough for the proper exposure.

In photographing out of doors, do not try to take portraits or groups with the sky, or water reflecting the sky, for a background. In such cases the features will come out dark. We saw a view lately, of a group of people on the upper deck of a lake steamer, taken towards the open water and sky. The only one showing

plainly in the print, was a lady who happened to have behind her the black smoke-stack. Had the steamer been headed the other way, towards the high hills, the portraits would all have been good.

In the house, a high side light is preferable, which can be fixed by cutting off the lower part of window.

For ladies, the costume should be simple and flexible, and it should be arranged gracefully. Both nose and mouth are important, and not always easy to photograph. It is not uncommon to see noses that turn to the one side or the other. It should therefore be noticed in which position of head it looks best. Also, one side of face may look better than the other. A pug nose should be taken with face looking down, and a long nose looking up. If the eyes are quite large they should be looking somewhat down, or if they are small they will appear larger looking up.

The moment for exposure comes only when the sitter seems entirely at ease, and apparently unconscious that the exposure is made. This is very important with children and infants. Then the most rapid plates must be used, the full opening of lens, and a noiseless working shutter. Some photographers succeed wonderfully with young children, by having an attendant blow soap bubbles to attract their attention. Still more important is it in the case of adults. "Now, look pleasant, please!" But one cannot look pleasant or natural at command, and the effort to do so often results in grotesque failure. For successful portraiture, the artist, whether with color or camera, must know the sitter in order to secure a faithful likeness, the likeness being always the desideratum.

CHAPTER XIV.

ON INTERIORS.

INTERIORS are too often neglected by the amateur for want of the proper lens, the patience requisite for the long exposure, and the fancied difficulties.

The lens should be a "wide angle," to take in as much of the interior as possible, capable of showing three sides of a room. A bright day should be selected, to give the greatest quantity of light in the room, and this should be diffused by hanging white sheets over the windows furnishing the light, taking care that it does not shine directly into the lens. If a window comes in view, it should be covered with dark cloth, hung inside the window frame, and when the exposure is nearly complete, this cloth can be removed for a few seconds.

In focusing, the camera must be level, to have perpendicular lines show correctly. A piece of white lace, or something of the kind, laid over a chair at the chosen distance, will be an easy thing to focus on. Use the smallest stop, as details and "depth of focus" are wanted. A rapid plate should be used, as the time will be long in any case, and over-exposure need not be feared. In a fairly lighted room, a quick plate may require half an hour; in a dim light, half a day. Therefore choose a bright day, but let no sunlight in the room. The artistic skill and taste of the operator will have ample swing in arranging the various

articles, furniture and ornaments, to make an attractive picture. Polished surfaces of chairs or tables may reflect light; they should be moved or partly covered to avoid the unpleasant shine.

In photographing interiors, it is sometimes desirable to take the view towards an open window, showing not only the interior plainly, but also the landscape without. The simplest method we have found to accomplish this result, is to give a double exposure, one by daylight for the landscape, and the last for the interior, by flash light after dark, it being understood that the camera must remain in exactly the same position for both. The focus should be made on the interior, with the stop used for flash light, and the landscape taken with a small stop. Then, leaving the camera in position, make the second exposure by flash light after dark, with the larger stop, remembering, of course, to leave the window in the same condition, curtain drawn aside, and sash up as before.

Interiors can be taken by gas light, using the most rapid plates and long exposure. The light should for this purpose be as brilliant as possible, and not come from any point where it can shine into the lens.

FLASH LIGHTS.

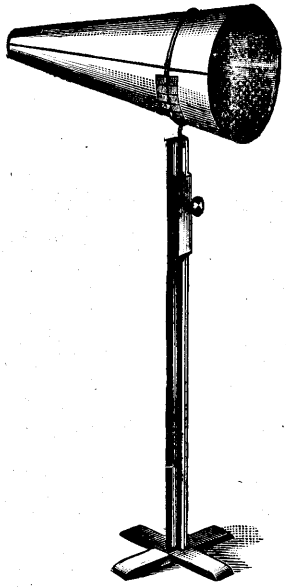
Interiors and portraits can be advantageously taken by using the magnesium flash light. In using this, care must be taken to procure a magnesium compound that is perfectly safe, and especially should one be careful in igniting it. We think the magnesium cartridges prepared by the Scovill and Adams Co. are safe to handle, and they give careful directions for their use. The cartridge should be placed on an old plate or something of

that kind, at the side of the camera and about on a level with it, and a little back of the lens. A large sheet of white paper or a white cloth sheet should be placed behind the flash, to reflect the light on the object to be photographed. There should be an abundance of light (gas or lamp light) in the room, so arranged that it will light up the subject well, and avoid disagreeable reflections. Focus on a lighted candle or lamp placed at the point which is to be in focus, and remove this before picture is taken. Use very rapid plates and a comparatively large stop. When all is ready, draw the slide, light the fuse and remove the cap from lens, replacing it immediately after the flash. Plenty of light in the room serves to eliminate the dark shadows caused by the brilliant flash. Where portraits, or groups are taken, it is well to have a black screen behind the sitters to absorb the shadows.

The main objection to magnesium cartridges or any magnesium compound is the volume of smoke and dust produced. These objectionable features are entirely obviated by the use of pure magnesium powder, ignited by means of a lamp so constructed that a large or small quantity of the powder can be blown through an alcohol flame. There are one or two admirable patterns of these flash lamps in market, and we advise the purchase of one as an indispensable addition to the amateur's outfit.

We prefer the flash-light for portraits to the ordinary day exposure. For these it is desirable to have an abundance of artificial light, gas or lamp, illuminating the subject, and it is well to have this quite near the sitter. And as this light should not shine directly into the lens, a screen must be interposed to prevent this. We illustrate here a contrivance which we have found very useful for flash-light portraiture, and which serves a double purpose, not only preventing the gas light near the sitter from entering the lens, but also allowing the flash lamp to be held in

front (at one side, of course) of the camera, and thus throwing on the sitter a stronger light. The arrangement consists of a large, hollow cone made of pasteboard, held by a rod of three-sixteenths round iron encircling the cone, one end of this rod fitting in the end of an inch square piece of wood which slides up and down on the wooden stand.



The one we use is made from two large sheets of pasteboard, glued together to form a sheet of double size. The cone measures twenty-five inches in length, twenty-two inches across the large end, and four inches at the small end, which is large enough to fit over the lens tube. The inside of the cone is blacked with common shoe blacking, which gives it a dead black finish.

This will also be found a very handy contrivance to use when taking portraits near a window in the house, as it will effectually prevent the light from entering the lens, which might fog a portion of the plate.

CHAPTER XV.

HINTS ON COPYING.

IN the winter the amateur can fill up his time and find ample use for his camera in making portraits, interior views, copying and reducing pictures, and making lantern slides and transparencies. He will have frequent occasion to copy large photographs and engravings or paintings, for the purpose of making book illustrations, or for lantern slides. In copying an engraving or photograph, or a painting, the process for each is very much the same, the main difference being in the time required for the exposure, and, in the case of copying paintings, the special kind of plate to be used for that purpose. To copy a photograph or engraving with the ordinary camera, the picture should be hung or clamped to an upright frame, where its surface can be made perfectly flat and smooth. The picture should be so hung that it may receive a strong light, not sunlight. If you have a window facing the north, the picture should be near the window and partly facing it; then the camera should be placed directly and squarely in front of the picture, the lens being of the same height as the center of the picture. Care must be taken to have the camera directly in front of the picture, so that the picture will be exactly parallel to the ground-glass; then there will be no danger of any distortion in the negative. This is of the utmost importance. No true copy of a picture can be made unless the plate or ground-glass and picture are parallel, A slow plate is the best to use for copies. In copying on cloudy days in the fall or

winter, we prefer very quick plates. The camera is placed near, or at some distance, from the picture, as the copy desired is to be large or small. In making a copy for a lantern slide it must, however, be remembered that the picture is to be copied *across* the small plate, and not the long way of the plate, in the same way that pictures are always printed upon lantern slides. The ground-glass should be marked in pencil so that it will show the location of all smaller size plates; that is, if your camera is a 5x8 size, you should lay out on the ground-glass the position of the ¼ size and 4x5, and also of the 4¼x6½, which is the half-size plate, if you expect to use them. Then, when, as in the present case, you wish to make a copy on a quarter size plate, the picture, when in focus on the ground-glass, will show whether the camera should be moved nearer to, or be set further back, in order to get the copy of the desired size. In copying it is essential that the focus should be as exact as possible, and, to aid in getting a fine focus, it is a good plan to lay a piece of printed paper against the picture and focus with the magnifying glass on the letters, remembering to remove the paper before making the exposure. When the focusing is done, a small stop should be inserted in the lens, and the cap put on so that it can be removed easily, which must be done without jarring the camera in any way. The time of exposure will vary according to the subject to be copied. We may say that, using an f32 stop, the time will vary from 50 seconds to 5 minutes. An ordinary engraving or photograph that has a dark, strong tint, will require less exposure than a picture printed light or altogether in half tone.

Highly burnished photographs, especially such as are not flat, are difficult subjects to copy. The light must be so arranged that no part of the polished surface will reflect any band of light into the camera.

To photograph white statuary requires a short exposure, and screens properly adjusted to light up the subject. A white screen should be used over the window to diffuse the light. If circumstances admit, altogether the best arrangement is to photograph statuary out of doors, in the shade, with a black screen for a background. In developing, use more than the usual quantity of No. 1, to secure proper intensity.

An engraving in outline, simply black lines, needs a short exposure. So, too, in making a copy of a printed page or letter in black ink on white paper, a short exposure is best, with long and intense development. Copies of paintings should always be made with orthochromatic plates, and the painting should be so hung for copying that no bright light is reflected from it into the camera. The light illuminating it should come from directly in front to avoid little shadows that might be caused by oblique light falling on thick patches of paint.

In making copies, it is a good plan, in order to test the time required for the exposure, to copy a number of similar objects at the same time on one plate. Suppose, for example, an engraving, an ordinary photograph, a black and white outline engraving, (or a printed page or other type matter on smooth, white paper) a white bust or placque. If the engraving or photograph should have a frame around it, of dark wood preferred, so much the better. These should be hung on an upright frame so that all will be in focus, and two or three exposures made of the group. If a plate of sensitometer 16 is used, give one exposure, with a small stop, thirty seconds; another one minute, and another five minutes, recording carefully the time given for each.

After development, one of these plates will show approximately the time required for the correct exposure for each of the objects. Some of them will need longer development than others to produce the proper density, and this can be done when such are afterward exposed separately. Also, as the image of each object is made small to get them all on one plate, it should be remembered that a larger view will require a longer time, other things, light, stop and plate being the same.

CHAPTER XVI.

LANTERN SLIDES.

LANTERN slides by the dry-plate process are made either by contact printing or by reduction in a reducing camera. In the latter case the slides can be made direct from any larger negative, provided that the negative is not too large to be used in the reducing camera. In making lantern slides by contact, the most convenient size for the negative is a quarter size, although slides can be made by contact from larger negatives in those cases where only a portion of the negative is required to be copied. As the simplest method of making slides is by contact, we will confine our present observations to a description of that process.

Lantern slides are made on plates specially prepared on thin glass 3¼ x 4 inches in size. They are usually made in the evening by lamp or gas-light, and in the ordinary printing-frames. They can be printed by daylight, but, as that light is so much stronger than artificial light the slides print in a much quicker time, and consequently the danger of over or under-exposing is very much increased. Where gas-light is available we much prefer that, but in places or towns where there is no gas, what is known as a No. 2 kerosene burner will take its place. In using gas-light care should be taken to maintain as even a pressure in the gas, and consequently as even a brilliancy in the light,

as possible. To do this the gas burner should be unscrewed and a little wad of fine cotton wool inserted, which will somewhat check the flow of gas and allow it to burn with a more even flame. Should we not do this the gas is liable to flare up at times, from too great pressure in the main, and give more light than we should expect, thereby tending to over-expose the plates. In printing the slides the negative is placed in the printing frame as in ordinary paper printing, and the thin plate placed upon it, with the two film sides in contact. Care should be taken to see that there is no dust on either of the two plates when they are thus placed in contact. It is well also to place back of the slide a piece of black cloth, cut to the proper size. The frame being filled, (and it is perfectly safe to fill the frames with these plates while the gas is turned down to a blue flame) it is held in the hand on a level with the gas jet, and about eighteen or twenty inches from it, and the gas quickly turned up. The time required for the exposure will depend upon the quality of the negative. This time may vary from two seconds to twenty seconds. In practice we have found the general time to be about seven seconds. In making slides with a kerosene lamp.the printing-frame should be covered with the focusing cloth, which can be removed at the moment of exposure and replaced immediately at the close. After making a few dozen slides it will be found that the appearance of the negative, while being exposed to the gas-light, will indicate the proper time. Experience will teach this accurately, as well as the exposure of plates in ordinary landscape photography. Very intense negatives, will, of course, require longer exposure, and can be held a little nearer the light; very thin negatives should have a sheet of white tissue

paper on the printing frame which will considerably increase the time of exposure. A very thin negative will also make a good slide if the frame, in exposing to the gas, is covered with a sheet of yellow or orange glass. In this case the exposure will need to be six to eight times as long as usual. It has been our experience that negatives developed with hydrochinon are the most even printers in regard to time. Negatives developed with pyro are extremely uneven, varying from very quick to very slow printers, while negatives developed with ferrous-oxalate are usually quick printers.

After the exposure has been made, the exposed plates can be immediately developed, or can be placed in a box, and a number of other plates can be similarly exposed. For the development we have a choice of several different developers, all of which are good. We can use either hydrochinon, pyro, ferrous-oxalate or eikonogen. As we think the hydrochinon developer is the safest for the beginner to use, we will use that for our first slides. The following formula we have found always to work well on lantern slides.

No. 1.

Sulphite soda crystals, - 400 grs.
Dissolve and filter, and add water to make 6 oz.
Hydrochinon, - - - - 120 grs.

No. 2.

Carbonate potassium, - 240 grs.
Water to make 6 oz.

For use take one ounce each of Nos. 1 and 2, and add two ounces of water; the quantity of water added can be increased or

decreased as may seem best. With this developer, the image begins to make its appearance in about thirty seconds, after which it proceeds rapidly. The development should be carried on until the picture comes out clear and distinct. That part of the plate outside of the image should be carefully watched during the development, as the plate should be removed from the developer before these parts lose their white color. If washed and transferred to the fixer, while this part of the plate is still white, after fixing the white portion becomes clear glass, as it should be in a perfect lantern slide. If, however, the plate is left in the developer until the white of these portions has turned slightly gray, or a little darker in shade, those parts after fixing will be found somewhat clouded, and the image on the glass in consequence will be too intense.

The fixer, for lantern slide plates developed with hydrochinon, should be a little weaker than is used in ordinary fixing baths. We have found a good proportion for this, is one ounce hypo. dissolved in ten ounces of water. A weaker solution of hypo. will fix lantern slides; we have used it as weak as one ounce hypo. to twenty-four ounces of water. The exact proportions do not appear to be very important, but we think it should always be much weaker than for ordinary plates. After fixing, the plates should wash in running water for half an hour, then carefully swab under the tap, with a wad of fine cotton wool and place in the rack to dry.

Lantern slides, for use in the lantern, require to be mounted. The usual way is to cover the slide with a plate of thin, clear glass, placing between the glasses a mask of thin black paper, cut out the proper shape inside to show the picture, and then the edges of

the two plates are bound with a strip of black needle-paper; it being understood, of course, that the film side of the slide comes between the two glasses. Another way, which we have found to be practically as good as the above, is to paint the slide with a good opaque, applying this to the film, covering all of the plate except the picture, and leaving if desired, a slight margin of clear glass around the image. After this is thoroughly dried, it can be covered with thin glass and the edges bound as above.

Many prefer to bind their slides with glazed tape or ribbon, which can be bought at any dry goods store. This will not tear at the edges, and should be about one-half inch wide, and black, as that color does not soil easily. Apply it with starch paste.

Lantern slides should show clear glass only in the highest lights. Exposure should be a little over-timed rather than any under-exposure as the slight over-exposure is less injurious than the under. If, with the former, there is a slight veiling, it may be removed with a clearing solution.

Too dense portions or veiling may also be locally reduced, with a weak solution of red prussiate potash applied with a brush or a tuft of cotton in a glass tube.

In making slides, where the exposure is uncertain, it will be found economical to cut a plate with a diamond or glass cutter into several pieces, and make the experimental exposures on these.

In cutting unexposed plates in the dark room, they should be laid film side down on a sheet of clean tissue paper, cutting on the back.

Lantern slides can also be made by reduction, by the use of an

electric (arc) light, a lantern with either lime light or a powerful oil lamp, or magnesium. With all of these there should be a sheet of very fine ground glass between the light and the negative, and about an inch from the latter. This glass should be larger than the largest negative one may wish to reduce.

In using the magnesium ribbon, hold it with pliers and light with a match. The ribbon should be held as near as possible to the ground glass, and constantly moving about to illuminate evenly the whole of the negative. The exposure can be timed by the length of the ribbon.

A few experiments, with either of the above lights, will suffice to show the time for average negatives.

CHAPTER XVII.

TRANSPARENCIES.

TRANSPARENCIES are usually made in the same manner as lantern slides by exposing to gas or lamp light. In printing, a mat or mask of opaque paper should be used, so as to leave a narrow margin of clear glass outside the picture. Transparencies can be made on any plate, either rapid or slow, the latter being preferred. As in all contact printing both the negative and the plate should be carefully dusted before placing in the frame: and it is well to place a dark cloth above the plate to avoid any reflected light from the back of the printing-frame. A slow plate, of sensitometer equal to a Carbutt B 16, requires an exposure, at eighteen inches from an ordinary gas-light, from two to six seconds, according to the intensity of the negative; while a quick plate of sensitometer 25, needs from one-eighth to one or two seconds. As soon as the exposure is made the plate can be taken from the printing-frame and developed immediately, or placed in a light-tight box and developed later with others.

The transparencies should be developed in the same way and after the same formula as the lantern slides, but the development should be carried a little further and be made somewhat intense. When finished the transparency should be backed, the film inside, with a sheet of ground glass or imitation ground glass, which we

shall describe how to make in our formulas hereafter. Then it can be bound at the edges with paper, or placed in metallic frames kept by all dealers.

Some dry-plate makers prepare a special plate for transparencies, having an opal or ground-glass finish on one side, which requires simply a sheet of plain glass on the film side to protect it from injury.

A very neat way to make transparencies is to print them by contact and gas-light on Eastman's transferotype paper. These require an exposure of from fifteen to forty seconds, and should be developed with the *hydrochinon lantern slide developer.* After development they should we well washed, then fixed in hypo, and washed again. When washed the print should be laid face down on a sheet of clean, clear glass, of the proper size, and the water removed with a rubber roller or squeegee. The glass and the print should then be laid on some flat surface, with a sheet of blotting paper on the back of the print, and left to dry under pressure. When dry the print will adhere to the glass, and, if desired, the paper can be removed as described in the directions accompanying the package of transferotype paper, and backed with ground glass.

We think, however, the better way is *to leave the paper on,* and simply back it with plain glass, as the paper is a most excellent substitute for the ground glass.

It is sometimes of advantage to duplicate a negative, which is done by first making a transparency, which is a positive, and from that, in the same way, a second transparency, which will be a negative. In the same way a new and stronger negative can be made from a very weak one.

Sometimes one may have occasion to make a transparency for enlargement from a negative which may be very intense in certain portions while very thin in others. To correct these inequalities in the transparency, make a mask of thin white paper, of the proper shape to cover the thin portion, which can be supported on a pasteboard frame, the opening in which is the size of the negative. During the printing, this mask, by means of the stiff frame, can be held close to the printing-frame so as to shield the light from the thin parts, allowing it to act on those which are too intense, to bring out detail, the mask of course, being kept constantly moving. A new negative can be printed by contact from a transparency so made, in which the original defects of local intensity or thinness will be found corrected, the result being better than if resort were had to chemical means.

Very pretty blue transparencies can be made from old and unexposed plates, and also from old negatives. Usually negatives, which prove to be failures through improper focusing or exposure, or some other trouble, are thrown away, but they are still of use, as they make excellent transparencies. Old and unexposed plates should be soaked in the ordinary plain hypo. fixing bath until perfectly clear. This removes the silver, and after a thorough washing they should be dried and put away. Old negatives require soaking in a weaker hypo. bath, which contains also red prussiate potash, in about the following proportions:

Hyposulphite soda, 300 grains.
Red prussiate potash, 100 grains.
Water, 5 ounces.

In this bath the negatives will become quite clear, and, after

washing, they are to be dried and kept with the other plates above.

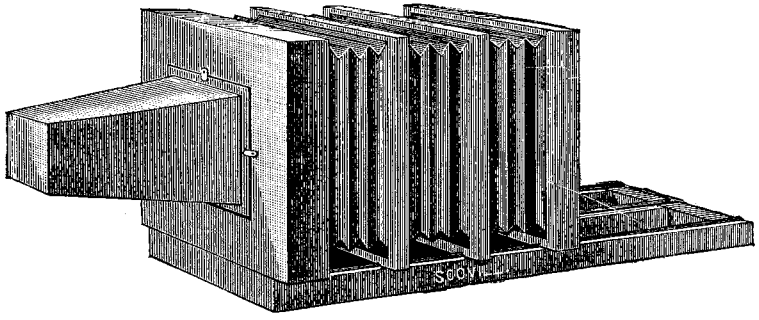
To sensitize these plates for blue transparencies, they should be first laid in water for five minutes to soften the gelatine film, and then soaked for two or three minutes in a sufficient quantity of the solution previously described for preparing blue paper. This operation should be performed in the dark-room, where they should then be dried and stored in a light-tight box for use. No more plates should be sensitized than are to be used within a few days, as they do not keep as well as blue paper. They are to be printed the same as blue paper, in sunlight, and as they cannot be examined during the printing, they should receive about one-fourth longer exposure than would be given for blue paper, and developed with water.

Another way to prepare the plates is to soak them in a solution of citrate iron and ammonia (200 grains to 2 ounces water) for five minutes, and, after drying, expose over negative in printing frame for at least double the time given for blue paper on the same negative. In this case, no image shows on the plate, but is brought out by flowing over the plate in a tray a solution of red prussiate potash (120 grains to 2 ounces of water). We prefer this method, as it seems to give the transparencies a richer blue.

CHAPTER XVIII.

ENLARGING AND REDUCING.

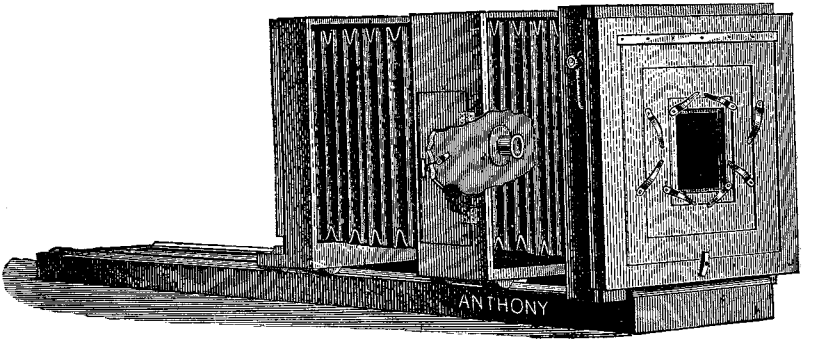
THE amateur will have frequently to make an enlargement or reduction of a picture or photograph, or copy exact size; and to enlarge or reduce from a negative. Reduction from a picture can be done in an ordinary camera, and full-size copies can also be made, if they are not to be larger than the largest size of the plate used with the camera, by attaching a cone to the front,



and placing the lens at the extreme end of the cone. The cut above shows how this is arranged.

A different arrangement is required for making enlargements, and we therefore give an illustration of an enlarging, copying and reducing camera.

The entire length of this is about five feet, and it is suitable for making copies either full size, or larger or smaller; for making positives direct from negatives in either size; for making negatives direct from transparencies or positives; and for making lantern slides direct from large negatives. The cut shows the lens mounted on the central frame, in position for making a reduction or lantern slide, or an enlargement, the negative being placed in one of the kits in the front. with the film side towards



the lens. Double sets of kits for all the ordinary sizes of plates usually accompany these cameras, for use in the plate-holders and the front; also a table, showing the location of the lens, with respect to the front and ground-glass, for different degrees of enlargement and reduction, for lenses with a focus of from two to nine inches. In enlarging or reducing from a negative, the light enters through the negative, and the camera should face the open sky. If trees or buildings intervene, the camera should be placed near the window, with a white board or mirror on the outside, inclined upwards at an angle of forty-five degrees, to reflect the light into the camera, avoiding sunlight. The time of exposure

will depend upon the amount of light, the quality of the negative, the sensitiveness of the plate or paper, and the degree of enlargement. The larger the copy required, the longer in proportion must be the exposure. If an exposure of two minutes is correct for enlarging a 4 x 5 to an 8 x 10, it will require eight minutes to enlarge to 16 x 20, etc.

The correct exposure must largely be a matter of experiment. We have found the time for enlarging on bromide paper on a bright day to double size, (note that 8 x 10 is four times the size of 4 x 5), varies with different negatives from about one and a half to two and a half minutes, enlarging from a 4 x 5 transparency to an 8 x 10 Carbutt 16 plate to take from forty to ninety seconds, with an f32 stop; to make lantern slides on a bright day to vary from two and a half to fifteen minutes, the latter extreme being from a very intense negative.*

In experiments, for the purpose of determining the correct time, it is not necessary to waste large plates or large sheets of bromide paper, as a small piece of the paper or a quarter plate will answer as well, to receive simply a portion of the enlargement.

In enlarging or reducing from a negative or transparency use the smallest stop; in enlarging from a picture or photograph use a medium size stop. In the latter case, if a small stop were used it would have the effect of showing too plainly the imperfections or grain of the paper.

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*As showing how great may be the difference between a bright day in summer and a cloudy day in winter, notice the following experiments which the writer tried on a dull, cloudy day in February, this year: To ascertain the time required to enlarge from a 4 x 5 to 8 x 10 on a 16 sens. plate, he exposed first for five minutes, then ten, fifteen and twenty minutes, and the latter was found to be the correct time, a stop f45.2 being used.

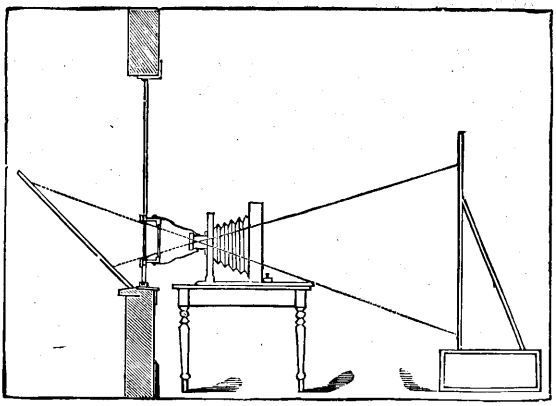
It is better always to have the enlarging camera point towards the sky rather than to use a reflector. This can be done, usually, by arranging the camera on a stand, sufficiently inclined to clear any trees or buildings which may obstruct the view. If, in cold weather, the window must be kept closed, care should be taken to see that the glass is perfectly clean and free from spots. The camera should be quite close to the window, and the particular pane of glass used should be much larger than the camera front.

In using the camera, either for enlarging or reducing from a negative or transparency, it is frequently difficult to focus accurately. This is especially the case when one has to enlarge in other than a brilliant light, or when the negative is somewhat intense. To obviate this trouble, a focusing negative should be prepared, by ruling, with a drawing pen, on a plate or old negative, from which the silver has been removed by soaking in a solution of hypo. and red prussiate potash, fine, jet black, india ink lines. This plate, which is all clear glass except the black lines, takes the place of the negative, film side in, and the lines can be focused exactly with the stop to be used.

In making lantern slides in a reducing camera, it will be found a great convenience to have a piece of cardboard, the size of the ground glass, with an opening in it, accurately cut in the center, the size of the lantern plate, or of any other plate that may be used. By holding this card against the ground glass, it will be seen at a glance when the image falls in the proper position for the small plate. Such cards can also be used advantageously whenever small plates are used in any camera of a larger size.

For enlargements or reductions it is not necessary to copy always the whole of a negative or picture. Very often a figure

or two, very small but clear, will stand enlarging; or portions of a street group, etc. In such cases, the part not wanted can be covered with a mat of black paper, or stopped out with opaque on the back of the negative.



HOME-MADE ENLARGING APPARATUS.

The above cut represents an enlarging apparatus that any photographer can improvise from ordinary apparatus and material, with the expenditure of a few hours' time. To construct it proceed as follows:

"Cut a hole in the dark-room shutter, two sizes larger than the largest negative to be enlarged from; fit into the opening a frame about two or three inches deep, glazed on the outside with a sheet of ground glass. On the outside edges of the frame, top and bottom, arrange grooves in which to slide the negatives, and when the negative is in position it will be brilliantly illuminated against the ground glass. Now, on a table or shelf, adjusted in front of the negative box, place an ordinary camera having the ground glass removed, point the lens toward the negative, and

connect the lens and negative box by means of a bag of opaque cloth, open at both ends, and provided with elastic bands, to close it tightly around the lens and negative box. This will prevent any light coming into the dark-room except through the lens.

In this apparatus the camera body serves no useful purpose; all that is required is to support the lens. In case a portrait lens is used, it should be put in position so that the back lens will be next the negative, instead of as shown in the cut.

The easel to hold the bromide paper is the next requisite, and this may be constructed by fastening a large flat board in an upright position upon a box of suitable size to serve as a base, so that the whole may be moved to and fro, to regulate the size of the enlargement. The face of the easel should be covered with white paper. Now, if the easel is put in position, facing the camera, the image can be focused on the screen by sliding the camera backward or forward on the shelf.

The size of the enlargement will depend upon the length of focus of the lens, and the distance the easel is set from the negative. The following table will give an approximate idea of the distance required for the apparatus to work in.

TIMES OF ENLARGEMENT.

Total distances from negative, in inches.

Focus of Lens.	2.		3.		4.		6.	
	To Easel.	To Camera.	To Easel.	To Camera.	To Easel.	To Camera	To Easel.	To Camera.
6 inches	27	9	32	8	37½	7½	49	7
8 inches	36	12	42⅔	10⅔	50	10	65⅓	9⅓
10 inches	45	15	53⅓	13⅓	62½	12½	81⅔	11⅔
12 inches	54	18	64	16	75	15	98	14

From the above table it will be seen that the total distance required for working the easel when making a six-times enlargement and using a twelve-inch lens is less than ten feet. For heads from cabinet negatives a six-inch focus lens is quite large enough, and when such a lens is used for life-size heads they can be made in a space of less than five feet.

Any lens that will make a negative can be used for enlarging, and the proper size for the lens depends wholly upon the negative to be enlarged from, and not at all upon the enlargement to be made. If the lens will cover the negative it will make an enlargement from it of any size.

For enlarging from negatives 5 x 8 inches and under, a half-size portrait lens is suitable. It can be worked nearly wide open for heads, but will have to be stopped down for half and full length figures. Rapid rectilinear lenses are also suitable, but, of course, do not work quite as quick on heads as portrait lenses, because they have not as large an aperture, but they should be used in preference to others for enlarging groups, landscapes, mechanical drawings, etc. For full and half-length figures they are quite as rapid, because for this purpose the portrait lens requires to be stopped down as far as the rapid rectilinear."

The above is from a publication of the Eastman Kodak Company, who kindly furnish the illustration. Such an apparatus will answer for making enlargements on bromide paper, for enlarged transparencies on glass or transferotype paper, or for enlarged negatives from transparencies.

Enlargements are usually made by the Kodak Company by electric light, which is more uniform than daylight. They can

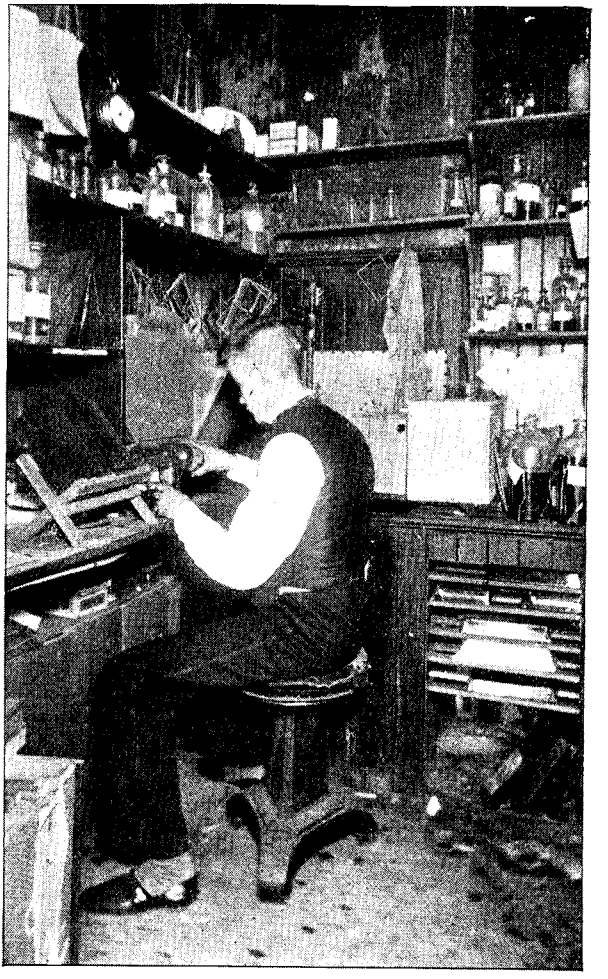


PLATE I.

In the Dark Room. A Flash-Light.

PLATE II.

GRACEFUL GROUPING. Vignette from a 4 x 5 Negative.

PLATE III.

NOTE PAPER DECORATION. Vignette from 4 x 5 Negative.

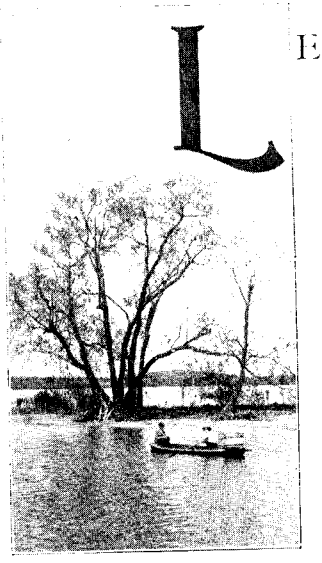


PLATE IV.

PLATE V.

NOTE PAPER DECORATION. Vignette from a 4x5 "Detective" View.

PLATE VI.

Vignette from a 5 x 8 Negative.

PLATE VII.

IN FLORIDA. Vignette from a 4x5 "Detective" View.

PLATE VIII.

On Nippersink Creek. Example of a "Remarque Proof."

also be made by the light of a magic lantern, if it has double condensers and a powerful burner.

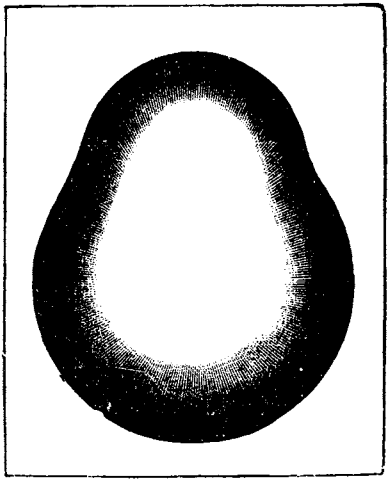
If the lantern is small, only small negatives can be enlarged as the condensers must be large enough to fully cover the negative, or, in other words, the diameter of the condensers must be greater than the diagonal of the negative. Of course, it must be obvious that an enlargement by such light must require a much longer exposure than when daylight is used.

CHAPTER XIX.

ORNAMENTAL PHOTOGRAPHY.

THERE is scarcely any limit to the different ways in which photography can be applied ornamentally. Photographs on watches, on handkerchiefs, on collars and various articles of that description; photographs on china ware, glass ware, and in fact photographs on every thing. We wish to describe only one or two processes and leave it to the ingenuity and patience of the student to apply the same in other directions. To our mind, one of the prettiest ways in which the camera can be made useful, is to photograph a bit of landscape, or a head, or a small group on letter paper. For this purpose we can use any paper suitable for making blue prints, or the plain salted paper. Let us first make some blue prints on letter paper. Suppose we take a sheet of folio paper of good weight, the same kind that we use for our best blue prints, and cut the sheet into quarter size. The size of folio paper is 17 x 22 inches, and a quarter would therefore be $8\frac{1}{2}$ x 11 inches. Now if we fold one of these quarters to make a four page sheet of note paper, the size would be when folded $5\frac{1}{2}$ x $8\frac{1}{2}$ inches. We do not need, however, for our present purpose to fold the paper, but merely to make a short crease in it, in the center of one side, which is merely to show where the paper will be folded after it is finished. This crease is merely a guide for us to show where we are to sensitize the paper with

our blue solution. We mark a number of sheets in this way. We then prepare a few drams of our solution as described in the chapter on blue prints, and apply it with our sponge. To lay this on, it is only necessary to swab in one direction the part of the paper on which we wish to print, and we do this either in the upper left-hand corner, or the right-hand corner, or in the upper center, or across the whole of the top. If we wish the picture in



the upper left-hand corner when folded, and we know about the size of the picture, we lay on enough of the solution to surely cover all of the space where the picture is to go, being careful to brush near the crease, which, when folded will be the left-hand and the upper edge of the paper. After the solution is applied, it is not necessary to hang up the paper to dry, but it can be laid on a table or newspaper, or anything of that kind, where it will dry in a few minutes. When it is dry, the paper

should be neatly folded along the line of the crease which we have previously made, and laid away in a dark box, till wanted for use.

Now for the printing. For this purpose it is better to use what are called vignette papers,* sets of which are for sale by all dealers. We take our printing-frame, and lay in it a sheet of plain glass (and for this purpose we need to use a frame at least as large as 8 x 10); then, having selected our negative from which we wish to print, say a head or small figure on our paper, we select a vignette paper which will just take in this head, and place the negative in the frame, face up with the vignette paper underneath; then, with some strips of opaque paper, we cover all of the negative which we do not wish to use. The object of this is to prevent any impression being made on the small, sensitized portions of the note paper, which may happen to fall outside of our vignette paper. It will be seen, of course, that the negative must be so placed that it will be held in position by both halves of the back of printing-frame, so that it will not be moved from its place when the frame is partly opened to examine how the printing is progressing. After this, we very carefully lay our folded paper in position on the negative, so that the head will come in the corner of the paper where we wish it to be printed. We close the frame and set it in the sunshine to print. As we are printing through the vignette paper, the time required may be about twice as long as we should give for ordinary blue prints. When it has printed sufficiently, we take out the paper and develop it in water in the usual way and hang up to dry, and when it is nearly dry the paper should be placed between sheets of smooth blotting paper and put in a press, or under heavy pressure, where it will dry perfectly smooth.

*See illustration, previous page.

To make purple or black prints on note paper, we use the same size paper as we have just described, and salt it as described in the chapter on plain salted paper, and with our silver solution we sensitize simply that part of the paper on which we wish to print, and print on this with vignette paper as described above. The prints can then be washed and toned and fixed in the same way as prints on regular salted paper, and, after being washed and dried, pressed to shape. When this is neatly done, the result will be very gratifying and beautiful.

We give an illustration of a sheet of note paper prepared in the manner described, which is not as fine or delicate as the amateur can make for himself.

We know a young photographer who uses his camera in this way to decorate and illustrate his compositions at school.

Another one who photographs his little sister's head on the corner of her invitation cards for an occasional party.

With these hints an ingenious amateur will think of a multitude of ways in which he can make his camera a delight.

One other idea, before we close this chapter. In engravings and etchings we have "proofs before letters," "artists' proofs," and "remarque proofs." We wish to show how the young photographer can make of his prints one of these, "remarque proofs." We will turn back to chapter X, and take one of our prints, with broad margin on plain paper, before it has been washed or toned. These broad margins have not yet been exposed to the light, and can still be printed on, and under the lower right-hand corner of the picture we propose to print the head of the artist photographer, which we may probably find among the negatives in his collection. For this purpose we require one of our largest

printing-frames, ten by twelve, or eleven by fourteen inches. We use one of the smallest vignette papers, and place it under the negative on the glass in the frame, as previously described in this chapter. We then have to cover with black paper all the glass in the frame, excepting the space for the vignetting, to prevent the light from reaching any other portions of our paper. When this is done we lay on the picture so that the head to be copied will come in the right place, and right side up, and expose to sunlight as before. After the printing is done, the prints will be ready to wash, tone and fix.

In our illustrations, which explain themselves, are given three specimens of ornamented note paper, plates iii and v; three of vignette work, plates ii, vi and vii; a flash light, plate i, initial letters, plate iv, and a "remarque proof," plate viii. All of these, with the exception of the dark room and initial letters, are the work of young amateurs. They are not intended as illustrations of fine photography, but simply to make more intelligible what we have tried to explain.

Initial letters, of which we give several styles, reduced from portions of prints ranging in size from 4 x 5 to 6½ x 8½, are extensively used in illustrating books and magazines. Here is a wide field for the artistic skill of the photographer.

CHAPTER XX.

CONCERNING LENSES.

WITHOUT attempting to enter upon the laws of optics, which are now so universally taught in our higher schools, it is our purpose here to call the attention of the amateur, as briefly as possible, to certain definitions of various terms used in connection with lenses, to their different uses and qualities, and to endeavor to make clear the law of conjugate foci, which it is essential that every photographer should thoroughly understand.

The angle of view of a lens is determined by the proportion its focal length bears to the length of the image on the plate, and the angular aperture depends upon the proportion of working aperture to the focal length.

As the focal length is reduced, the angle is increased. In wide angle lenses, therefore, the focus is much shorter than in those of the rectilinear type.

Astigmatism is a fault caused by the spherical form given to the surface of lenses, and exists to a greater or less extent in all lenses of the symmetrical type.

Astigmatic charts are used by opticians to detect this defect in the human eye. Such a chart can be made by the photographer, by ruling on a sheet of paper with ink a series of parallel, vertical and horizontal lines. When this chart is focused sharp in the center of the ground glass it will be found that one series of the lines on the margin of the glass will be comparatively sharp while the others are indistinct. Even when the chart is

focused on the margin of the glass, only one series of the lines will be sharp. Only lenses of the highest grade are entirely free from this defect.

"The equivalent focus of a lens is a term applied to a compound lens. It is the focus of parallel rays entering the lens. It is termed equivalent, from being compared with a single lens that would produce the same sized image at the same distance from the object." (Abney).

Practically, the equivalent focus of a double lens can be found by measuring the distance from the diaphragm to the ground glass, when the lens has been focused on a distant object; the equivalent focus of a single lens by measuring the distance from the lens to the ground glass.

Definition in a lens is its power to concentrate or focus the rays from any object to one point, and thereby give a sharp, clear image. A failure to do this condemns the lens as inferior. In such a lens the definition may be improved by the use of diaphragms, but this is at the expense of speed.

Of late years there has been a very great improvement in the construction and quality of photographic lenses, which has been made possible by improvements in the manufacture of glass for optical purposes. This has resulted in the production of lenses entirely free from astigmatism, an increased flatness of field, and a greater depth of focus in proportion to the aperture.

Flatness in a lens is the quality of defining an object equally distinct on the entire surface of the plate. At present a perfectly flat field appears to be unattainable, because in the nature of things there is a certain amount of curvature. The nearest approach to perfect flatness is when a large lens is used to cover

a very much smaller plate than that for which it was intended—as to use an 8 x 10 lens for a 4 x 5 plate.

That quality of a lens which shows objects in different planes with equal distinctness is called depth of focus. This depends upon the angle of view, the working aperture and focal length. The depth of focus is increased by reducing the size of diaphragm or by decreasing the focal length. In landscapes, where it is desirable to use considerable foreground which should be distinct, a lens of short focus should be used, giving clearness to the foreground and everything beyond. This can be accomplished also by focusing on an object in the near foreground and using a small diaphragm. This, of course, would require a prolongation of exposure, as great speed in a lens—that is, working with large aperture—is incompatible with great depth of focus.

Sometimes, owing to faulty construction, in photographing in a bright light, a "flare spot," or circular patch of light appears on the ground glass directly in line with the center of lens, which forms a fogged central patch in the negative. This is caused by the reflection of the aperture of the diaphragm by the surface of the lens. In a single lens this can be overcome by slightly altering the position of the diaphragm, moving it a trifle nearer to or farther from the lens. Should it occur in a double lens the position of the diaphragm may also be altered; but then some degree of distortion may be produced, in which case the lens should be returned to the manufacturer as defective.

Therefore, it is of the highest importance that the diaphragm should be placed at exactly the proper distance from the lens. In single lenses this is usually placed at one-fifth to one-seventh the focal length. In a double lens it must occupy a position

proportional to the different foci of the two lenses. When the two lenses are symmetrical—that is, both exactly alike, though facing in opposite directions—their foci are equal, and therefore the diaphragm is placed half-way between them.

An aplanatic lens is one so curved as to bring all rays to the same focus—a lens, therefore, that can be worked with full aperture.

The working aperture of a lens is that part of the lens which is used in forming a correct image on the plate, and this aperture determines the speed of the lens by its relation to the focal length. The speed of the lens is expressed by the fraction resulting from dividing its working aperture by the focal length. Thus, if the working aperture (and bear in mind that this does not mean the entire diameter of the lens) is $1\frac{1}{2}$ inches, and the equivalent focal length 9 inches, the aperture is one-sixth the focal length, and is expressed as f 6, which would be in the case of a lens of proper construction extremely rapid. By inserting diaphragms in the lens its speed is reduced in the proportion that the diaphragm bears to the focal length. In the above lens a diaphragm of 1 inch would be f 9; of $\frac{1}{2}$-inch, f 18, the speed being reduced in geometrical proportion with each smaller diaphragm.

In other words, a reduction of speed means a longer exposure for a given plate, f 18 requiring four times the exposure of f 9. Hence, knowing the time of exposure for f 9, the proper exposure for f 18 can be known by dividing the square of 18 by the square of 9.

The conjugate foci of a lens are any point in any object and the image of that point. Thus, with a camera, we focus on a

house across the street—a given point in that house and its image on the ground glass are its conjugate foci. So the conjugate focal distances are the distances from the optical center of the lens to these two points.

When the object is near, by measuring either of the conjugate focal distances the other can be easily calculated by the following equation:

Let x represent the distance from the optical center of the lens to the ground glass, y the distance from the object to the optical center of the lens, and f the equivalent focus of the lens. Then

$$\frac{1}{x} = \frac{1}{f} - \frac{1}{y}$$

Suppose f to be 10 inches and y to be 100 inches. Then

$$\frac{1}{x} = \frac{1}{10} - \frac{1}{100} = \frac{9}{100}$$

$x = 100$ divided by $9 = 11$ 1-9 inches as the focal length of that lens for an object 100 inches distant.

Suppose, however, y to be 1000 inches. Then

$$\frac{1}{x} = \frac{1}{10} - \frac{1}{1000} = \frac{99}{1000}$$

$$x = \frac{1000}{99} = 10 \text{ 1-10 inches about.}$$

When, therefore, the distance of the object, y, is very great, it may be discarded, and then x will equal f.

Again, with the same lens, suppose the object to be at a distance exactly twice the equivalent focus, or 20 inches, we shall then have

$$\frac{1}{x} = \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$$

or $x = 20$ inches.

Therefore, when an object is at a distance from the optical center of the lens equal to twice the equivalent focus, the conjugate focal distances will be equal, and the image of the object on the ground glass will be the same size as the object.

Again, place the object at a distance of 15 inches. Then

$$\frac{1}{x} = \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$$

or $x = 30$ inches.

In this case we should have an enlarged image of the object on the ground glass.

This equation is of use in ascertaining the conjugate focal distances for reductions or enlargements. To find the conjugate foci for a reduction we use this equation:

Let $\frac{1}{a}$ represent the required reduction of the object, which is the same as saying that the larger conjugate focus, y, should be a times greater than the shorter, x.

Then

$$\frac{1}{f} = \frac{1}{x} + \frac{1}{ax} = \frac{a+1}{ax}$$

$$\text{or } x = \frac{f(a+1)}{a}$$

And ax or $y = f(a+1)$.

Assuming that the equivalent focus of lens is 10 inches and the required reduction is to be $\frac{1}{8}$, we now substitute for f and a their values, which are 10 and 8, and we have

$$x = \frac{10\ (8+1)}{8} = \frac{90}{8} = 11\tfrac{1}{4} \text{ inches.}$$

$$y = 10\ (8+1) = 90 \text{ inches.}$$

That is, to reduce an object to one-eighth its length, the distance from center of lens to object must be eight times the distance of lens from ground glass. And in enlarging we simply change the positions of object and image, having the distance from lens to ground glass the longer conjugate focus.

By reference to the above equations we are enabled to make easily remembered rules for calculating the focal lengths.

$$y = f\ (a+1)$$

That is, the distance of object from lens will be the number of times the reduction plus one multiplied by the equivalent focus; while the distance of ground glass or image from lens will be the distance of object from lens divided by number of times of reduction. Hence, also, the focus of lens is one plus $\frac{1}{a}$ times the equivalent focus for each diminution in the reduction. Thus, to reduce two times or to one-half, equivalent focus being 10 inches; actual focus is 15 inches. To reduce to one-third, focus is $13\frac{1}{3}$ inches; to reduce to one-quarter, focus is $12\frac{1}{2}$ inches. So in enlarging, the focus is one plus a times the equivalent focus for each enlargement. To make image equal size the focus is one plus one times, which is twice the equivalent focus. To enlarge two times the focus is three times equivalent focus; to enlarge ten times it is eleven times the equivalent focus, and so on.

The relation of the conjugate foci to one another also governs the exposure.

Let us suppose that experience has taught the proper exposure for a given subject in an average light at such a distance that the actual focus will be the same as the equivalent focus.

Now, we wish to photograph an object at a comparatively short distance from the camera, thereby, of course, making a larger image than if the object were distant, and also increasing the focus of the lens. To ascertain the exposure, where the distance is less than, say 25 times the focus of lens, we divide the square of the actual focus of lens (as focused on the near object) by the square of the equivalent focus, and multiply the resulting fraction by the known exposure for the normal distance. For example, in photographing a horse distant 100 feet, our usual exposure might be one second. We wish to have the image larger, and we move camera 10 feet from the horse. With lens of 10 inches equivalent focus the actual focus would then be 10 9-11 inches. Then the square of 10 9-11 or $\frac{144}{121}$ divided by $100=\frac{144}{121}$, and this multiplied by 1 second gives $1\frac{23}{121}$, or about 1 1-5 seconds as the proper exposure. In the same way it will appear that if we wish to photograph an object full size, in which case the actual focus is double the equivalent focus, the exposure should be four times the normal.

So in enlarging, if the ground glass or screen is 5 times the equivalent focus from the lens, we have to multiply the normal exposure by 25.

A single lens must always be used with a diaphragm, because without it the image will not all be in the same focus, and consequently there will be a want of definition or clearness. This is

partly obviated by the use of a diaphragm, either before or behind the lens, which has the effect of utilizing only those rays of light that fall on the central parts of the lens. Even with the diaphragms there will be a distortion in the image. With the diaphragm in front the image of a square object would be curved outwardly at the four sides, and when the diaphragm is behind the sides would be curved inwardly.

Therefore, for near architectural work or for copying, a single lens would not answer. But for landscapes the distortion is not apparent. By placing a lens on each side of the diaphragm, which then becomes a double lens, this distortion can be overcome.

All lenses should be achromatic—that is, they should be so constructed that the light rays which form the image on the ground glass should focus at the same point as the chemical rays which form the photographic image. If they are not so the image on the ground glass may be focused clearly, but the negative will be indistinct.

Lenses are made achromatic by combining into one lens glasses of different quality and shape. Single lenses, highly suitable for landscape work, are made in the form of a meniscus, convex on the front or outside and concave on the inside, and are usually formed of two or more lenses of crown and flint glass cemented together.

For portraiture the two pairs of the double lens are placed further apart than in those for landscapes and other work, in order to increase the depth of focus. The camera is generally placed near the object to be photographed, and as great speed is a desideratum the different planes must focus equally sharp

without the use of small diaphragms, which would seriously reduce the speed. Large lenses are required for this work, as their increased separation diminishes the field of view.

On the other hand, bringing the lenses nearer together increases the field, which is the same as widening the angle. Therefore, in wide angle lenses, the two pairs are brought much closer together than in landscape lenses.

Wide angle lenses are used for interiors, where it is required to get as much of a view as is possible on the plate. And, as the nearness of the lenses requires the diaphragm to be closer to the lens, the wide angle lens gives the least distortion. Therefore, a wide angle lens is well adapted for copying, especially when used on a smaller plate than that which it is intended to cover.

TESTING LENSES.

It is frequently a matter of considerable importance for the amateur to decide whether a particular lens which he may desire, is, for his purposes, a more perfect lens than the one he is using. He may wish a lens chiefly for so-called instantaneous work—one that should cover the plate and give a sharp image with the largest diaphragm. Or, he may wish a lens for landscape work, —one that will be used for timed exposures—and that will, with small diaphragms, give an even illumination over the whole plate, and at the same time a sharp image. It will be noticed in focusing with a lens that the center of the ground glass is the brightest, and this brightness decreases towards the margin of the glass. So in the negative the density decreases from the

center outwards. Therefore it is important to have as even an illumination over the entire plate as possible.

In testing a lens it is obvious that it should be compared with another of similar form. For the purpose of comparison each lens should be tested with diaphragms of the same proportional size and under the same conditions as regards light and exposure. A suitable subject for the test would be a well laid brick wall, with the mortar lines sharply and squarely pointed, or a wall on which are pasted large posters containing black letters or designs, in all about eight or ten feet square. The camera should be placed directly opposite the center of this and distant from it twenty-four or more times the equivalent focus of the lens. The focusing should be done very carefully, using a magnifying glass to get it as sharp as possible. Use in each lens the largest diaphragm they will both work with. That is, if one lens has a working aperture of *f* 7.2 and the other *f* 8, we must use in each *f* 8. Then each must have exactly the same exposure and the same kind of plate, and the two plates should be developed together. With a magnifying glass we then examine the two negatives, or carefully taken proofs on smooth paper, and measure the area of sharpness in each. And it will be evident that that lens is the more perfect which shows the largest field sharply defined. At the same time an examination of the two negatives will show which of the two lenses gives the most even illumination throughout the field. A lens which in such a test gives perfect sharpness up to the margin, and also an even illumination, may safely be called one of the highest grade. In ordinary lenses it is not unusual in such a test to find that the one which gives the best definition with the large diaphragm

may prove inferior to the other when both are tested with a small diaphragm. In such a case one's choice of either lens should be governed by the class of work for which one intends to use the lens.

CHAPTER XXI.

PHOTOGRAPHING MOVING OBJECTS.

IN this class of work it is usually a matter of prime importance that the image of the moving object should be reasonably sharp in the resulting negative. To know whether the image will be sharp, we have to consider the rate of motion and the distance of the object, and the speed of the shutter, and then we need a plate of sufficient sensitiveness to register the impression during the interval of the required exposure. Every point in a moving object must make an enlarged image of the point in the negative, unless the shutter could work with the speed of light, which at present is not possible. But, if this enlarged image of the point is not larger than the one-hundredth of an inch, it will be sharp to the eye. A larger image would show an apparent blur, therefore the motion of object should be slow enough, or the speed of shutter quick enough to keep the image of each point within the one-hundredth of an inch. From the relation of conjugate foci to each other (see Concerning Lenses, Chapter XX) we know that the image of an object, one inch in length, at a distance of one hundred times the focus of lens, will be one one-hundredth inch, which would be to the eye a point. Therefore every point in any object at that distance could move during the exposure one inch, and still be sharp. If the focus of lens is 6 inches, the object can be 50 feet distant; if 8 inches focus, 66⅔ feet; if 12 inches focus, 100

feet, and so on. Now, if the shutter has a speed of $\frac{1}{50}$ second, the object could move at rate of 50 inches a second, and still be sharp. From this it must be evident that the nearer a moving object is to the lens the shorter must be the focal length of that lens with a given speed of shutter to produce sharpness in the image, and also that with a short focus lens a less rapid shutter can be used than with a long focus lens. This we shall have occasion to refer to hereafter.

It is a fact of common observation that the nearer we are to a moving object the greater is its apparent speed. When we stand on the platform of a railroad station as an express train rushes by, it appears to move with almost lightning speed; and again as we view the same train from a distance of several miles, it seems to just creep along. And as it is thus with the eye, so is it with the photographic lens.

An express train is a favorite subject for the amateur, and failures to secure a sharp picture are the usual results. Let us see how rapid must be the shutter in such cases. Take a train moving at rate of 50 miles an hour, which is about 73 feet per second. If the hand camera has a focus of 6 inches, a shutter speed of $\frac{1}{50}$, and distance from train 50 feet, the train will move during exposure about $17\frac{1}{2}$ inches, and its image on the plate nearly $\frac{1}{6}$ inch, and the image of course would be blurred. As every point to be sharp should be within the limit of $\frac{1}{100}$ inch, this exceeds the limit $17\frac{1}{2}$ times, and therefore to produce sharpness, the shutter would require a speed of $\frac{1}{50}$ divided by $17\frac{1}{2}$, or $\frac{1}{875}$. Or, as will be apparent, to use the shutter speed of $\frac{1}{50}$, the camera should be $17\frac{1}{2}$ times the 50 feet distance from the train, 875 feet. In the same manner it may be shown that with a

larger camera, of 12 inches focus, and speed of shutter $\frac{1}{50}$, the same train must be at a distance of 1750 feet from the lens.

As a simple rule to determine the allowable motion during exposure, we divide the distance of the moving object by the focal length of lens, and that result by 100. Thus, for the above train, focus of lens being 6 inches, we divide its distance, 875 feet, or 10,500 inches by 6 inches equals 1,750 inches, and that divided by 100 equals 17½ inches, which is the distance the train goes in $\frac{1}{50}$ second. And to find the speed of shutter required, we divide the allowable movement by the rate of movement per second. The allowable movement above is 17½ inches, which, divided by rate of movement, 73 feet or 876 inches, equals about $\frac{1}{50}$.

In all the above examples it is supposed that the moving objects are proceeding directly across the field of view. If they are coming directly towards the camera, or receding from it, there would be little apparent motion, and if they cross the view at other than a right angle, the apparent speed will be reduced. This shows why, in photographing a rapidly moving object, as a racing horse or an express train, we should make the exposure while they are coming nearly towards us. And from what has been said before, it must also be plain that such objects should be taken with a short focus lens on a small plate and afterwards enlarged.

Failures to make sharp images of moving objects are very common, and we see why, in so many cases, it must be so. The photographer with his hand camera, tries to take a broadside picture of a trotting horse, or a bicycle rider, or a boy diving. With a camera of 6 inches focus, horse moving at a three minute

gait, or 29 feet in a second, and distance from operator 50 feet, the speed of shutter must be $\frac{1}{348}$ second. But the shutter of a hand camera rarely works in less than $\frac{1}{60}$ second, and therefore to get a sharp picture in this case the photographer must be at least six times the above distance from the horse, not less than 300 feet. And, of course, attempting this with a large camera, and lens of longer focus, the speed of shutter must be proportionately greater. In the case of a boy diving, suppose we try to photograph him with our hand camera (6 inches focus) while he is moving at a speed of 10 feet per second, the camera being 25 feet distant.

Three hundred inches divided by 6 (the focus) equals 50, and that divided by 100 equals one-half inch, the allowable motion. And that divided by the rate of speed, 120 inches, shows the required speed of shutter to be $\frac{1}{240}$, which is at least four times as quick as the shutter works. Therefore, the image must be hopelessly blurred unless the camera is 100 feet or more distant.

These rules for computing the required times of exposure can be easily remembered, and their use will save wasted plates in attempts to do the impossible.

CHAPTER XXII.

HAND CAMERAS.

IT has grown to be a common saying that "the hand-camera fiend is everywhere." And amateur photographers have suffered from this reproach brought upon them by the obtrusive and impertinent conduct of thousands who think that the whole art of photography chiefly consists in pressing a button. The button-presser fires at everything, hit or miss, generally miss, and few are safe from his random shots. Like the boy with his breech-loader and pockets full of shells, everything is game for him, and song birds suffer. It is so easy to slip in the shells, and what is the gun for if not to fire off?

Still, even in the hands of those who know nothing about photography, the possession and use of one of these cameras is a comfort and delight, especially to those who have an eye for the beautiful, the quaint and the picturesque. They will make many failures, but these will cause the thoughtful to investigate the reasons for their want of success, to attempt and learn one of the most interesting processes of photography, development, and they will become amateur photographers. In development one sees the errors of incorrect exposure more clearly than by the examination of finished prints made by another, and the endeavors to correct these, lead to better work.

Failures in hand-camera work are due to a variety of causes,

which are mainly insufficiency of light, causing under-exposure, incorrect focusing, jarring the camera at moment of exposure, not holding the camera level, and defects in the camera itself.

The chief cause of failure is the attempt to make the exposure when there is not sufficient light. Because they are commonly, though erroneously, called "instantaneous cameras", it does not follow that views can be taken with them everywhere and at any time. Where, as customary, these cameras are used in the hand, they require not only very rapid plates, but also an abundance of light on the subject. The spring and summer months are the best times of the year to use them, as then the light is so much stronger. Then, again, the light varies considerably during the day, sunlight early in the morning and late in the afternoon having less actinic power than towards midday. For some views, too, such as sea and open water views, very open landscapes and light buildings, in a bright light, a medium sized diaphragm is required to prevent over-exposure. On dull days and for views in shaded places, the shutter should be worked slowly, and with a large diaphragm. If moving objects, however, are to be photograph ed, itmust be done in a very bright light, and with the quickest speed of shutter. And not only should the object be in a good light, but the brightest side shonld be taken, which is only another way of saying that the light should come from behind, or partly behind, the operator. It is not easy to tell, without experience, when the light is sufficient. Those who are accustomed to work with a tripod camera learn to judge of the light by the brightness of the image on the ground glass when focusing.

Another frequent cause of failure is incorrect focusing. On

hand cameras there is usually a scale to show the focus required for different distances; 5, 10, 25 and 50 feet. Many find it difficult to determine hurriedly, with any accuracy, these distances, and often they forget to set the focus at the proper mark, which will result in blurring the image. The ideal perfect camera should have a finder lens with a focus exactly the same as the lens which takes the view. This would enable the operator to see at a glance exactly when the object was in focus, without referring to any scale or estimating the distance. The image, too, in such a finder, would be the same size as that on the plate, which would be a very great convenience for the photographer.

Again, failures arise from a slight jar to the camera when pressing the spring which releases the shutter, especially when one is in a hurry. To prevent this the camera must be held perfectly still while the shutter is moving, and various directions are given as to the manner of holding the instrument; directly in front, against the body, or under one arm or the other. Each one will learn for himself, by practice, the best way to hold his camera, and should remember always to have both hands on it, pressing the spring by a movement of the thumb or finger. A pneumatic release of shutter greatly lessens the danger of a jar.

Failures are sometimes due also to development. This is apt to occur when one has taken "lots of views," and rushes through with the development, in a hurry to see how they all look. Of course, haste in such a matter simply invites poor work. Hand camera views require care in developing because the exposure is so often uncertain, and good results require deliberation in every process.

Sometimes, failures arise from a defective construction of the camera, carelessness in attaching the focusing scale, and in the adjustment of the finder. If the camera has a ground glass for focusing for time exposures, it will be very easy to test the focusing scale at the different distances and correct it if wrong; and also, to test the finder, to see that the view in that coincides with the image on the ground glass. The image of any object which appears in the center of the finder should also fall on the center of the ground glass. If it does not, either the finder lens is not parallel to the camera lens, or the small mirror is not set at the right angle.

A hand camera, fitted with a lens of high quality, is excellent for taking views for lantern slides and for enlargement. Subjects for such work abound everywhere if one is on the lookout for them. In cities there are street scenes, street venders, strolling musicians, boys playing marbles and other games, processions, fire engines and fires, etc.; in the country, besides pretty bits of landscapes, there are farm views, the various operations about a farm, haying, plowing, harvesting, cattle, sheep washing and shearing. For all such views one should use the hand camera, because it is always ready and unobtrusive, and the exposure can be made before the subjects have time to be frightened or attempt to pose.

Hand cameras are made in all sizes from $6\frac{1}{2}$x$8\frac{1}{2}$, which is rather unwieldy and heavy, down to one small enough to carry in a vest pocket. We think the best sizes are, either 4x5 or 5x7. The latter, fitted with a bellows, rising front, swing back, ground glass, and tripod, can be used for all the work of either hand or tripod camera.

Directions for working the instrument usually accompany the hand cameras, and these should be carefully studied so that every part of the camera is thoroughly understood. Otherwise some mistake is likely to occur in the hurry of making the first exposures.

Those who are handy with tools will have no difficulty in making their own hand cameras, and will be sure to enjoy the satisfaction of taking views with instruments of their own construction. An unmounted lens, suitable for this work, can be procured at a comparatively low cost, and mounted in either a metal or pasteboard tube. We have in mind one young man who has lately made five small cameras for himself, taking views varying in size from one inch square to two by two and one-half inches, using as plates for the latter 4x5 cut in quarters.

One of these little cameras is small enough to go in one's vest pocket. For the largest he made double plate-holders, and in another is a roll holder for films. His plates for one of the smallest are $1\frac{1}{4}$x4 inches, cut from 4x5 plates. On these he makes four exposures, sliding the plate along for each exposure by means of a pin inserted in the back.

For all of these he has shutters of simple construction which work in about one-fortieth second.

CHAPTER XXIII.

SPEEDS OF SHUTTERS AND PLATES.

TO ASCERTAIN THE SPEED OF SHUTTERS.

AN amateur photographer wrote from his home after returning from a visit to the World's Fair: "What can have been the trouble with my plates? I send you some proofs, and am sorry to say that they are nearly all just like these. I was advised to take with me these extra rapid plates, and all of my exposures were instantaneous. It seems clear the plates were very poor."

It was very evident that his plates had been very much over-exposed, and also that he had the common, though mistaken, idea that every "snap-shot" exposure with a hand camera was instantaneous. The beautiful white buildings, rendered dazzlingly brilliant during the Chicago summer, perfect weather almost without a break from the middle of May to the end of October, required an exposure with the most rapid plates very much shorter than can be given with ordinary hand cameras. For exposures on such buildings, open landscapes, and water views, it was requisite either that the speed of the shutter should be very great, that the lens should be stopped down, or that a less rapid plate should be used.

As the exposure is of the highest importance in securing a good negative, it should be made as nearly correct as possible; but this is difficult to accomplish when the time is less than two or three seconds; still more difficult when it is required to be the fraction

of a second. For the latter it is essential that a shutter should be used, and of these there are practically three varieties: "time" shutters, which require one pressure of a rubber ball (shutters with pneumatic release) to open and another to close them; "instantaneous," which open and close quickly with one pressure of ball or button; "time and instantaneous," which combine those two actions, using either one at will. Some of the latter work automatically, requiring simply a pressure of the ball to set the mechanism in motion, which then opens, holds the shutter open for the specified time, which may vary from the one-hundredth to three seconds, and closes it again. The shutters on hand cameras usually have two or more rates of speed, which are governed by altering the tension of the actuating spring.

Every photographer in using a camera with a rapid shutter, either pneumatic or with button release, should know the speed at which his shutter works. There are several ways of testing the speeds of shutters, one of the simplest of which is the following:

We take a bicycle, preferably one of the old style with a high wheel, which we stand upside down upon the ground or floor, securing the frame with weights on the handle bars, so that it can revolve freely without vibration. Then fasten to one of the spokes a thermometer tube with the bulb about an inch from the tire, and another tube to another spoke directly opposite, so that a line joining the two bulbs would pass through the axle of the wheel, having the two bulbs at equal distances from the axle.

We use two thermometers in order to secure on the plate two lines for determining the diameter, and, by comparison of the two lines to get the length of one of them accurately, which length, as will be seen hereafter, shows the speed of the shutter.

The wheel should face the sun, and if possible, there should be a dark screen behind the wheel. Then set the camera squarely in front and near enough to have the wheel cover the plate, so as to have the image as large as possible. Focus sharply on the wheel, and stand ready to release the shutter at the proper moment. Now have some one stand behind the wheel, and revolve it, until, by timing, it is revolving ten times in ten seconds. To facilitate counting the revolutions, a piece of paper can be fastened to one of the spokes. When it is going at the rate of ten times in ten seconds, which is one complete revolution in a second, make your exposure, and develop the plate. It will not be difficult to see the two curved black lines made by the moving bulbs. If the shutter could work absolutely instantaneously the two bulbs (and understand that it is not the entire bulb which shows, but merely a point on the bulb which reflects the sun), would show as black points; but the shutter takes time to work, and during this time the bulbs mark their movement on the plate in a fine curved line. If the exposure had been exactly a second, this line would be a circle, as the wheel revolves in a second. Therefore it is clear that the length of the exposure will be the proportion that the line in the plate bears to the entire circle of which this line is a part. The distance from one line to the other at the opposite side of the wheel measured through the center of the wheel, will be the diameter of the circle, which can be measured with a fine rule, and this diameter multiplied by 3.1416 will give the circumference of the circle. With fine dividers we then step off the length of one of the bulb lines, along its curve if it is long, and with the rule get its exact length. And the ascertained length of the circle divided by the length of

this line, will give the part of a second in which the shutter works.

For example, the above diameter is found to be just 4 inches, and the length of the bulb line one-half inch. Proceeding as above, we find the circumference of the circle is 12.5664 inches, which, divided by one-half, equals 25.1328,—or, in effect, 25 times, and therefore the shutter has a speed of one-twenty-fifth second.

By testing shutters in this way it will be found that shutters frequently and, indeed, generally, work more slowly than might be supposed. For instantaneous work on rapidly moving objects, that shutter which gives the greatest illumination with the required speed is the most efficient.

RELATIVE SPEED OF PLATES.

Who makes the most rapid plates ? There is a growing demand in these days for plates of increased speed, which, we think, is not in the line of progress.

Plate-makers are obliged to meet this demand, although aware that their plates are already sufficiently rapid for every purpose. And it is not unusual to see the claim made, whether by the manufacturer or by the experimenter, that such and such plates are positively the " most rapid plates made."

It is not a difficult matter to test the different plates, and learn the relative speed of all the rapid plates in use. In making such a test it must be evident that each plate should be subjected to precisely the same conditions, as regards lens, light, exposure and development. It must be obvious, also, that if, in comparing a

number of plates, one exposure should follow another, there might be some slight difference in exposure or some unnoticed change in the light. To obviate this difficulty our own method has, for a number of years, been as follows :

Directly across the street stands a block of buildings of cut brown stone, with delicate carvings around every window. Every line of stone and carving shows sharp and clear in the afternoon sunshine. We use an 8x10 camera and lens, and, in a 5x8 inside kit, we lay side by side a number of strips from different plates, each cut to $1\frac{1}{2}$x5 inches, marking each strip to identify it after development. Then they are all exposed at once, each receiving, of course, precisely the same exposure, and all are developed together. With a small diaphragm and very short exposure, some of the strips will show under-exposure, and strips from those plates are tried again with a longer exposure or larger diaphragm, until there may be only one left which appears to fall short of a full exposure. A comparison of the negatives will then show the relative rates of speed of the different plates.

In a recent test of five of the reputed most rapid plates made in this country, the result of the first exposure, using a shutter speed of 1-100 second, and diaphragm *f* 32 on a very bright afternoon, was as follows :

Plate No. 1 showed only a faint sky outline of the building ; in No. 2 this outline was a little more marked, and the windows were just visible; in No. 3 there was a gain in distinctness; No. 4 was still sharper, the carving showing plainly; and No. 5 came out a perfect negative, as sharp and clear as one could wish. Placing the five strip negatives side by side, the different rates of speed of the five plates were perfectly apparent. A further test,

five minutes later, practically in the same light, showed that plates 1 and 2 required the use of stop *f* 16 (about the same as four times the exposure) to produce as sharp a negative as No. 5.

Doubtless it would be considered unfair to publish the names of plate-makers in giving the results of such a comparison, but the tests can be made by every photographer for himself.

CHAPTER XXIV.

ARISTOTYPES.

WITHIN a few years aristotype paper has come into quite general use, superceding to a large extent albumen paper. This paper, when burnished or "squeegeed" on a ferrotype plate, takes a very high polish, which makes it popular with those who consider a glossy surface the proper style. It is used everywhere by the professional photographer for small portraits, because it is easy to work, and is demanded by the public. It brings out the finest details that exist in the negative, and therefore is an excellent paper for all small prints where details are required.

Aristotype paper, as at present made, is of two kinds: collodion and gelatine. Some of the collodion papers have a tendency to curl in the washing and toning, which is obviated by the use of warm water. Aristotype paper is sold under a score or more of different names. It is an economical paper for the amateur to use, because it will keep fresh and in good condition for a long time, and is always ready to use, as it requires no previous fuming. It is best preserved by keeping it well wrapped to exclude air, in a dry place, under pressure.

Each manufacturer gives his own directions for working his particular brand of paper, and it is well to follow these. We think the best results are always obtained by toning and fixing

in two separate baths, and we prefer the formula for toning gelatine aristotype paper which will be found on a following page.

Aristotypes are generally quicker printers than the old style albumen paper, and the printing should never be examined in a strong light. In printing in sunlight, unless the negatives are very dense, the frames should be covered with one or two thicknesses of white tissue paper.

In washing the prints prior to toning, care should be taken to use a perfectly clean tray which is used for no other purpose. The papier mache tray is excellent for this, because it is light, deep, easily kept clean, and will not break. If a japanned tray must be used it should be carefully dried after using, and occasionally recoated with asphaltum to prevent rust, which would cause spots to appear on the prints. Either a glass, porcelain or papier mache tray should be used for the toning, and that tray should be used for toning only. The fixing may be done in either a japanned (if kept in good condition as above) or papier mache tray. The different trays should be plainly marked so that they cannot be mistaken one for the other. Black stains on the prints may be caused by impure water or by rust in the tray; yellow stains by hypo coming in contact with the print in some operation before fixing, and red stains from air bubbles in the toning solution. To avoid these air bubbles which adhere to the print, swab each print with clean cotton wool once during the first washing before toning.

The yellow stains sometimes appear when one feels confident that no hypo has been anywhere near the prints. A friend had been troubled by these stains, but was sure that no hypo could possibly have come in contact with the prints until they were

actually in the fixing bath. But a careful investigation of the various manipulations showed the probable cause. His plate and print fixing was always done on a broad shelf by the side of the sink, and on this the hypo bath was frequently spilled, so that, to a certain extent, the shelf became covered with hypo. Then when giving the prints their first washing before toning, the trays, wet outside, were laid on this shelf. They thus absorbed the hypo, which came in contact with the hands in lifting the tray, and so reached the prints when one hand or the other was used to stir them or remove to the toning bath.

Aristotypes should not be washed after fixing longer than an hour in running water, or an hour to an hour and a half in a flat tray, changing the water about once every ten minutes. If there is any doubt whether the hypo is entirely removed, the surface of the print can be rubbed with a swab of clean cotton wool; this will be blackened if hypo is present, and the prints will need a longer washing.

In the early days of aristotype printing doubts were expressed as to their permanency. As far, however, as time has given them a test, they appear to be as stable as any prints. Insufficient fixing, which is sometimes the case where a combined toning and fixing bath is used, and especially a prolonged washing after fixing, will cause them to fade. We think that one of the great dangers of the combined toning and fixing bath is that through improper washing or careless preparation of the bath, the prints will not for a long time retain the tone they have on emerging from the bath.

We have seen many prints that would not keep their tone for even a year, but turned to a dull, muddy color, and showed evi-

dences of sulphuration. One of our professional friends, in a western city, who "knew it all," repeatedly had trouble with different brands of this paper, trying one after another, and finding them all worthless. As usual in such cases, there was no defect in the various papers, but in his persistence in using his combined bath. His difficulties vanished when he consented to try toning and fixing in two separate baths, and all of the papers which he had condemned he found to work with perfect satisfaction.

SEPARATE TONING AND FIXING BATH FOR GELATINE-CHLORIDE ARISTOTYPE PAPER.

BORAX STOCK SOLUTION.

Powdered borax, 120 grains.
Hot water, 32 ozs.

Shake till dissolved and filter when cold.

CHLORIDE GOLD SOLUTION.

Chloride gold, 15 grains.
Water, 30 drams.

Each dram will then contain one-half grain of the gold.

To prepare the toning bath for one dozen cabinet prints pour into a small tray about three ounces of the borax solution, a like quantity of water, and add one dram of the gold. The prints should first receive a thorough washing in half a dozen changes of water, and then be placed, one at a time, face down, in the above bath. Keep changing the prints from bottom to top, replacing them face up, so that, as the changes are made, the toning can be easily watched. They should tone slowly, and when they have changed to a light cherry red, if light tones are

wanted, they are to be placed in a clean tray of fresh water. If darker tones are desired continue to tone till they become a deeper red, and then remove to water as before. The prints should remain in the water about five minutes, changing the water once, and then be placed one at a time, face down, in the fixing bath for about fifteen minutes, and then be washed as previously described.

The fixing bath we prefer is a sufficient quantity of the stock solution, hypo and alum, as used in the combined toning and fixing bath, reduced by three times its bulk of water. That is, to two ounces of the hypo and alum, add six ounces of water.

It is better in fixing prints to rock the tray occasionally and change the prints once or twice from bottom to top.

COMBINED TONING AND FIXING BATH.

FOR GELATINE-CHLORIDE ARISTOTYPE PAPER.

Hyposulphite soda 27 ozs.
Water, 100 ozs.

When dissolved add:

Powdered alum, 12 ozs.
And water to make 128 ozs.

Shake well and set in a dark corner for a day or two. Then decant or syphon off the clear liquid into any old, clean bottles, and label them: Stock solution hypo. and alum.

It is well to have a gallon of this, as it is also used as the fixing bath for aristotypes toned in a separate bath.

To prepare the combined bath pour into a quart bottle 24 ozs. of this stock solution.

Add slowly to this, shaking the bottle continually:

12 grains chloride gold,
Dissolved in 12 drams water.

Then add

½ oz. sulphocyanide ammonium,

and shake well.

Lastly, add slowly, shaking the bottle as before,

30 grains nitrate lead,

dissolved in 12 drams water, and filtered.

Finally add water to fill the quart bottle.

For use take a sufficient quantity of this solution—say 3 ozs. for one dozen 5 x 8 prints—and add about one ounce of water.

Lay the prints, without previous washing, one at a time in this, face up. They will quickly turn to a yellow, which will gradually change to a cherry red. Keep the prints moving, changing from bottom to top, and as soon as they turn to the cherry red, which may be a dark red, if dark tones are desired, lay them in a tray of clean water. When all are toned, the water in which they have been placed should be changed once, and then the prints should be placed in a bath made up of

Stock solution hypo and alum, 2 ozs.
Water, 6 ozs.

for three to five minutes.

After this they are to be washed for an hour in either running water or in trays of water for the same time, changing the water every ten minutes.

We do not advise the use of any combined toning and fixing both for aristotypes, as the separate toning and fixing produces better results.

CHAPTER XXV.

GENERAL HINTS.

IT is well for the amateur to accustom himself to standing on either side of the camera in taking views. This is a matter that may seem to be of trifling importance, yet it is not a good plan to "get into the rut" of always taking one position when preparing to uncap the lens, or removing the slide, otherwise mistakes may occur. Elsewhere we have advised a fixed habit of invariably taking plates from developer and fixer and washing in the same manner, but it is different in using the camera in the field. One illustration will show the force of this.

Two amateurs, whom we will call James and John, of considerable experience, were tramping for views along the bank of a picturesque stream, and both hit upon the same spot, a scene of rare beauty. The bank was high and steep, and James planted his camera close by the water's edge, while John placed his a few feet behind and about ten feet above him where the bank overhung the stream. They adjusted their focuses, and, to make their exposures, were obliged, from the nature of the ground, to stand on the left of their cameras to withdraw their slides and remove the caps. The exposures were made, and John was replacing his slide when he suddenly shouted out "ha! ha!"

Immediately his companion looked up at him, and in a rather provoked tone said "What are you laughing at up there?"

"Well," said John, "I pulled out the back slide, and spoiled my plate."

"I did the same thing," said James, "and supposed you saw me and were laughing at my mistake. And the worst of it is that I spoiled one I had exposed already."

They had reversible-back cameras, and each one, unconsciously, pulled the back slide, as the side that was towards his right hand.

PLATE-HOLDERS.

If, after using a plate-holder for some time, signs of fog are detected in the plates and you suspect the plate-holder is not light-tight, you can glue a slip of velvet over the slit in the holder and when it is dry cut through the slit with a sharp knife. This will usually make the holder safe to use.

When filling plate-holders it is a good plan to make a pencil mark in one corner of the plate corresponding with the holder number. This is indispensable when one is going on a journey, intending to expose a goodly number of plates which may not be developed for some time afterwards. These marks will show plainly on the finished negative, and will serve to identify it, the number of the holder being entered in the record book.

TO FOCUS QUICKLY.

Set up the camera and focus on some object at a measured distance of twenty feet, and make a mark on the camera bed on a line with the front, with the figures 20 against it; do the same at 40, 60 and 100 feet. You will learn to judge these distances with sufficient accuracy, and, the distance being known, the

focus can at any time be found by moving the front to the required line. It will be convenient to do this on many occasions when there is not time to use the ground-glass. Objects beyond one hundred feet will lie in the same focus as at that distance.

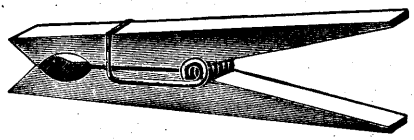
MICROSCOPIC PHOTOGRAPHS.

To make a photograph of any object for use in the microscope the following arrangement is advised:

By the side of the object to be photographed, and exactly on the same plane with it, place some large letters which you can easily obtain from some large hand-bill, then take the camera far enough away until the letters are as small as they can be and yet clearly discernible on the ground-glass and accurately sharp and distinct. A magnifying glass, of course, should be used to examine the letters on the glass; at this distance the image of the object to be copied will probably be too small to be seen by the naked eye.

The exposure can be made in the regular way.

After developing, the negative should be examined with a microscope to see that the details are brought out distinct and clear, and from this negative a positive can easily be made for use in the microscope.



For suspending paper for drying, whether salted paper, sensitized paper, blue paper or soda blotting paper, in fact any paper

or print which does not curl, we know of nothing so handy and inexpensive as the ordinary spring clothes pin.

These can be strung on tightly stretched cords in the dark-room or any place where they will not be in the way.

DEVELOPMENT AND EXPOSURE.

The first plate that the beginner tries to develop will probably seem the most perplexing operation that he has ever attempted unless he has had the good fortune to see the work performed by another, and has carefully watched and understood the various details. Even then, when he attempts the development of a plate alone in his dark-room, and endeavors to remember all that he has seen or read or been told, he may imagine more difficulties than there really are. Let him not worry, but go boldly on, and if the negative does not turn out to be what he hoped, he can afterwards recall each thing he did, quite likely discover what was wrong, and guard himself against a repetition of that error.

Proper exposure must be learned. Nearly correct exposure will generally do; but much too short or too long produces failures. The result of the first gives no details, or some details only in what are called the high lights; that is, the sky and water reflecting sky, or the light colors on which the sun shines, while all else is obscure or entirely blank. In the second case, of over exposure, there are plenty of details everywhere, general thinness of the image and, because there is no contrast, flatness.

Great under-exposure cannot be remedied, but over-exposure can, to a great extent, be controlled in development; but it is not always easy.

When it is known that an exposure of two seconds or three seconds is correct, one must learn to get those times exact. Very many do not seem to have a clear understanding of what a second is, and, in practice, they are likely to guess at it, and make it a half second too short, or get it two or three seconds too long. In long exposures one can use a watch, but that is useless for one or two seconds; one must learn to count seconds as described in Chapter II.

Over and under-exposures are always liable to occur, and where these are suspected they should be corrected, as they can be if not immoderate, in the development. Every amateur should prepare his own developers, and should keep them in two solutions, the active agent, the pyro, or hydrochinon, or other chemical, the No. 1, in one bottle; and the accelerator, soda or potash, the No. 2, in another bottle. It does not follow, that because the directions are to use equal parts of Nos. 1 and 2, that they should invariably be used in that way. Where over-exposure is suspected, and that is more frequently the case, except with "snap shots," than the reverse, the development should be begun with the normal quantity of the No. 1, and about one-third of the No. 2. This may prove sufficient; but if the image does not begin to appear in a minute or two, pour off the solution into a graduate, add more of the No. 2, and again pour the developer over the plate. Then, if all the details do not come out, the developer should again be poured off, and the balance of the No. 2 added. In strengthening a developer, remember that the added parts should not be poured into the tray while the plate is in it, but in the manner given above. If one has a number of plates to develop, it will be well to use two

or three trays, and have them contain solutions of different strength, from weak to full strength.

With under-exposures the above development should be reversed, and the plates should be started in the full amount of No. 2 and a smaller quantity of the No. 1.

Use a brush in developing. High lights take care of themselves. When they have come out fairly, pour off developer and work up detail in shaded parts with brush. Then pour back developer and rock till requisite density is obtained. Or, have part of developer in tray and incline dish, so that it will cover only the shaded parts and work them with brush, occasionally letting developer flow over all the plate. In this way clouds may be saved. Warming a particular spot in negative with finger, changing fingers as one gets cold, will help to bring out detail.

Drying negatives in a strong light will prevent their losing density, but beware of attempting to dry them in direct sunshine as the heat might cause the film to flow from the glass.

If an exceedingly intense negative is needed, as for copy of black and white subjects, printed matter, etc., use two or three times the quantity of No. 1 and a very little No. 2, adding latter little by little, if image after two or three minutes does not come out fast enough. There is no danger of carrying development too far; for such negatives it should be carried on till it is an intense black all over, and fix in acid fixer.

Great contrast is not needed in landscapes. Portraits, slighter contrast and fuller exposure. It is safe generally, where exposure is not known to be correct to use normal quantity of No. 1 and add No. 2 gradually.

If failures happen—and they have an exasperating way of coming when least expected—try to find out where and when they occurred and the reason, and remedy it. Do not blame the developing formula. Many are continually doing that; taking up one new formula after another, and repeating failure after failure.

"The fault, dear Brutus, is not in our stars,
But in ourselves."

Something has been overlooked, something done wrong; remedy it.

In summer use an acid fixing bath with chrome alum or bisulphite soda.

Do not keep using the same fixing bath over and over. One of the cheapest chemicals used is hypo, and it will produce the best results when used fresh.

In using hydrochinon, development is hastened by pouring off developer and then after a few moments replacing it.

A beautiful smooth surface can be given to negatives, after they are dried, by cleaning them with a soft rag dipped in alcohol, and rubbing them when the spirit has evaporated.

Very little bromide is required with either pyro or ferrous oxalate, much more with hydrochinon and amidol.

With both amidol and metol, bromide acts as a preventive of fog as well as a restrainer.

When one is on a journey and has occasion to develop plates, they can be washed sufficiently by letting water from a faucet flow over them, and swabbing with cotton. Then lay the plate face down in a bowl (not flat) of water for an hour. Then swab again under tap, and dry.

The intensification of a negative is not always attended with success. Frequently the cause of the failure is in not washing it thoroughly after fixation, as all the hypo must be removed from the film. It is possible to redevelop a negative and, in that way, make it more intense. To do this well it is best to take a negative immediately after its final washing, and, while the film is soft, soak it for several minutes in a strong solution of common salt. Then transfer it to a solution of

Bichloride mercury 50 grains
Water 5 ozs.

The tray should be rocked as in developing, and the negative will gradually bleach, the image disappearing and again reappearing. We then wash the negative in several changes of water, finally swab with fine cotton wool under the tap, and redevelop it in a strong light, clear sunshine if possible. The best developer for this purpose is, we think, hydrochinon. In this the negative will gain all the density required, after which it simply requires to be well washed and dried.

PRINTING.

Sometimes one has a negative, part of which is very dense, and part very thin. This will occur in landscapes where one part is all in sunshine, brilliantly lighted, and balance in shadow, or in drop-shutter views of water reflecting a strong light, and foliage. To bring out details in the foliage, the water is over dense.

To print this so as to make the picture harmonious, hold the negative towards the light, and on a paper held against it, trace with pencil the dividing line between the dense and thin

portions. Cut the paper carefully on this line, and then trace the line on a sheet of thicker white paper, as long as the printing frame, saving the part which covers the thin part of negative. Fasten this to front of frame, so that it shall exactly cover the thin part of negative, and on it place another sheet of white tissue, with one edge cut like the other, and allow this edge to project from one-eighth to one-quarter inch beyond the thicker paper. Over all lay a sheet of white tissue entirely covering front of frame. Then print in sunlight till the dense parts of negative are printed nearly deep enough for the finished print.

Then remove all the paper and print in the shade till the thinner portions are of the right depth. During the sunlight printing, the position of the frame should be slightly changed occasionally, with respect to the light, to prevent the formation of a distinct line in the print where it is covered by the edge of the thickest paper.

If this is intelligently done, the print will be found to be very greatly improved.

This may also be accomplished by working on the back of the negative, using opaque, thinned if necessary, and other colors, prussian blue, sepia, or india-ink. In order to allow the colors to flow evenly on the back of the negative the glass should be carefully cleaned, using first ammonia and then alcohol. The color should be applied with a brush to those parts of the negative which print too quickly. Thus, the high lights, which are the most intense portions of the negative, are modified or reduced by this increase in the density of the thinner portions or shadows.

PRINTING FANCIES.

Small landscapes, or bits of landscape from a large negative, small portraits, and very small prints generally, can be made very pretty by printing in the following manner:

Suppose you wish a small oval picture, say two inches long by an inch and a quarter wide. Cut an oval of those dimensions from black paper, and paste this on the center of a piece of clean glass the size of the paper on which the print is to be made. Lay this glass in printing frame, with the paper on the upper side, and on this put your printing paper just the same as if printing from a negative. Expose in sunlight till the paper prints to a rich brown or almost black. On taking it out the oval in the center will be found to be still clear white. Now put the negative in frame, and lay on it this paper, so that the white oval will cover the part of negative you wish for your picture, and print as usual. Tone and finish, and you will have a pretty picture with a broad border, like a mat, of rich brown around it. Other shapes besides ovals will suggest themselves, stars or squares or circles.

In a similar way very neat portraits can be printed by using what we call a reversed vignetter for printing in the background. Prepare such a vignetter in this way; cut out a small oval of opaque paper, and then half a dozen or more of same shape from white tissue paper, each one being a trifle larger than the other. Lay the largest one on a sheet of tissue paper, large enough to cover front of frame, and on this the next larger, with a touch of paste in the center, and so on, till the opaque oval is added last. This will be your reversed vignetter, which should be fastened to front of printing frame, and the print paper, laid on a piece of

glass, should be exposed in this to sunlight, keeping the frame directly facing the sun. When printed sufficiently, remove the vignetter, replace it with an ordinary vignetter, and place the negative in frame so that the portrait will be directly under the central, thinnest portion of vignetter, and then lay on negative the print paper, taking care to have its white center on the portrait,

Print to proper depth, and you will have a very effective print, with its background blending gradually to a rich brown.

GROUND GLASS IN PRINTING.

It will pay to have two or three pieces of fine ground glass to fit each size of printing frame. They will be found very handy for helping out in printing from negatives that need restraining in some parts, or for making passable vignettes.

Suppose you have a negative in which the sky is very thin, which would cause it to print dark without the required contrast. Lay the negative in the printing frame, film side down, and upon this the ground glass, ground side up. Then by holding the frame to the light, work on the ground glass with a pencil, either blue or black, over the parts of negative which are too thin. Then take out the two glasses and replace in frame for printing, with ground glass side down and film of negative up.

If some portions of negative are too dense, the ground glass over them can be touched with thin gum water, applied with a fine brush, which will have the effect of making the ground glass where it is applied transparent.

CLOUDS.

In printing in clouds from a cloud negative, care must be taken to see that the clouds are appropriate to the picture, also that the clouds are less distinct than the prominent part of the view. Otherwise, it would be too evident that the printing had been done from another negative, as the more distant clouds naturally are less distinct than the foreground, and too fine details in them would mar the harmony.

Where clouds are in view at moment of exposure, remove the lens cap by an upward motion, replacing it from above, in order to give the shortest exposure to them. If a shutter is used, and the exposure is sufficiently long, the slide of plate-holder should be held in front of the upper part of lens during part of the time, thereby lessening the cloud exposure and giving ample exposure for the balance of the view.

HAND CAMERA PRINTS.

It is not unusual to see hand camera prints which are dark in the corners, caused by thinness in the corresponding parts of the negative, because the lens does not entirely cover the plate. In printing from such negatives, paste bits of tissue paper, with irregular edges, across the corners of the frame, so that they will cover the thin corners of the negative, and print in the shade. Other negatives may be very dense in the high lights; cover the entire frame, in such cases, with tissue, cutting it away directly over the dense parts. Or, if there are thin portions which need restraining in printing, cover the frame with tissue, with an extra tissue over the thin parts.

In all these cases, the position of printing frame should be

altered frequently to prevent the formation of sharp lines where the negative is shielded from the light.

MOUNTING PRINTS.

Lay long side of print on mount first. It is easier in that way to make it parallel with the edge, and square on the mount.

Stand the print on edge to dry. This allows it to dry equally on both sides and lessens the liability to curl.

DOUBLE NEGATIVES FOR VARIOUS VIEWS.

There are many views which require for certain well lighted portions a very short drop-shutter exposure, while other parts need time. Such are views with clouds, distant mountains and great distance generally, waterfalls with dark rocks or foliage, and many snow scenes where some detail is wanted in shaded portions. In all these, the clouds, distance or water, can be taken with the shortest exposure, and, immediately after, without allowing the camera to be moved, making a time exposure on another plate.

Stop out with opaque from the first negative all the under-exposed parts, and from the other the clouds, water or distance. If the stopping out is neatly done, one negative can be printed after the other, care being taken that the paper registers the same on both, which can be done by holding the printing frame toward the light, so that it can be seen exactly where the paper is to cover the second negative.

VIGNETTING NEGATIVE ON ITS BACK.

Take asphaltum varnish, and paint with it all the back of negative, except the head, or part to be vignetted. If a

portrait, leave a small margin unpainted around the head. Dip finger in turpentine, and soften out the edge of varnish nearest figure.

After a few trials you will be able to do this so that the shades will blend perfectly. All the varnish can be removed at any time with turpentine or kerosene.

This vignetting may also be done with opaque, but the blending will be a little more difficult than with asphalt.

In using the opaque, after the back of the negative has been covered with it, the central portion can be rubbed out with finger moistened with water, and the edges thinned off with a moistened brush.

Also, glass vignetters can be easily and quickly made, of any size or shape, with opaque, in the above manner, to fasten to front of printing frame.

Always in vignetting from small plates, surround opening in vignetter, between that and negative, with cotton wool. This will cut off the edges of plate, which otherwise might show, especially if vignetting is done on a large sheet of paper.

NEW NEGATIVES FROM VERY DENSE NEGATIVES WITH SHARP CONTRASTS.

Make a transparency close to gas light, over exposed, to let light get through intense parts. Develop in a developer weak in No. 1 and well restrained.

Take this transparency, which is thin, but with full details, and make a new negative at more than ordinary distance from the light. It will make a very much improved negative, without the strong contrasts. In case of a thin negative, reverse this process.

TO MOUNT PHOTOGRAPHS ON GLASS SO THAT THEY WILL HAVE A HIGH POLISH.

Get a piece of glass the right size, free from bubbles, and after thoroughly cleaning it, flow over it dammar varnish. This will harden sufficiently in several hours or it may stand over night, and should be kept in some place free from dust. When the varnish is sticky and nearly hard, lay the unmounted photograph upon it, face down, and rub it with some pressure, to exclude all air bubbles and make it adhere to the varnish. Then it can be laid one side and allowed to harden; after which, the back of the paper is moistened with water and rubbed with the finger until all of the paper comes off, leaving simply the film of the photograph adhering to the glass. When it is quite dry, brush off carefully any little pieces of paper or dust, and varnish, using any good negative varnish.

SENSITIZING ALBUMEN PAPER.

Do not imagine that because there is a present sort of craze for aristotype papers that albumen paper has passed away.

Buy the albumen paper in any quantity desired. It will keep in a dark, dry place.

When ready to sensitize, cut your large sheets into quarters, or any other size that can be cut without waste into the size required for use. The small sheets are more convenient to handle, and they allow the use of a smaller tray and consequently a less amount of silver solution. Before sensitizing (which is done at night by gas light) lay your sheets of albumen paper, prepared side down, on one or two sheets of clean, white paper,

placed on a drawing board or table. Cover them with several thicknesses of newspaper, which should lap over the albumen paper on every side, and on these lay a sheet of blotting paper soaked in water, or a clean, wet towel, with the water wrung out of it. This should remain on the paper about twenty minutes, rendering it somewhat limp and in the best condition to take the sensitizing.

Lay paper albumen side down, holding it by opposite corners, on the solution. The corners may turn up at first, but they can be pressed down by laying on them light sticks at first. Bubbles may be seen underneath and they should be removed by raising alternately the two ends and touching them off with an ivory paper cutter, or smoothly rounded stick.

The paper should be floated about a minute and a quarter, in cold weather a little longer. Arrange a glass tube or stirring rod at one end, held in place by strips of paper pasted to outside of tray to draw paper over in removing it from tray. Hang up by clips in your dark room to dry.

Prepare only what paper you wish to use the following day. Trim and save clippings. Fume it in the morning. Fuming box should have a door that fits tight, so all the ammonia vapor will stay in box. Pour back solution into bottle, and strengthen it next time. If it gets discolored, clear in sun shine.

DIFFERENT PAPERS FOR DIFFERENT NEGATIVES.

Plain papers and platinotypes are better for negatives showing strong contrasts; aristotype paper is suitable where there are no strong contrasts.

KEEP NEGATIVE WASHING BOXES CLEAN.

It is necessary that the boxes or trays or troughs in which plates are washed should be kept clean. Especially is this the case where these boxes are made of tin, iron or zinc. Both tin and iron are unsafe to use as they rust easily, unless they are occasionally painted with asphaltum. After long use there accumulates in the bottom of washing boxes a slimy paste, which, if it is not discovered and cleaned off, may ruin a batch of plates. We not infrequently hear of negatives that come from the final washing covered with small blisters the size of a pin head, and when such a thing happens one is apt to ascribe it to a defect in the plate.

Such an experience occurred with the writer, the blisters appearing on a dozen plates that were developed, fixed and washed at one time. As there were several different makes of plates used, it seemed clear that the trouble was not in the plate. Trying other plates in fresh trays containing fresh developer and fixing solution, with the same results, located the trouble in the washing box, and an examination of that showed the slime that had been accumulating for a year or more. The box was thoroughly cleaned, and painted inside and out with asphaltum, and no more blisters appeared on the plates. Also, a hole was made in the bottom of the box and a small tin tube soldered over this, so that there could be a constant draining from the bottom of the box into the sink.

PANORAMIC PICTURES.

To make a panoramic picture on two 5 x 8 plates, so that you will have one print, say 4½ inches wide by 10 or 11 inches long,

use a long focus, rapid rectilinear lens, with shutter, and have two plates in a holder of same speed, so that two exposures can be made exactly the same. Adjust camera so that it will turn smoothly on tripod. Select some prominent object for center of picture, and focus so that this will be 2½ inches to right of center on ground glass. Make exposure; then remove holder and turn camera to right till above central object is 2½ inches to left of center of ground glass, and expose. Develop both at once in a large tray to get both negatives of same density.

Now for printing. You can print on two sheets, and after toning, cut through the center of object, and mount on one card, joining them as neatly as possible; but this will not make as neat a job as to print both on same sheet of paper, say 5 x 11 (half of a 10 x 12). To do this use a large frame, say 9 or 11 x 14, with a large glass in it to support negative. First print from one negative, having the above central object come in center of paper. On back of first negative block out with opaque all of the negative, from a straight line cutting the central object in halves, to the nearest end of negative, which is 1½ inches from object. Then lay frame in bottom of a deep box, with tissue paper over front, so that light will fall upon it perpendicularly, and print till tone is right. Then block out other negative in the same way, from same line. Put this negative in frame, and by holding it up to light, adjust the paper to it so that the half of the central object in first print will come right against the other half on the second negative, and print as before. Of course, in printing these two, all of the paper outside of negative must be shielded from light by opaque paper or card placed against it. See that the second print is exactly the same tone as the first.

It may be that there will be a very narrow white streak at the center where the two negatives join. This can be removed by scraping away about $\frac{1}{16}$ inch of the opaque on back, and exposing to light a short time in frame, covering all but a very narrow strip with card board. Let light through this a short time and watch carefully till tone is right.

COPYING.

Many have trouble in getting good copies of various prints, such as photographs, engravings, photogravures, and black and white line work. The difficulty is mainly to get the correct exposure. If one has several photographs of different sizes to copy, all the copies to be of the same size, as for lantern slides, it must be remembered that the exposures must have a certain relation to the sizes of the pictures; because, to produce negatives all of the same size, the camera must be placed at different distances from the object, and the distance of the lens from the object governs the exposure, as we have seen in the law of conjugate foci. (Chapter Concerning Lenses).

Then, too, the color of the print will affect the exposure. (See page 59).

It is not, however, entirely in the exposure that failures occur. An uneven illumination always makes trouble, causing part of the negative to appear under exposed. This is frequently the case in copying black and white, such as a page of printed matter or writing. If the work is done near a window the portion nearest the window will receive the strongest light, which will show in the resultant negative.

The best plan is to use for such work a good north light and

notice particularly that all parts of the object are evenly illuminated. Slow plates should be used for copying black and white line work. For a developer we prefer either hydrochinon or amidol. The development should be slow, and should be continued until the whites of the drawing or print appear in the negative to be jet black, and the black lines clear glass. If over-developed, this clear glass will be clouded. Such negatives should be fixed in an acid fixing bath.

Those who have much copying to do will find their work greatly simplified by using an exposure meter.

Copying, especially from black and white work, can be done by gas light, with quick plates and long exposure, or by placing two kerosene lamps (one on each side) near the object, shielding their light from the lens.

IN PHOTOGRAPHING MACHINERY

Use quick plates with small stop, have the camera level, or rather the plate vertical, and expose for least lighted portions to get full details. If polished surfaces are too bright and reflect too much light, smear them with a dirty piece of greasy waste. If parts of machine do not seem to be well enough lighted, use reflecting screens of white cloth. A sheet of paper laid on the floor where it will not be in the view will help to light the machine.

When the negative is finished, dried and proved, block out on the film side with opaque all the background, but not the foreground. This is a delicate operation, and the color must be laid on next the machinery with a fine pointed brush. If there are straight lines, the blocking out may be done along

them with a smooth drawing pen and ruler, filling in all outside this line with brush.

FOR ARCHITECTURAL VIEWS

A fine lens must be used, and camera should have rising front and double swing. Where the buildings are high and streets narrow a wide angle lens is necessary, and the view should be taken from an elevation. The light should fall on the building obliquely, at a time of the day when the shadows are not too deep, not in the middle of the day. In this class of work details are desired, and as small a diaphragm should be used, as will give a good illumination on the ground glass.

It is rarely advisable to photograph a white building, or a white boat with the sun shining directly on it. Take it when the sun is behind a cloud. If it is a white house in the country, with trees near it, which are also to be a part of the view, the brilliantly lighted house would need the quickest speed of shutter, while the trees would be greatly under timed.

ORTHOCHROMATIC PLATES.

In a yellow light, as towards sunset, when an ordinary plate may be too slow for good work, an ortho plate of same sensitiveness will make a fine negative. The yellowness of the light then acts as a screen.

In winter, when the light is dull, ortho plates with a screen will make fine negatives, when it would be impossible with ordinary plates to get anything but a flat negative.

The screens can be made of thin, clear gelatine, stained with

an aniline dye. Screens are needed in copying oil paintings, not always for flowers. In portraiture, ortho plates are fine. Screen may be omitted, and light tinted by letting it come though yellow tissue or thin yellow fabric. No screen is needed for flash lights, as the light is slightly yellow.

An English photographer, who has been very successful in rendering color values in his pictures, giving them an atmosphere, and overcoming the danger of halation, uses in his lens two colored screens, one of green behind the front, and one of yellow in front of the back, lens. The use of a yellow screen alone prolongs exposure, but the addition of the green shortened the time to one-tenth of what the yellow alone would require.

ANOTHER WORD ABOUT PRINTING.

It is not unusual for amateurs to have trouble with their printing. Sometimes it may seem impossible to get a good, clear, plucky print from a negative, and one is very apt to suspect that the paper is poor, when the trouble almost invariably is in the negative itself. A good negative will make a good print on almost any paper, while the very best paper that ever was made will not bring a good print from a poor negative.

Every amateur will have frequently (and the more experience he has the more he will get such) a negative that is technically a very fine one, that always prints well; such negatives are the result, more than anything else, of a correct exposure; that is, one that was exposed exactly the right time; such exposures are not very likely to be spoiled in development unless one is very careless, because, having been correctly timed, they seem to develop themselves naturally.

So when you have trouble with a lot of prints, some or all of them coming out weak or poor, you can ascertain at once where the trouble lies by testing some of the sensitized paper on which you have been making your prints, with one of your favorite negatives that always prints well; if that makes a good print on your paper, the trouble with the others evidently must be sought for in the negatives themselves. It will probably be found that every negative producing poor prints was either under or over-developed or under or over exposed.

CHAPTER XXVI.

RESIDUES.

EVERY amateur who does considerable developing and printing should save the clippings from paper or prints (before toning), which contain silver, and the cotton brushes used for sensitizing plain paper; the first two waters used for washing silver prints; old fixing baths; and toning baths.

The clippings from silver paper, with the old brushes referred to, and untoned proofs, should be carefully burned from time to time, as a sufficient quantity accumulates, on a clean shovel, or in an iron pan, or in a clean grate, and the ashes saved. These ashes contain silver which can be extracted in several ways.

The following is one of the simplest ways for the reduction of the ashes. It may be done in a stove using coal, or a furnace, or a small forge. Common sand crucibles are used, either eight or sixteen ounces in size, the latter being about as large as one can conveniently handle with coal tongs. Make a mixture in the following proportions, and stir well to make the mass uniform:

Paper ashes, 2 lbs.
Bicarbonate soda, 1½ lbs.
Borax glass, powdered, ½ lb.
Saltpetre, 1½ ozs.

The borax glass can be bought, or can be made from borax, as hereafter described.

Nearly fill a sand crucible with above, and in a coal fire let it heat gradually. When it gets well heated, set the crucible lower down in the coals, and heap coals about it up to the top. Have a good draft to the stove or furnace. As it gets to a white heat, the mass will begin to melt and boil, and settle down in the bottom of the crucible. The ashes which may adhere to the sides should be poked down into the boiling mass with a clean poker, and more ashes, mixed as above, can be added with a long handled iron spoon in small quantities. Keep doing this till the melted liquid ceases to boil. Then the crucible can be removed and allowed to cool. On breaking up the crucible, a button of pure silver will be found at the bottom.

Another way of reducing the ashes is by the

LEAD PROCESS.

Make a mixture as follows:

Ashes, 2 ozs.

Bicarbonate soda, 1¼ ozs., or a heaping table-spoonful.

Powdered borax glass, level table-spoonful.

Litharge (red-lead or oxide of lead), 1½ ozs., or a level table-spoonful.

Wheat flour, tea-spoonful.

Fine sand, tea-spoonful.

These are to be fused in a crucible, as described before.

Under the influence of heat, litharge is reduced to metallic lead by the reducing action of the flour. As lead is heavy, it goes to the bottom of the crucible, and picks up the silver on its way down. That is practically what is done. The soda, borax, sand (silica) and part of the litharge unite to form a thin slag. When

the fusing is complete, the crucible can either be removed and allowed to cool and then broken, or its contents can be poured into a mould. The lead button will go to the bottom and the slag remain on top. When cold, turn the mould over and the lead button will easily separate from the slag. Hammer it into a cubical shape on an anvil, and then it is ready for the cupel.

Cupellation is done in a muffle. This is a fire clay box, in shape something like a half cylinder, closed at one end, with a flat bottom, and heated below. No flame passes through it. In the muffle is placed a little cup made of bone ash, called a cupel. The piece of lead is placed in this cupel, and when the lead melts, part of it is absorbed by the cupel and part goes off in fumes. When all the lead is gone, a button of pure silver remains.

For cupellation a special furnace is required, no ordinary fire will give the necessary heat. Therefore, it will be better to separate the silver from the lead by the wet process, which is as follows:

Hammer or roll the lead button out thin, and then dissolve it in nitric acid. Dilute three ounces of strong nitric acid with three ounces of water, put the lead in a good sized beaker or a bottle and pour on the acid. Stand it on the back of a stove, or on a steam radiator if more convenient, or in a sand bath on a stove, and let it stay until the lead is all dissolved. Possibly, more acid may have to be added. When it is all dissolved, take about $\frac{1}{2}$ oz. strong sulphuric acid and add it slowly and carefully to about 3 ozs. water. It will get pretty hot. Add this dilute sulphuric acid to the lead solution and stir it with a glass rod. Add water until you have about 20 ozs. White sulphate of lead will precipitate. Let it stand for a few hours or over night, and then filter into a

beaker or a wide mouth bottle. Now get some strips of sheet copper or pieces of heavy copper wire, clean them with sand-paper and stick them into the silver solution. Let it stand over night, and all the silver will be separated as a fine gray powder.

Take out the copper, wash the silver thoroughly by filling the bottle with water, and pour off the water after the silver has settled. Do this six or eight times, pour it all into a paper filter and let it drain. The precipitate is pure silver.

BORAX GLASS.

This can be made by fusing borax in a crucible, or in an old unused and rather deep frying pan. Fill either crucible or pan half full of borax and heat carefully. It will probably swell up to the top and may run over, but when all the water is driven off, it will melt down to a small quantity. Keep adding more borax in small amounts, and when all is melted, pour it out on a sheet of tin or an iron plate, and pulverize in a mortar. In large pieces, this looks like glass; hence its name, borax glass.

OLD FIXING BATHS

should be kept in a jar, and when this is full, place it in a window or out of doors and add to it sulphuret of potassium (liver sulphur). A precipitate of black sulphide silver is thrown down. Syphon off the supernatant water, scrape off this powder, and keep by itself. When a sufficient quantity is accumulated, the powder should be thoroughly washed and placed in a crucible, and exposed to a white heat. The sulphur will be expelled, and pure metallic silver be found at bottom of crucible.

SILVER PRINT WASHINGS.

The first two wash waters of silver prints should also be kept in a jar by themselves.

The addition of common salt in small quantities, or till it ceases to cause a precipitate, will throw down white chloride silver. When enough of this has been collected, it should be washed, and placed in a porcelain dish. Over the chloride lay a piece of zinc and add enough water to cover it. Add a few drops of sulphuric acid, and set it on a shelf for a few days. A grayish, black powder will be precipitated which can be converted into metallic silver by heating in a crucible. Or, it may be converted directly into nitrate of silver crystals by the addition of nitric acid, heating in a porcelain dish set in a basin of hot water to evaporate the excess nitric acid, then dissolving residue in water, and evaporating till nitrate silver crystals are formed.

TO RECOVER GOLD FROM TONING BATH WASTES.

To the old toning baths add a strong solution of sulphate iron, acidified with sulphuric acid. A little muriatic acid should also be used to throw down the silver as a chloride.

In adding the sulphate iron solution, do so gradually, and stir all the time with a glass rod till all precipitation of gold ceases. It should then be placed to one side and allowed to settle. Then the liquid can be decanted or syphoned off, and the residue dried. When dry, subject to white heat in a sand crucible, mixing with it equal weights of nitre and borax. A button of gold and silver will be found when the crucible is cold. If the gold is in excess, which is likely, add about twice the weight of button of pure silver, melt in crucible, and pour the molten metal into water in

a cup. This will granulate the metal, and the silver can then be dissolved by adding to the metallic grains nitric acid, converting it into nitrate of silver. The gold remains, and it can be dissolved in a solution of three parts nitric acid and five parts muriatic acid. This should be done preferably in a test tube, which can be set aside in a warm place. The resulting solution is chloride gold. Evaporate this nearly to dryness, by heat, to remove most of the excess of liquid; dilute with distilled water, and keep in a dark, covered bottle, for a chloride gold solution for toning. If the above grains of gold were carefully weighed before dissolving, enough water can be added to make each ounce of the solution contain two grains of the gold chloride, which will be a convenient strength for use in toning bath.

These are all very interesting processes, and they are not difficult for those who have the proper conveniences. In large photographic establishments the various wastes are saved and sent to silver refiners for reduction.

When one takes into consideration the time required to reduce clippings to ashes, and to melt the ashes and chemicals; estimates the value of the coal consumed in the heating, the chemicals used, and the crucible destroyed; the resulting silver will be found to cost more than it is actually worth. This need not, however, deter the amateur from making the experiment, because of the satisfaction he will have in being able to produce silver from ashes, and each little button of silver will seem worth its weight in gold.

The clippings from aristotype paper do not produce as much silver as those from albumen and plain paper, and should not be mixed with the latter.

To the amateur, who wishes to reduce his own waste as a source of profit, we think the print washings and old fixing baths are the only wastes worth saving. With these the chemicals used in the reduction are inexpensive, and small, cheap crucibles can be used. Especially rich and valuable are the first two wash waters from plain silver prints, as can be easily seen in the very milky appearance of the water. The use of plain silver paper for portraiture and landscapes is growing rapidly as photographers learn its many excellencies, and how simple a matter it is to prepare it, and a very large percentage of the silver used in sensitizing this paper can be easily and profitably recovered.

CHAPTER XXVII.

FORMULAS.

IN all formulas given for solid measure we use avordupois weight, by which drugs and chemicals are usually sold. When an ounce is mentioned, solid measure, we mean 437½ grains. It would be well if all followed this rule, or any one rule, as it would lead to less confusion.

In formulas of Seed, Cramer and Blair, by one ounce is meant 480 grains; while Carbutt, Eastman, and some others use an ounce of 437½ grains.

I.

A RELIABLE HYDROCHINON DEVELOPER IN ONE SOLUTION.

Sulphite soda crystals,	-	500 grains,
Phosphate soda granular,		240 "
Carbonate soda crystals,		500 "

Water to make 16 ounces.

Dissolve and filter, and add hydrochinon, 100 grains.

When dissolved, filter once more. For instantaneous exposures, use full strength. For long exposures add from one to two ounces water to each three ounces of developer.

II.

HYDROCHINON DEVELOPER IN TWO SOLUTIONS.

No. 1.

Sulphite soda crystals, - 500 grains,
Phosphate soda granular, 120 "
Water to make - - 8 ounces,

Dissolve and filter, and add hydrochinon, 100 grains.
Filter again when dissolved.

No 2.

Carbonate soda crystals, - 500 grains,
Phosphate soda granular, 120 "
Water to make - - 8 ounces.

When dissolved, filter.

This is the same as the first formula, but put up in two solutions. It will keep fresh for at least a year in the dark room. It is more convenient to have it in this form, allowing the use of more or less of No. 1 as desired.

Use equal parts, reducing with water as before.

III.

ANOTHER GOOD HYDROCHINON DEVELOPER.

Sulphite soda crystals, 400 grains.
Carbonate soda, " 400 grains.
Water to make 8 ounces.
Dissolve and filter, and add
Hydrochinon, 60 grains.

For use take two ounces solution and add two ounces water.

IV.

STILL ANOTHER GOOD HYDROCHINON DEVELOPER IN TWO SOLUTIONS.

No. 1.

Sulphite soda crystals, 400 grains.
Water to make 4 ounces.
When dissolved and filtered, add.
Hydrochinon, 60 grains,

No. 2.

Carbonate potassium, 200 grains.
Water to make 4 ounces.
Filter when dissolved.

For use take one ounce each of Nos. 1 and 2, and two ounces water. This is especially good for timed exposures.

We use it generally for copying.

All of these hydrochinon developers can be used repeatedly as long as they remain clear. After use they should be filtered into a separate clean bottle.

This old solution will not keep fresh in a partly filled bottle, as it is affected by the air. It should therefore be kept in a tightly corked bottle, which it will entirely fill. This should be observed always in preserving mixed developing solutions.

V.

HYDROCHINON DEVELOPER FOR INSTANTANEOUS EXPOSURES.

Sulphite soda crystals, 200 grains.

Carbonate soda crystals, 480 grains.

Water to make 8 ounces.

Dissolve and filter, and add

Hydrochinon, 50 grains.

For ordinary exposures use an old developer.

VI.

HYDROCHINON DEVELOPER, FOR LANTERN SLIDES AND TRANSPARENCIES.

No. 1.

Sulphite soda crystals, 500 grains.

Water to make 8 ounces.

Dissolve and filter, and add

Hydrochinon, 125 grains.

No. 2.

Carbonate potassium, 300 grains.

Water to make 8 ounces.

Filter when dissolved.

For use take one ounce each of Nos. 1 and 2, and from one to two ounces water.

While this developer is most excellent for lantern slides it is also equally good for bromides and photo-chloride prints. It is also an excellent developer for dry plates generally.

It can be used repeatedly as long as it remains clear.

VII.

HYDROCHINON DEVELOPER.

FOR UNDER-EXPOSED INSTANTANEOUS EXPOSURES.

No. 1.

Sulphite soda crystals, 200 grains.
Water to make 8 ounces.
Dissolve and filter, and add
Hydrochinon, 50 grains.

No. 2.

Carbonate potassium, 50 grains.
Caustic soda (sticks) 20 grains.
Water to make 1 ounce.

For use take two ounces No. 1 and one to two drams No. 2.

VIII.

ANOTHER HYDROCHINON DEVELOPER.

No. 1.

Sulphite soda crystals, 400 grains.
Water to make 6 ounces.
Dissolve and filter, and add
Hydrochinon, 50 grains.
Bromide potassium, 1 grain.

No. 2.

Caustic soda (sticks)80 grains.
Water to make 5 ounces.

If desired, an equal weight of caustic potash can be substituted for the caustic soda.

For use add to each 4 ounces of No. 1, 4½ drams No. 2.

After use, filter into a separate, clean bottle. This bottle should be washed clean every time before an old developer is filtered into it.

Use repeatedly as long as it remains clear, adding each time 30 drops of No. 1 and 6 drops No. 2.

This is an excellent developer for dry plates, and we have found it to work well, also, with bromide and photo-chloride paper.

IX.

EIKONOGEN DEVELOPER.

No. 1.

Sulphite soda crystals, 120 grains.
Water to make 8 ounces.

Dissolve and filter, and add

Eikonogen, 60 grains.

To dissolve thoroughly, the bottle containing above should be well shaken every few minutes, repeating this several times.

No. 2.

Carbonate potassium, 300 grains.
Water to make 4 ounces.

Filter when dissolved.

For use take three ounces No. 1 and one ounce No. 2.

X.

EIKONOGEN DEVELOPER FOR LANTERN SLIDES.

No. 1.

Sulphite soda crystals, 250 grains.
Water to make 8 ounces.
Dissolve and filter, and add
Eikonogen, 20 grains.

No. 2.

Carbonate potassium, 32 grains.
Water to make 1 ounce.

For use take two ounces No. 1 and one dram No. 2.

We have thoroughly tested this, and know it to be excellent.

XI.

A COMBINED EIKONOGEN AND HYDROCHINON DEVELOPER FOR LANTERN SLIDES.

No. 1.

Eikonogen, 48 grains.
Meta-bisulphite potassium, 48 grains.
Water to make 8 ounces.
When entirely dissolved, filter and add
Hydrochinon, 48 grains.

No. 2.

Carbonate potassium, 250 grains.
Carbonate soda crystals, 250 grains.
Yellow prussiate potash, 250 grains.
Water to make 8 ounces.
Filter when dissolved.

For use take one ounce No. 1, one ounce water, and forty drops No. 2. The image should make its appearance in about a minute. If it is slow in coming up, add a half dram of No. 2.

XII.

FERROUS-OXALATE DEVELOPER.

No. 1.

Neutral oxalate potassium, 960 grains.
Bromide potassium, 8 grains,
Hot water to make 8 ounces.

When dissolved and cold, add oxalic acid till it turns blue litmus paper red. Then filter.

No. 2.

Proto-sulphate iron, 240 grains.
Water to make 2 ounces.
Sulphuric acid, 2 drops.

Filter when dissolved.

For use pour one-half ounce No. 2 into two ounces No. 1.

In this developer the iron is the main factor, and for good results it should be kept fresh, dissolving only the quantity named at a time.

The oxalate solution should be filtered occasionally to keep it clear.

XIII.

RAPID DEVELOPER FOR INSTANTANEOUS EXPOSURES.

No. 1.

Sulphite soda crystals, 450 grains.
Water to make 8 ounces.
Dissolve and filter, and add
Hydrochinon, 75 grains.

No. 2.

Caustic soda (sticks), 80 grain
Water to make 8 ounces.
For use, take equal parts Nos. 1 and 2.

XIV

AMIDOL DEVELOPER.

STOCK SOLUTION.

Sulphite soda crystals, 800 grains.
Water to make 8 ounces.
Dissolve and filter.

For use, pour into a four ounce bottle one ounce of the above, add ten grains of amidol and three ounces of water. Shake for a few moments and pour into developing tray. This may be weakened, if desired, for full exposures, by the addition of another ounce of water. The addition of a few drops of a ten per cent. solution of bromide potassium tends to the production of rather brighter negatives when full exposure has been given.

For lantern slides this developer, weakened as above, and with

the addition of bromide, will be found very successful, giving an image of good tone, while the high lights remain perfectly free from stain.

The above is the manufacturer's formula, which we have found excellent. Amidol is a powerful developer, and does not require as long an exposure as other developing agents. Exposures should always be made with reference to the developer one intends to use, and this should be remembered when that developer is to be amidol. A plate properly exposed for a pyro developer would be much over exposed for amidol, and result in a thin negrtive.

XV.

METOL DEVELOPER.

Concentrated stock solution:

Metol, 130 grains.
Water, 6 ounces.

When dissolved, add

Water, 6 ounces.
Sulphite soda crystals, 960 grains.)

When this is dissolved, add

Carbonate soda crystals, 1,200 grains.
Water to make the whole up to 16 ounces.

For portraits, dilute with equal bulk of water.

For landscapes, mix one part of stock solution with two to three parts of water.

XVIII.

TONING BATHS—THE BORAX BATH.

Powdered Borax, 1 ounce.
Hot water 16 ounces.

When dissolved and cold, filter.

For use, take a sufficient quantity of above, add an equal quantity of water, and one grain chloride gold and sodium for each dozen 5 x 8 prints.

This can be used immediately.

XIX.

ACETATE OF SODA BATH.

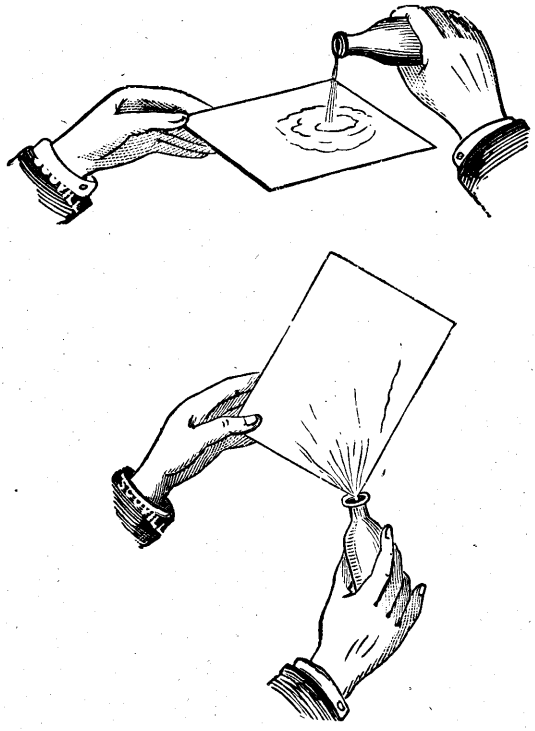
Acetate of soda, 120 grains.
Chloride gold and sodium, 6 grains.
Water to make 32 ounces.

This should be made the day before wanted for use. It can be used several times, by returning the old solution to a separate bottle, adding each subsequent time about one-half dram of the stock gold solution. (See chapter on Toning).

There are numerous other toning baths, all of which give good results, but we think the above will be found sufficient for all albumen or plain silver prints. It must not be forgotten that a good negative is the most important factor in securing good results in toning, and thorough washing before placing the prints in the toning bath.

XX.

A SUBSTITUTE FOR GROUND GLASS can be made by dissolving in two ounces of commercial ether 90 grains gum sandarac and 20 grains gum mastic. When these are dissolved, add to the solution two ounces benzole. This must be kept in a tightly



corked bottle and not opened near a light or fire. To use it, gently heat the glass to be coated and apply the solution as below. Great care, however, must be taken to avoid letting the solution flow upon the film side of the plate.

Holding the plate by one corner between the thumb and forefinger, so that the thumb will hardly touch the top surface of the glass, pour on the solution in the center, till it covers a third or more of the plate, tilting it gently each way. When the solution has thus spread over the whole surface, let it drain back into the bottle from one corner. By standing the glass on edge, it will then dry in a few minutes. The illustrations were designed to show the operation of varnishing a plate (which is not necessary with dry plates), but they answer as well to show the above process.

XXI.

GUM FOR ADHESIVE PAPER.

Place in a half pint wide-mouth bottle

1 ounce alcohol,
5 ounces water,
1 ounce acetic acid,

And pour into this slowly

2 ounces dextrine.

Place this bottle in a basin of hot water, occasionally shaking it, till the dextrine is dissolved.

This can be spread on sheets of paper and will dry quickly. Such paper will be useful for making labels to paste on bottles, or small strips to number negatives.

XXII.

ANOTHER GUM

for the same purpose can be made by boiling in six ounces of water

60 grains gum arabic,
60 grains laundry starch,
1 ounce white sugar.

If ordinary mounting cards are coated with this and allowed to dry, wet prints will adhere to them by pressing them with clean sheets of blotting paper to take up the surplus moisture.

XXIII.

TO PREPARE RUBY GLASS.

Dissolve in two ounces of hot water,
50 grains sheet gelatine,
1 grain chloride ammonium,
When this is cold, add a solution of
Nitrate silver, 10 grains,
Water, 1 dram.

The glass, after being thoroughly cleaned, should be warmed, and upon this flow enough of the solution, warmed to about blood heat, to cover the surface. The glass should then be laid on a level shelf for the solution to set and dry. When this is afterwards exposed to the sunlight, the color will change to an orange ruby, suitable for use in a dark-lantern.

XXIV.

A BLACK VARNISH

for coating the inside of lens tubes, plate-holders, cameras, etc., can be made by dissolving

300 grains gum sandarac,
20 grains gum camphor,
in 2 ounces alcohol,

And adding a sufficient quantity of lamp black. Apply with a fine brush.

XXV.

TO INTENSIFY NEGATIVES.

No. 1.

Bichloride mercury, 240 grains,
Chloride ammonium, 240 grains.
Distilled water, 20 ounces.

No. 2.

Chloride ammonium, 480 grains.
Water, 20 ounces.

No. 3.

Sulphite soda crystals, 480 grains.
Water, 10 oz.

The negative to be intensified, should be soaked in cold water for fifteen minutes, and then, after pouring off the water,

flow over it sufficient of No. 1 to cover it, and allow the film to either partially or entirely whiten; the longer this is allowed to act, the more intense will be the result. When sufficiently whitened, pour off the solution into the sink, and flow over the plate some of No. 2, allowing it to act one minute; then wash off, and pour over or immerse in No. 3, until changed entirely to a dark brown or black. No. 3 can be returned to its bottle, but the used portions of Nos. 1 and 2 had better be thrown away. After the last operation, wash the plate thoroughly and dry.

We are indebted to Mr. Carbutt for the above.

To intensify locally, use "Hall's intensifier" (for sale by dealers). This should be applied very carefully with a brush. It will bring out details in shaded parts.

Local intensifying can also be done mechanically by applying indigo blue with the finger to the glass side of negatives, moistening the color with gum-water. This will intensify enough to lighten deep shadows.

XXVI.

TO REDUCE NEGATIVES.

Bichromate potassium, 60 grains.
Muriatic acid, 1 dram.
Water, 6 ounces.

Lay the plate in water for a few minutes, and transfer to the above till the reduction is sufficient, after which wash the plate thoroughly.

This can also be applied with a fine brush to parts requiring local reduction.

XXVII.

TO REDUCE LOCALLY.

Prepare a solution of

Hyposulphite soda, 35 grains.
Red prussiate potash, 5 grains.
Water, 4 ounces.

Apply this carefully to parts needing reduction, with a fine, soft brush, after soaking the plate ten minutes in water to soften the film. Wash the plate and repeat, if necessary.

We have seen portrait negatives, in which the face was so intense as to require prolonged exposure in sunlight to bring out any detail, which were successfully reduced in the above way.

XXVIII.

FARMER'S SOLUTION FOR REDUCTION.

No. 1.

Hyposulphite soda, 1 ounce.
Water, 16 ounces.

No. 2.

Red prussiate potash, 55 grains.
Water, 2 ounces.

For use add one half dram No. 2 to each ounce of No. 1. The negative is immersed in the solution, and as the high lights are attacked first they may be effectually reduced before the shadows are touched. The larger the quantity of No. 2 used, the more

rapid will be the reduction. To reduce locally, apply the mixed solution with a soft brush to the particular parts. Wash plate well after these operations.

This same solution may be used to reduce over-printed photographs on paper without affecting the tone in the least.

XXIX.

LOCAL REDUCTION.

If any parts of a negative show in printing too great intensity, they can be reduced by soaking for ten minutes in cool water, and then applying a weak solution of chloride of lime to the parts till sufficiently reduced. During this process the negative should be kept wet, and afterwards thoroughly washed. Some photographers rub the parts with the finger wet with the lime solution, but an unskilled hand is liable, in doing this, to injure the film. If the intensity is noticed during development it can be reduced by applying the lime as above, after fixing and washing.

TIN DEVELOPING DISHES.

These can be coated with a quick-drying asphalt varnish, the same kind as is used on bicycles.

IN REGARD TO GLUE.

Glue, with a small percentage of glycerine added, adheres to metals. A small amount of molasses added to glue will act in the same way.

FIXING TRAYS.

Japanned trays, which are in common use for fixing baths for plates, after long use begin to rust. They should not be used while rusty, but the rust should be scraped or sand-papered off clean, and the trays painted with asphaltum or lacquer. If the trays are very rusty, or the rust is in corners where it cannot easily be removed, they can be soaked in a strong solution of caustic potash, which will remove the old japan, and then kerosene will soften and remove the rust. After being well cleaned they can be painted as above, which will make them nearly as good as new.

PARTS AND WEIGHTS.

Frequently formulas will be found which are given in parts. When all these parts are solids there is no difficulty in making up the preparation; but these formulas in parts generally include some liquid, principally water. Thus:

Hydrochinon, 1 part.
Sulphite of soda, 4 parts.
Water, 32 parts.

In such a case, substitute grains for parts, and the formula will then read:

Hydrochinon, 100 grains.
Sulphite soda, 400 grains.
Water, 3,200 grains.

A fluid ounce of water weighs about 456 grains, and the above quantity of water would then be about 7 ounces.

ACID FIXING BATH.

A

Chrome alum, 1 ounce.
Hot water to make 16 ounces.

B

Sulphite soda crystals, 4 ounces.
Water to make 16 ounces.

C

Water, 4 ounces.
Sulphuric acid, added slowly, 2 drams.

D

Hyposulphite soda, 32 ounces.
Water to make 92 ounces.

When all are dissolved, add C to B, pour that into D, and lastly, add A. In cold weather, one half the quantity of chrome alum will be sufficient.

This is an excellent and economical fixing bath for plates.

After using any required quantity, filter it into a separate bottle, and this can be used repeatedly, as long as it remains clear.

The above is, we believe, Mr. Carbutt's formula.

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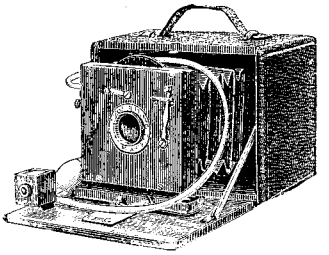
BO-PEEP.

SIZE, 4X5 AND 5X7.



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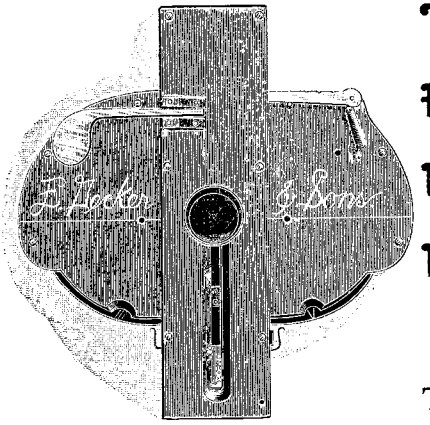

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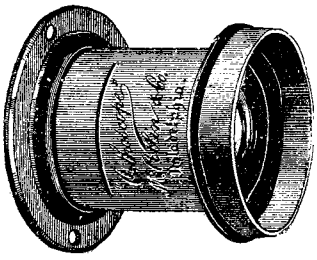

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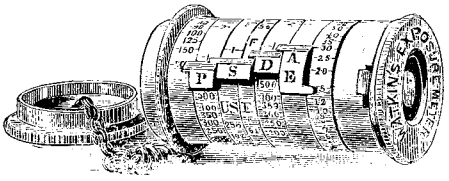

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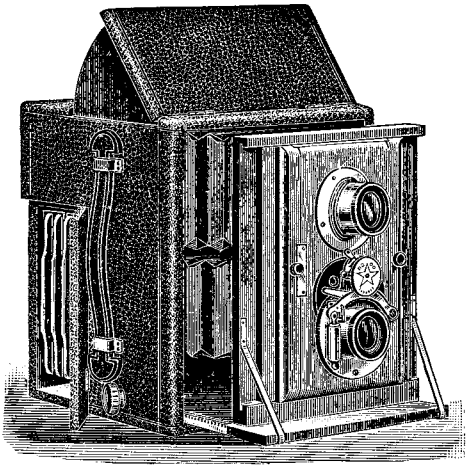

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