# Early Work in Photography

A Text-Book for Beginners.

With Negative and Positive on Celluloid.

BY

W. ETHELBERT HENRY, C.E.

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## A TEXT-BOOK FOR BEGINNERS.

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*WITH A CHAPTER ON LENSES*

BY

H. SNOWDEN WARD.

*Editor of* THE PHOTOGRAM.

Illustrated with an actual negative and positive on celluloid, and numerous explanatory diagrams throughout the text.

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# A HINT TO BEGINNERS.

(Based upon Personal Experience.)

IF you wish to be an all-round slip-shod dabbler, try every different make of plate, paper, developer, and toning bath, that each of your friends recommends —of course before mastering any of the technical details of photography.

But, on the other hand, if you wish to become a clean and careful worker, capable of producing excellent results, stick to one brand of plates, one formula for developer, and one toning bath, until you understand them thoroughly and can produce a good negative and a good print every time—or else know the exact cause of failure.

When you can do this—the field of experiment is ready to offer you a welcome.

# INTRODUCTORY.

IN this instruction book the student is advised to begin his photographic education with silver-printing. In every other hand-book (so far as we are aware) negative-making is the first branch described, apparently because making a negative is the first step in the production of a photographic picture. We are sure, from a wide experience of beginners and their requirements, that our system will save the student both time and money, will render the path to proficiency easier and far more pleasant than it usually is (especially for those who have to work entirely alone), and will result in a larger proportion of competent workers from a given number of aspirants, than any other method. In everything we have aimed at simplicity.

The recommendation of the hydroquinone developer arises from the fact that hydroquinone is the best developer for "all-round" work for negatives, lantern-slides, bromide paper and chloride paper, and because one formula may be adapted to all classes of development according to the amount of subsequent dilution. Some of the newer single solution developers might have been recommended; but, if a *knowledge* of photography is the student's aim, there is a distinct advantage in beginning with the use of developer, accelerator, and restrainer, in separate solutions.

No attempt has been made to exhaust the subject. Our object is to enable any beginner, who will work, to do *well* all that is necessary to the production of good photograms. When he has *thoroughly* mastered the first principles contained in this text-book he will have acquired the basis for further work, and may then fearlessly launch into the innumerable and fascinating branches of photography, and its many applications to the arts and sciences.

Study this text-book closely, and apply its teaching practically, chapter by chapter. If you fail in any detail, do not pass on to the next until that one has been properly mastered. Do not dabble with more than one make of paper, one make of plate, or one formula for developer, until you can honestly say you have ***mastered*** the contents of this book. If you are content to do this, and will plod steadily onwards, you are bound to succeed.

Finally, as to our use of the word "photogram" as indicating a photographic print. Its adoption is simply an effort towards consistency and purity in that English language of which we are justly proud. The noun "photogram" is superseding the incorrect term "photograph," and its adoption among the educated classes is rapidly taking place. What should we think of a person who sent or received "a telegraph"?

# CHAPTER I.

## FIRST LESSONS IN PRINTING.

### The Action of Light.

*Materials Required for this Chapter:*—One ¼-plate printing frame (cost about 9d.), and one packet of ¼ plate gelatino-chloride printing-out paper (cost 1s.), one pound of hypo (costs 2d.), one deep porcelain tray (costs 10d.), one piece clear glass 4¼ × 3¼. These may be obtained from any dealer in photographic goods.

BEFORE we begin operations, it will be well for readers to have some knowledge of the *action* of light in photography, upon which all photographic processes are based. It is almost generally known that many substances undergo a decided chemical change under the influence of light, and this change is more or less visible in different cases. Note the effect of *lunar caustic* upon the skin; all our readers are acquainted with the decided black mark that clings so persistently after an application of this chemical, which is, after all, simply nitrate of silver (used by photographers), fused into sticks.

Many other chemicals undergo a similar change under the influence of light, and are used, more or less, in various photographic processes. Of these we shall treat fully in a later book. Silver nitrate, then, is the most important chemical used by photographers. In conjunction with other chemicals, it forms the sensitizing agent in the photographic papers and dry plates of which we shall treat.

Gelatino-chloride "printing out" paper (often called "P.O.P.") is made by mixing certain proportions of nitrate of silver, chloride of sodium, citrate of potassium and gelatine; this mixture forms an emulsion* which is subsequently spread upon a sheet of paper and dried in the dark. The presence of chlorides increases the sensitiveness of such a paper (nitrate of silver, alone, would be practically useless for the purpose), but there always remains a *slight* excess of silver nitrate, which tends to give the vigorous image required in this process. Before attempting a more interesting experiment, let us realize the effect of light upon this sensi-

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*See Glossary.

tive paper. Take a small piece (say an inch square), put it face (or shiny side) up on a book, and cover one half of it with any opaque substance, such as a piece of cardboard, then remove it to the window, and expose it for a minute to daylight. Then lift the cardboard, and notice the difference in color between the part that was protected from, and the part that was exposed to, daylight. In one minute this will probably be slight, but, if you replace the card and expose the paper again for five minutes, a great change will be noticeable: you will observe that one half the paper is white (having been protected from the action of light), while the other half has turned to a deep reddish brown. Photography is founded upon this action. You will also notice that the paper, as you buy it from the dealer, is enclosed in a red or orange-coloured wrapper; this is done to protect it from the action of light, because a ruby coloured or yellow light does not exert the same action as white or blue light. In dealing with gelatino-chloride printing-out paper, it is only necessary to handle it in a diffused light (about five or ten feet from the window in an ordinary room), and to keep the stock of paper stored in a light-tight box, or in an opaque envelope. Having satisfied yourself as to the effect of light upon sensitized paper, and the necessity for protecting unused paper from its action, we will now undertake a more interesting experiment, which will further demonstrate that varying degrees of density depend upon the varying *amount* of light admitted to the paper.

Take a piece of glass the size of the quarter-plate printing frame ($3\frac{1}{4} \times 4\frac{1}{4}$ inches) and paste upon it half-a-dozen pieces of tissue paper (each one half-an-inch longer than the rest), as in the diagram on page 9.

No. 1 being covered with one thickness of tissue, No. 2 with two thicknesses, and so on. Then put the sheet of glass (paper-covered side downwards) into the printing frame, next cover the glass with a sheet of sensitive paper—being careful to place the coated (or shiny) side of the paper downwards—and re-adjust the back (hinged part) of the frame in its place. You will note that the pressure of the springs holds the back of the frame firmly in place, and, of course, presses the paper firmly to the glass, thus ensuring perfect contact. Now remove the frame and its contents to bright daylight, and expose the paper-covered glass thereto, for about fifteen minutes. After exposure, remove it into a shady place (the interior of a room, for instance) and examine the course of the printing. To do this, without moving the paper, requires a little care at first, but is really very simple.

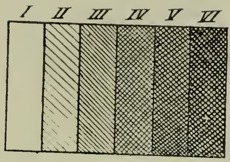
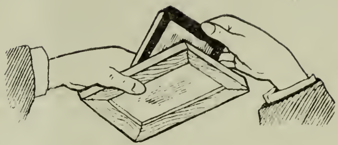



*Diagram of Tissue Paper.*



*Opening a Printing Frame.*

*Skeleton Leaf.*

*Negative of Skeleton Leaf.*

Hold the frame, back upwards, in the left hand, keeping the thumb firmly pressed upon the lower half of the back, to prevent it moving; with the right thumb, release the top pressure spring, and turn it clear of the back. The top half of the back may now be opened, and the paper turned back, so that its face (or sensitive side) may be examined. You will notice quite a variation in the depth of colour, representing a scale of tones. It is this variation of colour according to the amount of light action that causes the subtle half-tones in a photogram. A practical application of this experiment may be made with a piece of lace or dried seaweed, or, still more beautiful, a dried or a skeleton leaf. In this case it is only necessary to put a sheet of clean glass in the printing frame, and on it place the leaf (or other object); then cover it with a sheet of sensitive paper; replace the back of the frame and expose to daylight, until the visible portions of the paper are quite black. The leaf will then show in beautiful white or tinted tracery upon a black, or very deep brown, ground. On no account remove from the frame until the printing has proceeded far enough, or the result cannot fail to be disappointing in its "washed-out" appearance, due to the fact that the fixing operation (about to be described) lightens the tint of such prints to a considerable degree. Many varieties of dried leaves and ferns may be reproduced in the same manner; but it must be borne in mind that it is necessary to use them only in a *dry* state, otherwise, the sap would injure the paper, and probably cause it to stick to the glass.

It is necessary to keep these prints protected from the further influence of light, until they have been "fixed."

And now let us consider what is the nature of the change effected by light in the salts of silver, with which we have been dealing; it is simply this: The silver salts have been reduced to their metallic* state, more or less, according to the intensity of the light attacking them. It will be clearly understood that portions of the paper, hitherto protected from light, still contain sensitive matter, capable of reduction if exposed to light, and it will be equally obvious that if we can remove this sensitive matter without removing the parts already altered by light we shall have a picture composed of metallic silver, the white portions of which contain no matter sensitive to light, hence no further change can be

*This statement is made for the sake of impressing the action upon the beginner; as a matter of fact the visible image consists of a mixture of metallic silver and silver photo-chloride, and the latter usually preponderates.

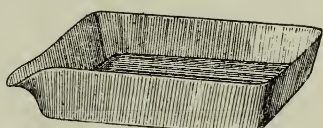
effected by light. This is the principle upon which the operation, known as "fixing," is based.

Sodium thiosulphate (commonly known as "hypo") possesses the power of attacking and dissolving the sensitive salts of silver existing in the paper, without attacking those parts which have been altered by the action of light. We will, therefore, make up a small quantity of solution, called by photographers "the fixing bath."

| | |
|---|---|
| Hypo ... ... ... ... ... | 3 ounces. |
| Water ... ... ... ... ... | 20 ounces. |

The hypo must be quite dissolved in the water, and the solution must be used cold, otherwise the gelatine coating of the sensitive paper would probably be dissolved. In order to render the prints insensitive to further light action, we must immerse them singly in clean cold water, until they lie flat and limp (about 15 minutes), and then transfer them to the fixing bath, which may be contained in a basin or deep soup plate or, better still, a deep porcelain tray* (about 7 by 5 inches), which may be had from a stock-dealer for about tenpence.

While they are in the fixing bath, the prints must be kept moving constantly—lifting the bottom print to the top, slowly and steadily—examining each print and removing air bells if any are formed on the surface. Fifteen minutes in the fixing bath will be sufficient to thoroughly remove all the sensitive silver salts from the prints, which must then be freely washed in several changes of clean cold water, in which they must be constantly moved in order to permit the water to act freely upon their surfaces. When we say immerse *singly*, we do not mean that only one print may be fixed at a time, but that a lot of prints must not be dumped in together, otherwise they would stick to each other. Directly one print is *quite* immersed—another may follow, and so on until all are in the bath.



*Deep Porcelain Tray.*

Two dozen ¼ plates may be fixed in twenty ounces of fixing bath, and after use the bath must be thrown away; never attempt to keep it for a day or two after once fixing a batch

*This tray must be reserved *exclusively* for use with hypo, and for washing the prints *after* fixing. On no account must it be used for any other chemical if it has once been used for hypo, nor must it be used to wash prints *before* fixing them, as a contamination of this salt would certainly be a fruitful source of failure and vexation.

of prints in it. Using an old fixing bath is a fruitful cause of stains and yellowness in photographic prints.

It is advisable to give the prints at least ten changes of water, washing them for about six minutes after each change; they may then be mounted on cardboard or laid, face upwards, on blotting paper to dry. On no account attempt to dry them by heat, or the gelatine surface will melt and the picture be spoilt.

If prints are to be mounted it is best to trim* them before wetting them at all. There are many devices for this purpose, and some of them are very ingenious, but the simplest plan is to put the print, face up, on a piece of glass, apply a straight-edge firmly along the part of the margin to be removed and then cut it off by means of an ordinary pocket knife.

*Trimming Knife.*

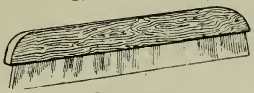
If any difficulty exists in securing true angles—and bad trimming is very objectionable—there are several trimming boards in the market that render untrue trimming almost impossible. One of these is a sheet of plate glass ruled with lines at right angles, and another is an arrangement with a plate glass bed and two graduated edges, at right angles, which lock over the print and hold it firmly while it is being trimmed. Both of these appliances are very useful to a photographer, but are not absolutely essential.

Mounting the photograms is an easy operation when properly understood, but very messy if not done in the right manner.

The best way is to take the prints from the last washing water and put them face down on a piece of clean wet glass—first one, and then another on the top of it, and then another, and so on, until all are in a neat pile on the glass. Then rest the glass on a perfectly flat table, cover the heap of prints with four or five folds of clean blotting paper and then roll a round ruler (or a glass bottle) firmly over the top so as to press out the superfluous moisture. Quite a decided pressure is necessary to do this, if there are more than a dozen prints in the pile, and that is the reason why the glass must be laid upon a *perfectly* flat surface to avoid breakage. There are several other methods for driving out the water, one of which is the squeegee—a narrow strip of rubber mounted in wood. It is used thus: The prints are covered with a sheet of tough writing, or cartridge, paper, instead of blotting paper; a squeegee is then grasped in the right hand

* See Glossary.

(the left hand being used to hold the covering paper from moving) and firmly dragged from the centre to one end of the pile of prints. They are then turned end for end and the operation repeated. This effectually expels the water, but as some practice is necessary before a beginner can thoroughly master the squeegee, we recommend the former plan for the present.


*Squeegee.*

When all superfluous water has been driven from the prints the top one is coated with a thin layer of arrowroot paste, applied with a bristle brush, and then lifted by one corner from the heap. It is then turned face upwards and firmly held about an inch towards the centre from the top right hand and bottom left hand corners. The top left hand corner is then lowered to the required position on the mount, the top edge is allowed to follow it, and, when it is in correct position, the rest of the print falls easily into its place. It must then be covered with a sheet of clean dry blotting paper and rubbed firmly into place with the side of the hand. After a little practice this soon becomes a very simple and easy matter, and the print always dries free from creases.

Paste for mounting photograms may be bought of most stock dealers, but the following formula is an excellent one:

| | |
|---|---|
| Bermuda Arrowroot (best) ... | $3\frac{1}{2}$ ounces |
| Gelatine (Nelson's No. 1) ... | 160 grains |
| Methylated Spirits ... ... ... | 2 ounces |
| Carbolic Acid (pure) ... ... | 12 minims |
| Water (cold) ... ... ... ... | 30 ounces |

Mix the arrowroot into a stiff cream with two ounces of the water, while the gelatine is placed to soak in the remainder. When the gelatine is softened and the arrowroot well mixed, pour all together into an iron saucepan and bring to the boiling point. Keep at this heat for about five minutes, being particularly careful to stir continually from the moment the mixture is placed on the fire. When sufficiently cooked, pour into a basin to cool. When cool, add the carbolic acid and spirit (previously mixed) in a thin stream with constant stirring. Then bottle and keep well corked.

# CHAPTER II.

## FIRST LESSONS IN TONING.

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*Materials required:*—One tube of gold (price about 2s.) ; one oz. bicarbonate of soda (price 1d.) one 10-oz. graduate (cost about 8d.) ; two 20-oz. bottles (cost about 2d. each).

IN the last chapter we dealt with the simplest method of producing pictures by light, and gave formula for a fixing bath to prevent such pictures undergoing further change under the influence of light. It will be noticed, however, that the color of such photographic prints, after removal from the fixing bath, is not agreeable, but ranges from a more or less impure white, through various shades of yellowish brown, until it ends in a deep reddish chocolate, altogether different from prints made by professional photographers.

We suggested the use of the fixing bath in order that students should early become acquainted with the simple method of checking the change that light produces upon sensitive silvered paper, and we advise students to become thoroughly familiar with this action before entering upon the more complex change brought about in the toning bath.

We will take for granted that the color of a print, simply fixed and washed, is objectionable; let us now consider how it may be altered (previous to fixing) so that it will assume the pleasing purple and black tones* so peculiar to photograms made by professional workers.

The principle of the so-called "toning" action may be simply described thus:—After all the free nitrate of silver has been removed from the print (as it comes from the printing frame), by washing in several changes of water, it is then treated with a weak alkaline solution of gold chloride. In its alkaline state (and this is why an alkali should always be present in a toning bath) the gold present in solution is attracted by the metallic silver present in the print (which forms the picture) and becomes deposited upon it in a finely divided metallic state. These fine particles of

*See Glossary.

gold, if collected as a precipitate, would be found to exist as a beautiful purple powder—resembling that known to painters as "purple of cassius."

The longer a print is immersed in such a toning bath, the deposition of gold of course becomes heavier, and causes a deepening of the tone until the print changes from red, or reddish brown, to a purple brown, then to purple, and finally to a blue black. The color of the resultant photogram therefore depends, to a great extent, upon the length of immersion in the gold toning bath, and it will be readily inferred that the permanence of the print will be much improved by receiving a deposit of gold—which is so little affected by atmospheric influences as compared with silver.

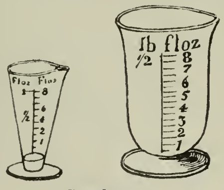
Toning, therefore, answers a two-fold purpose: it improves the color of the silver print and increases its permanence. The action of the gold bath also exerts a pleasing influence upon the white parts of the print, changing the slight yellowish deposit of silver into almost invisible pale violet or purple, thus enhancing the brilliance of the high lights; this will be very noticeable as we proceed with the toning.

In order to avoid waste in preparing a toning bath (as well as on account of general neatness), it is desirable to make up the following stock solutions:—

*Gold Stock Solution.*

| | | | |
|---|---|---|---|
| Gold chloride | ... | ... | 15 grains |
| Water ... | ... | ... | 15 ounces. |

The gold chloride is sold in hermetically sealed tubes containing 15 grains each. The water must be measured in a graduate divided into fluid drams and ounces. Care is necessary in breaking the tube of gold so as to prevent waste. The best plan is to put the tube of gold into the graduate and press it, or tap it smartly, with a thick glass rod or piece of clean smooth hard wood. When the tube is broken, add a few ounces of water and stir it up with a glass rod and then pour the solution into a stoppered bottle; add more water and pour it off as before, and so on until fifteen ounces have been measured. The fragments of glass will remain in the graduate and may be thrown away. It is advisable to keep this solution in a cupboard away from strong daylight, or else cover the bottle with a sheet of brown paper.



*Graduates.*

Next make up the

*Alkaline Stock Solution.*

| | | |
|---|---|---|
| Bicarbonate of soda ... | ... | 1 ounce |
| Table salt ... | ... | 1 „ |
| Water, to make ... | ... | 15 ounces. |

This may be kept in an ordinary corked bottle.

To use a toning bath proceed as follows:—

The prints must appear darker than we wish to have them when finished (for reasons we have already given), and it is advisable to have a decided tinge of color in the parts that are to be white in the finished photogram. The *exact* depth can only be known after a few trials and possibly some disappointment.

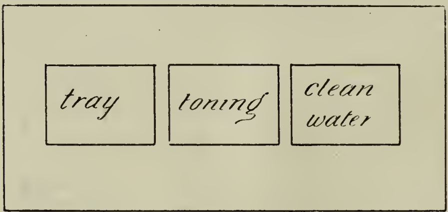
Instead of putting these prints into a fixing bath we must now immerse them in clean cold water and turn them over therein for five minutes; this had better be done four or five times, then cover the tray, containing the prints, with a piece of cardboard to exclude light, and make up the following toning bath in a clean deep porcelain tray, size about 7 by 5 inches, or, better still, 9 by 7 inches.

*Toning bath for use.*

| | | |
|---|---|---|
| Water, cold (about 65° F.) | ... | 20 ounces. |
| Stock gold solution ... | ... | 2 „ |
| Stock alkaline solution | ... | 2 „ |

This may be used at once, but will not keep.

Put the tray of prints on a table at your left hand, the toning bath in front, and a basin or tray of clean water at your right, as shown in the diagram. Take a print from the tray and immerse it face downwards in the toning bath, then turn it face upwards and remove any air bells that may have formed upon it and turn it down again. Keep it moving, first face up and then face down, being particular to keep it under the solution, except at such times as you may desire to lift it out for closer inspection. In about a minute, put another print into the bath and treat it in a similar manner, but do not forget to turn print No. 1, and



examine it at frequent intervals. In another minute or so, another print may be added to the bath, and if it is compared with No. 1 there should be a decided difference in their appearance; No. 3 should appear to be red, while No. 1 should be a decided brown color, and the white parts of No. 1 should begin to assume a purer appearance than No. 3. If this be so, no matter how slight the change, you may rest assured that the deposit of gold is taking place and the toning bath is working satisfactorily. Five or six prints may be treated together in the toning bath—putting them in at intervals, of course—but we do not advise a learner to attempt a greater number.

When No. 1 is sufficiently toned, which may be judged best by the brilliance and pureness of the white parts and the purple color of the deep shades, it must be removed to the basin of clean water on the right. For all purposes of washing photographic prints we have found good-sized glazed earthenware pancheons very serviceable; but purely chemical operations, such as toning and fixing, are best carried out in porcelain trays sold for the purpose. After the prints are all toned, the toning bath may be thrown away, and it is well to wash out the toning tray and put it away until it is wanted again.

The prints should next be washed for a few minutes in a change of clean water and may then be transferred to the fixing bath (hypo. 3 oz., water 20 oz.) where they are to be kept moving for fifteen minutes; they must then be removed to clean water, and well washed for at least an hour.

After this treatment the prints will be far more agreeable in color than when the toning bath is omitted. Should the color still be browner than desired, the cause lies in too short an immersion in the toning bath, and the remedy is obvious.

A slatey bluish black indicates too long continued an action of the toning bath.

In the course of a few trials the right moment to remove the prints from the toning solution will soon be learnt.

The operations of washing and toning may all be carried on in subdued daylight, so long as care be taken to prevent direct rays of strong light striking the prints. Candle or gas light has no apparent effect upon the paper, but it is difficult (owing to the yellow rays of such illuminant) to judge of the various degrees of color while toning them, hence we advise weak diffused daylight.

And here we most strongly recommend beginners to persevere incessantly: printing, toning and fixing dozens of small batches (of half-a-dozen or so, if need be, (until perfect confidence is acquired.

By perfect confidence we mean confidence in the ability to produce any number of prints from one subject of an equal depth both of light action and of toning; in fact, so that the prints shall be indistinguishable one from another. Then, and not until then, it will be time to learn to print from an actual negative.

### Probable Failures and their Cause.

*An indistinct image*, possessing no sharpness of detail.—Probable cause, film side of negative put *downwards* instead of up, thus interposing a transparent substance (the celluloid upon which the negative image is made) between the actual negative image and the sensitive paper. It is impossible to secure sharp detail without actual contact between the negative film and the paper.

*A blurred appearance*, as if two images existed instead of one.—Cause, carelessness in handling the printing frame when examining the print, thus slightly moving the paper from its original position and so securing a *double* impression through the negative.

*Veiled, foggy appearance of prints.*—Insufficient washing before toning.

*Measles.*---Too strong, or too alkaline, toning bath.

# CHAPTER III.

## PRINTING FROM THE NEGATIVE.

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*Materials Required:*—1 box of assorted masks and discs, $\frac{1}{4}$ plate size (cost 1s.).

HAVING thoroughly mastered printing and toning photograms of simple objects, we will now go on to the use of a negative in photography. As it is our intention to lead beginners gradually to the production of a negative, we shall not say much on the subject here, especially as we have provided a ready-made negative for their use, until we have taught them how to make negatives of any subject for themselves.

It will be sufficient, then, to simply state that a negative (in the photographic sense) is a transparent picture, *in which the lights and shades are reversed.* This peculiarity will be instantly noticed, if we examine the negative supplied with this textbook.

Let us hold this transparent picture to the light, and observe it critically: The sky is the darkest portion, and many details of varying degrees of opacity appear in different places, until we finally discover some quite clear parts. The negative should be, so far as light and shade is concerned, the exact reverse of the scene from which it was made.

A careful student will remember that the action of light upon sensitive paper causes it to rapidly darken; it therefore follows that if such paper is placed in contact *behind* a negative, through which light must pass before attacking the sensitive surface, it stands to reason that the light will act most rapidly through the clearest portions of the negative, while the very dark parts (such as sky and water) will be scarcely altered at all. To put this theory to a practical test, take a piece of clear glass (size $4\frac{1}{4}$ by $3\frac{1}{4}$ in) and fit it in the printing frame; then place the negative upon the glass, *film side* up-*

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*The *film side* may easily be recognised, as it presents a rather uneven appearance in comparison with the back, which is of a more glossy nature. In order to make the distinction more obvious—we have labelled the film side of the negative.

*wards*, and cover it with a sheet of sensitive paper—sensitive side downwards, *i.e.* in contact with the film side of the negative. Then replace the back of the printing frame, and expose the glass side to strong daylight.

At the end of about ten minutes the frame may be removed to a weaker light and one half of the picture examined, when the use of a negative in producing a positive image will at once be apparent. If printing has not been carried far enough, in other words if the photogram does not appear to be *several shades darker* than required, the frame must again be closed (care being observed to avoid moving either negative or print, during the operation), and again exposed to daylight.

There is no rule whereby the time of exposure can be accurately determined; all depends upon the quality of the negative, and the actinic* power of the light. For instance, if the negative be a dense one, more exposure must be allowed than if it be a soft one, full of delicate gradations. Again, if the sensitive paper is exposed to sunlight, the action will necessarily take place more rapidly than on exposure to diffused daylight. The light during the winter season is also much less powerful than of springtime or summer. All these matters tend to govern the time of exposure, hence the necessity of examining the course of the printing, at frequent intervals.

As a rule it is advisable that the printing be carried on until the deep shades are more vigorous than will be desired in the finished photogram, and the white portions are appreciably tinged with colour.

When the student is able to secure the same effects (from one negative) half-a-dozen times consecutively, he may venture to try some experiments in printing medallions and vignettes. And here we must again impress upon the student that our object is to make him feel quite conversant with the method of printing from, and handling, a negative before dealing with the more complex matter of making one.

In order to produce the so-called "medallion" prints, we shall require a packet of masks and discs ($\frac{1}{4}$ plate size), procurable of any stock-dealer. These masks are made of black paper, pierced with various sized openings in ovals, squares, and other shapes, and they are used as follows:

The negative is supported (film side upwards) upon a sheet of glass in the printing frame in the usual way, but, instead of then placing a sheet of sensitive paper directly in contact with it, we must first cover it with a black paper mask,

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* See Glossary.


**A MEDALLION**

(PRINTED WITH BLACK PAPER MASK).

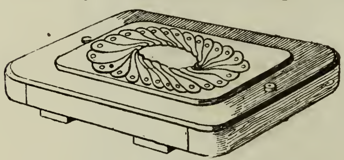
*From a Photogram by Friedrich Müller, Munich.*

having an opening of the desired shape. Upon this mask we next place the sensitive paper (face downwards) close the printing frame, and expose to the light in the usual way. The black part of the mask, it will be readily understood, prevents any light having access to those parts of the paper covered by it. Hence it follows that only that part of the negative, visible through the central opening, possesses the power of transmitting light to the paper with which it is covered. The result will be a print, having a centre of an oval (or other) shape, surrounded by clear white margins.

The student will find much amusement in cutting out various shaped designs, to suit his own taste, and trying their effect in printing from various parts of the negative. The best paper for this purpose is known as black needle-paper, and the designs can be easily made if the paper be supported upon a sheet of glass and the cutting done with a sharp penknife.

Another style of print which is popular among the general public, although personally we cannot confess to much partiality for it, is that known as a "vignette." A vignette usually has the main portion of the subject printed to full depth, while the edges are graded off until they merge into plain paper devoid of any impression.

This effect is due to a retarded action of light brought about by covering the negative with an opaque shield pierced with an opening of any desired shape. Appliances, known in the trade as "vignetters," are sold especially for the purpose of producing such prints, and some of them are admirable; but the student may easily try an experiment in vignetting if he will follow our instructions. We do not advise a beginner to encumber himself with such apparatus until he has made a few experimental trials with the make-shifts we are going to suggest, later on he may find it an advantage, especially if he adopts photography as a business.



*Vignetter.*

Still dealing with the same sized negative and printing frame as in the former experiments, we will now take a piece of cardboard, the dimensions of which are equal to the extreme *outside* size of the printing frame. A hole must now be made in the centre of this card—the shape being governed by individual taste—but for our experiment let it be an oval. The size of the hole must be *less* than will cover the amount of subject we wish to include when printing from the negative it is destined to cover. The hole may be made with knife or scissors, and it is not necessary to be at all careful in keeping the edges clean cut, in fact they may be quite rough in outline.

The pierced cardboard is now to be tacked upon the *outside* of the printing frame in such a position that the opening of the card comes over the part of the negative that is to be printed.

The negative and sensitive paper are placed in the frame as previously described, the opening in the cardboard is then to be covered with a piece of tissue paper to ensure diffusion of light, and the whole exposed to light in the usual way. In this position the negative, instead of being visible, will be covered with the cardboard vignetter, the opening of which is covered with tissue paper.

Of course, printing will take a longer time than when the negative is quite uncovered, and the result will be different from any other method of printing. Thus, when using a medallion mask the resulting print possesses a clean-cut outline, dividing the picture from its white margin; this is due to the opaque mask being in actual contact with both negative and sensitive paper.

The effect of the vignetter will be very different, for this reason: the vignette, although partially protecting the sensitive paper from the action of light, is placed *not in contact* with the negative film, but at a considerable distance from it, *i.e.*,on the exterior of the printing frame.

The light is thus enabled to strike beneath the protecting cardboard and exert a gradually lessening influence upon the sensitive paper which, therefore, yields a print with a softened and graduated margin.

If the outline is at all harsh in appearance, it is due to the vignetter being too near to the surface of the negative. This fault may be remedied by nailing a strip of wood (about half-an-inch thick) around the outside (front surface) of the printing frame and attaching the vignette to it. This will increase the distance between vignetter and negative, and so cause a greater diffusion of light and, of course, increased softness of margin to the print.

There are, of course, many other methods of dealing with sensitive paper (such as combination printing, &c.), but as they do not properly come within the scope of a first handbook, we shall defer their treatment for a later and more advanced work.

We ask the student to carefully and thoroughly practise the lessons contained in this chapter, and we beg him not to attempt to push farther ahead until he feels that confidence in himself that is bound to be the reward of dogged perseverance. In the next chapter we make another step in the direction of the mysterious darkened chamber so essential to the production of a photographic negative.

# CHAPTER IV.

## THE DARK-ROOM AND ITS FITTINGS.

DARK-ROOM is a misnomer, but we will try to explain why such a chamber, in which the critical operation of development is usually carried on, is designated "dark."

Most students are aware that white light, when examined through the spectroscope, is seen to consist of many beautiful and vivid colors. Now one end of the spectrum is principally formed of blue and violet light, while the constituents of the other end are chiefly yellow and red.

It is well known (even among the general public) that red cannot be photographed so quickly as can blue—hence it is also well known that a bright red dress usually appears black in a photogram, while blue, even dark blue, comes out white. Now we will try to show the reason for this. White light contains both rays of *light* and rays of *heat*. The spectroscope divides this light into its several parts and shows us that it is possible to so filter white light as to exclude the *active* rays of *light* at will. The blue and violet rays are the *actinic** ones, and exert the greatest power upon a photographic plate, of which we shall speak later. The red or heat rays are the non-actinic* ones and exert no influence on a light-sensitive plate. Photographic plates are now prepared to such a degree of sensitiveness that an exposure to white light of even a small fraction of a second is sufficient to impress it with a visible image, but the same plate may be exposed to red and yellow light for considerable time without leaving any sign of an impression. At the risk of repetition we once more impress upon the student the reason for this: the red and yellow rays transmit only heat; the blue and violet rays transmit *active light*.

How, then, can we so illuminate a chamber that we can conduct photographic operations without risk of injuring so sensitive a plate? Easily enough. We have said that it is possible to *filter* certain rays from others, and it is only

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* See Glossary.

necessary to exclude the blue and violet rays in order to have what is known as a "safe" light. Blue and violet light cannot pass through red glass, as such glass will only transmit the heat rays: red and yellow.

We must bear this fact in mind while providing illumination in the otherwise darkened chamber.

The chemical operation of development may be carried on in any room so long as *absolutely* no white light (even from the cracks beneath a door) is allowed access to it.

An ordinary window may be used, but it must be covered with a frame glazed with ruby glass, and provided with an extra frame covered with "canary medium," which is obtainable from any photographic dealer.

We shall give a plan showing a convenient way of fitting the dark room sink, &c., but we do not advise the beginner to make use of day light (even when filtered through ruby glass) chiefly because the fluctuation from such a source of light often leads to a bewildering state of uncertainty.

It is better to exclude *all* light from the room by covering the window with several layers of brown paper and covering all cracks with the same material.

For effective illumination, then, we strongly advise the student to buy a well-made dark-room lantern; it would hardly be becoming to specially mention any particular make, although some years ago we used a lantern that has since been our ideal.

As a guide to a beginner, we suggest the following features which should be possessed by a good dark room lantern.

It should be large.

It should consume either gas or paraffin.

It should be provided with deep ruby glass, fitted in grooves and easily changeable.

It should have *extra* grooves to permit of two panes of glass (red and yellow) being used, one over the other if desired.

The flame should be regulated from *outside* the lantern.

The chimney should be provided with "light traps" so that *no* white light can escape.

The ventilation must be perfect.

The price may range from 5s. to £1.

All lanterns of this class are glazed with ruby glass, through which the flame is distinctly visible in its full glare. In our practice we always paste a sheet of orange-colored tissue paper over each pane of glass, which causes a pleasant diffusion of light, less trying to the eyes than a direct flame.

The following features must be avoided in a lantern:

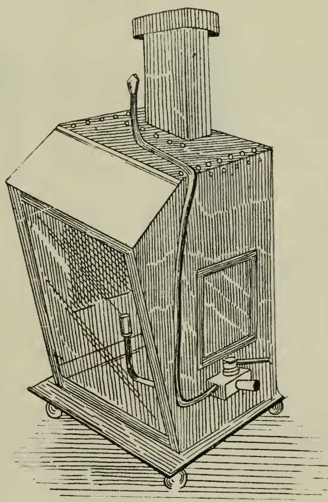
It must not be a so-called "pocket lantern."

It must not be so small as to become red hot in about five minutes—such lanterns (to avoid risk of explosion, we presume) are usually provided with an inch or two of candle, which melts at a critical moment.

The only means of access to the interior must *not* be through a patented spring arrangement at the top or bottom.

It must not have the flame within three inches of the ruby glass.

It must not allow the slightest suspicion of light (other than red) to escape. To test for this particular defect the best plan is to light the lamp and close it ready for use; then take a piece of cardboard, the size of the panes, and hold it over each sheet of glass, examining the sides of the grooves in which the glass is fixed. You will soon see if white light escapes. Instructions have been published from time to time in the photographic journals whereby a suitable lantern can be made at a small outlay.


*A Bye-pass Ruby Lantern.*

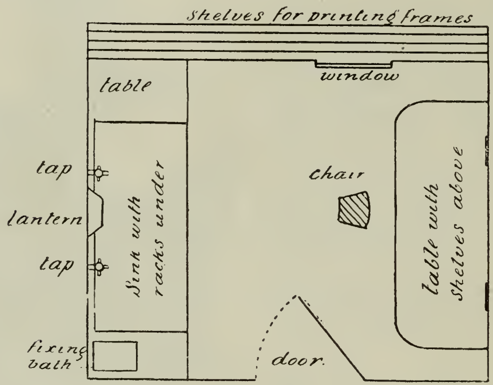
Having decided upon the lantern, let us now turn to the general fittings of the developing room.

If the student is fortunate enough to have a fair-sized room (say 10 by 8 feet) fitted with a supply of water and a waste pipe it will be well to adapt the place for use as a general photographic workroom, as well as a developing room.

The following plan is arranged upon this principle.

Plenty of shelving and a large sink are, in our opinion, of the first importance. An excellent sink can be made of matched boards put together in the form of a box about 3 feet long, by 18 inches wide, by 6 inches deep. This should be lined with thin sheet lead, and fixed permanently upon a framework at one end of the workroom. Beneath the sink it is advisable to have a number of racks in which to store the various trays used in the work.

At one end of the sink there should be a space especially reserved for the bath used when fixing glass plates. An excellent bath for this purpose—and we have never yet seen one we like better—may be made by anyone handy with carpenter's tools. It has the advantage of being usable with any sized plates from the smallest to the largest for which it is made, and it fixes the plate more thoroughly than any other pattern. It is made of two pieces of board screwed together lengthwise at right angles to each other, their ends being recessed into a rectangular board at each end. All the



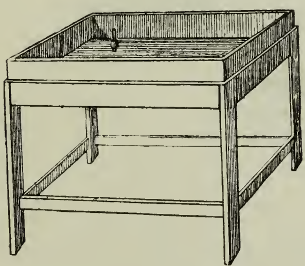

*Plan of General Workroom.*

joints should be put together with a liberal layer of red lead in order to ensure a watertight joint. The inside must be well coated either with asphaltum varnish or solid paraffin wax applied hot and worked in with a hot iron. The latter plan is the one we recommend.

The sketch on page 30 will give a general idea of the trough. When used for fixing it must contain a liberal supply of hypo solution, and the plates must be placed face downwards; but we shall speak of this matter in the next chapter.

The question of water supply is a matter for serious consideration and, wherever possible (especially if photography is likely to be adopted as a serious hobby), we recommend the student to arrange for a plentiful supply. Of course, if it is impossible to run a supply from the main we can arrange for a tank, or small keg, to contain enough for use during development; but we strongly urge the student to arrange for a direct supply, and a direct waste pipe. If he has these, photography will lose all its terrors and become a most agreeable and fascinating occupation.

We advise the beginner to permanently block up the top half of the window in his workroom and provide a sliding shutter (working up and down in grooves) to the lower half.



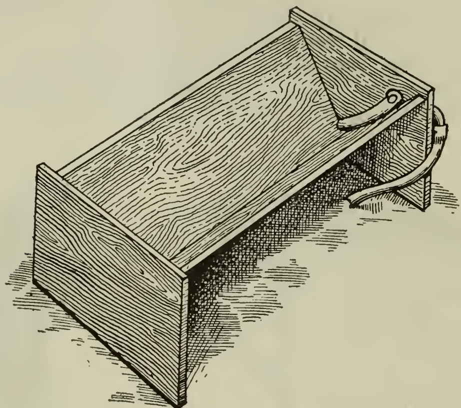
*A Cheap Sink.*

*Ruby Lamp suitable only for changing plates.*

Thus he can, at a moment's notice, convert his dark-room into a light workroom for ordinary work or *vice-versâ*. Both sink and table should be of a convenient height, so that development and other work may be undertaken while the operator is sitting in comfort, instead of standing for long periods watching the slow appearance of an under-exposed negative. It is a common mistake to build the sink so high as to be useless except while standing.

The dark-room door should be fitted with a spring latch, which will effectually prevent untimely intrusions while development is proceeding, and we recommend the use of a draw-curtain (inside the door) sufficiently long and wide to cover all the cracks around and beneath the door and so exclude even the faintest ray of unfiltered light.

It is a good plan to test the thorough darkness of the room by closing it and sitting in total darkness for five minutes. Long before this time has elapsed the student will observe innumerable rays of white light penetrating in places whence they are least expected. These should be carefully covered as fast as they become visible and the final result will be a



*A Home-made Fixing Trough.*

developing room in which a sensitive plate may be exposed without fear of ruining it.

We will now pass on to another distinct step towards the production of a negative, viz.: the development of the latent image on a sensitive plate.

# CHAPTER V.

## FIRST LESSON IN DEVELOPMENT.

### Lantern Slides.

*Required for this Chapter:*—One box slow lantern slide plates (price 1s.), porcelain developing dish and developer.

HITHERTO we have confined ourselves to the comparatively simple process of printing a visible image, by long exposure to daylight. We must now deal with a substance so sensitive as to be fully impressed with a latent or invisible image by an exposure of one second to daylight, or a proportionate time to artificial light.

The emulsion spread upon the plates we shall use for this purpose, differs from that with which the printing-out paper (chap. 1) is coated, in an essential feature. The emulsion spread upon that paper contains gelatine, chloride of silver, and *free nitrate* of silver. The plates we shall now use contain only gelatine and chloride of silver, without the least trace of nitrate. If any free nitrate of silver was present the emulsion would be useless for development. Plates that are made specially for development are prepared by ruby or yellow light, and must never be exposed to white light (no matter how feeble), except when we wish to impress them with an image.

The method of printing is briefly this: A negative is placed (film upwards) in the printing frame, and a lantern plate is placed upon it, film downwards, that is, both films in contact. The back of the frame is then replaced and fastened.

The negative is then exposed to daylight for a second, or to other illumination, as will be described.

Upon applying certain chemicals (known as the developer) to the film of the lantern plate, after such exposure, the latent image is converted into metallic silver, and becomes visible in various degrees according to the action of light. The image, so formed, is insoluble in the fixing bath (hypo), but the other parts of the plate, *i.e.* those not altered by the combined action of light and developer, still consist of chloride of silver, which is easily soluble in the fixing bath.

Therefore it follows that if, after development, the plate be immersed in a solution of hypo, the creamy-looking chloride of silver will be dissolved, leaving the insoluble metallic image upon a transparent film of colourless gelatine.

If the student will now examine the transparent positive that accompanies this handbook, he will understand exactly the qualities that must be sought when making lantern slides by development.

And now, to come to the matter of printing and developing in detail, we must impress one vital fact upon the student: The lantern plates are *extremely* sensitive to the faintest ray of white light, though they are not affected by deep yellow, orange, or red light.

The best and most comfortable light to use while working with lantern plates is a rich yellow, such as is transmitted through a pane of yellow glass, covered with one thickness of canary medium. It is positively necessary to use deep ruby light only when dealing with the plates of ultra sensitiveness, to be described in a later chapter.

Let us now shut ourselves in the dark room, and prepare to make a trial exposure: Place the negative (film up) on a sheet of glass in the printing frame; put a lantern plate (film down) upon it, and re-adjust the back of the frame.

And here it may be well to tell the student that makers of lantern plates always pack their plates in a similar manner, *i.e.* film to film, with either a slip of paper or small piece of card between. When a box of plates is opened (of course, only by yellow light, as described) it will be observed that the first plate always has its back (or glass side) *upwards.* The next plate will have its film side upward, and the next one the glass side upward, and so on.

But, if at any time there be any doubt as to which is the film side (and they are so exactly similar that this may easily happen in the yellow light of the dark room), the matter may be easily set right. Hold a plate by the edges, and turn it at such an angle towards the lantern that the light is reflected upon it; then breathe lightly on the surface. If the film side be uppermost, the breath will leave no impression, but, if the glass side be upwards, the breath will condense upon it. This is the simplest and neatest method we know for determining the film side of a plate.

The negative and sensitive plate being in contact, and ready for exposure, it is necessary to completely cover the negative, except during the time of actual exposure. This may be done with a book, or a piece of cardboard. The frame and its contents must next be taken into daylight (the convenience of a sliding shutter in the workroom will here be apparent), and the protecting cover removed for one second; in very dull weather two seconds may possibly be necessary. After exposure, remove again to the workroom, and (still by yellow light, of course,) remove the now invisibly impressed plate, and prepare for development.

For reasons explained in our introductory chapter, we strongly recommend the hydroquinone developer. This may be bought, ready prepared, of most photographic dealers; but as soon as the student feels confidence in himself we advise him to make his own. The following is a reliable formula:

A.

| | | |
|---|---|---|
| Hydroquinone ... ... | 720 or 160 grains |
| Citric Acid ... ... ... | 270 or 60 „ |
| Potassium Bromide ... | 135 or 30 „ |
| Sodium Sulphite ... ... | 9 or 2 ounces |
| Alcohol ... ... ... | 4 or 1 „ |
| Water to ... ... ... | 90 or 20 „ |

Dissolve the citric acid, bromide, and sulphite together, in about sixty (or fourteen) ounces of water; dissolve the hydroquinone in the alcohol, and then add gradually to the other solution with frequent shaking; finally add the rest of the water.

B.

| | |
|---|---|
| Potassium Carbonate ... | 13½ or 3 ounces |
| Sodium Carbonate ... ... | 13½ or 3 „ |
| Water to ... ... ... | 90 or 20 „ |

Before beginning to develop a plate, we must make up a fixing bath in a clean porcelain try, the following is the best strength for this bath:

*Fixing bath for lantern plates.*

| | |
|---|---|
| Hypo ... ... ... | ... 3 ounces. |
| Water ... ... ... | ... 10 „ |

This bath should not be used for lantern plates more than one day; if kept and used on a later occasion, stains will result.

To develop a lantern plate: Pour into a graduate* half an ounce of A, half an ounce of B, and add one ounce of water. Put the plate, film side upwards, into a small porcelain tray (about 4 by 5 inches in size) and, with a steady sweep, flow the developer over its surface. Do not hurry; do not *splash* the developer, or air bells will be formed; do not pour the solution on the *centre* of the plate. The best way is to

*See Glossary.

hold the tray in the left hand, and then put the lip of the graduate at the left end of the edge nearest to you.

Then, drawing the graduate along the edge of the tray from left to right, allow the developer to flow smoothly in one continuous wave across the surface of the plate; in this manner the plate will be quickly and thoroughly covered with the solution, without the formation of air bells.

As soon as the developer is on the plate, the dish must be gently rocked from side to side, and end to end, so as to cause a gentle movement of the solution.

The image will make its first appearance in less than a minute, and will gradually gain vigor and intensity; if the exposure has been correct, development should be complete in about three minutes.

If the image starts up instantly upon applying the developer, it is a sign that the plate has been exposed too long to light; the remedy is to expose another plate for less time.

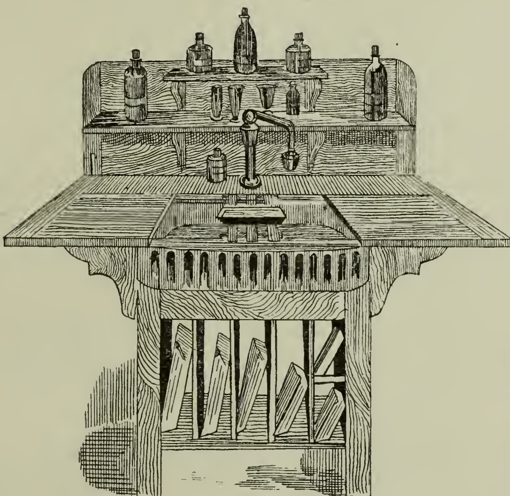
If the image fails to appear in two minutes you may be sure that the exposure under the negative has not been sufficiently long; therefore expose another plate for twice the time. These trials, when he knows why he makes them, and what to expect, tend to give a student confidence in the materials at his command. Supposing the image has come in sight gradually in about a minute after applying the developer: the action may be allowed to proceed for about another minute, and then it is advisable to examine the intensity of the image by looking through it at the yellow light. For this purpose the plate may be lifted (by its edges) from the developing tray and held between the eyes and the light. If the image looks weak, it is necessary to continue development; but if it looks dark, and full of detail, it may be rinsed and then fixed. In order that the student may form some idea as to the requisite density of the image, we advise him to examine the accompanying transparent positive under the same conditions as the plate he is developing, that is, by looking through it at the yellow light. Of course some allowance must be made for the creamy opalescence of the plate he is developing, which will increase, to some extent, the apparent vigor of the image.

We advise the student to make one or two trials that he may think incorrect; thus, carry development *considerably* farther than appears to be necessary, then fix the plate and judge of it by daylight. Stop development at the apparently correct time and fix the plate.

A valuable lesson will be learnt by comparing the results;

it will be seen that the image loses considerable vigor when the chloride of silver has been fixed out, and nothing left save the image and a thin film of transparent gelatine.

Another thing to be borne in mind, too, is this: the resulting picture is to be viewed by transmitted light—that is by light passing *through* it—not by reflected light, as ordinary pictures, so that we cannot judge accurately of the image as it appears to us while the plate is in the developer.



*A well-fitted Development Sink*

If we did so, and fixed the plate directly we saw an image upon it, the result would be almost clear glass with barely a trace of an image discernible on it. That is why we must examine the plate by allowing light to pass *through* it.

When we have decided that the plate is sufficiently developed, we must rinse it under the tap for about a minute, to free it of all adherent developer, and then place it film upwards in the fixing bath.* The plate may be examined in about five minutes, when the back (or glass side) will be

* If an ordinary tray be used. If the trough on page 30 is adopted the plates may be placed film down without injury.

observed to be almost entirely free of the creamy appearance it possessed before being put in the fixing bath.

This appearance proves that the hypo is dissolving the chloride of silver, and that everything is going on well. The plate must be returned to the fixing bath (even if quite clear) until it has had a total immersion of fifteen minutes.

After the plate is fixed it may be examined in white light, which can no longer exert any influence upon it. Then wash in running water for at least an hour. This may be done either in a special grooved trough sold for the purpose (which will hold about two dozen plates at once), or by putting the plate, film upwards, in a tray under the tap, letting the water run for an hour, or an hour and a half.

When the plate is sufficiently washed there will probably be a slight deposit upon its surface, due to impurities in the water. This must be removed thus: take a wad of cotton wool and wet it under the tap, then (still letting the water run on the plate, while you hold it in the left hand) firmly, but gently, pass the cotton wool from end to end of the plate, being particular to wipe it all over. A final rinse under the tap will remove all particles of cotton, and the plate may then be put away to dry in a place free from dust.

The best way to dry a plate is, at least in our opinion, to drive a couple of tacks in a wall (say three inches apart) and hang the plate between them with its back (glass side) resting flat against the wall, one of the corners being downwards. In this way a lantern plate should be thoroughly dry in a very short time.

We have mentioned other methods of exposure besides daylight. One capital plan (which has the advantage of being always constant) is to use magnesium ribbon. A sufficient exposure may be given to a lantern plate by burning one inch (more or less) of ribbon at a distance of three feet from the negative.

Gas or lamp light may also be used, but they necessitate an exposure of from thirty to ninety seconds at one foot from the negative—more or less according to the size of the flame Of all illuminants we much prefer magnesium ribbon for this purpose.

# CHAPTER VI.

## THE OUTFIT.

BY the time the student has overcome the difficulties of development, and has, to a reasonable extent, mastered the lesson contained in the last chapter, he will naturally be anxious to make his own negatives. If he is able to develop a lantern slide plate with any degree of accuracy, he may with safety make up his mind to buy a camera, and take up photography in earnest. The worst trials are over, and any future difficulties he may have, will only add zest to his pursuit.

The choice of apparatus requires deep consideration, and that is why we have gradually led the student up to the mystery of development.

Had we not done so, it is probable that the first purchase would have been a cheap and useless outfit, which would be cast aside in unspeakable disgust, after a few blundering trials, accompanied by unaccountable failures.

But now the student has sufficient insight into photography to know whether he will care to follow it up with enthusiasm, or to drop it, or only to dabble with it by fits and starts.

If the latter be the case we advise him to buy a small, moderately cheap, complete outfit which, for a size of $3\frac{1}{4}$ by $4\frac{1}{4}$ inches (commonly called "quarter-plate"), may be bought for about 35s. or 40s. This price includes a single lens, a camera, one dark slide (to carry two plates), and a tripod.

If, on the contrary, he is determined to take up photography as a favourite hobby, or for illustrative purposes, we strongly recommend the purchase *(at first hand)* of a perfect set of appliances. No matter what size is decided upon, let each article be the very best obtainable.

Let us now consider the matter of size, as suited to individual requirements. An artist who simply wishes to utilize photography as a rapid means of sketching "studies"—whether of still, or animal life—may find a quarter-plate camera sufficiently large for his purpose, and this small size has several advantages, that it will be well to consider. In the first place it is light and easy to carry; the camera, tripod, lens, and a dozen plates in holders, only weighing four or five pounds. The cost of such small plates is necessarily very low (about 1s. a dozen), and the cost of paper, mounts, developer, and everything else, is in the same proportion. Then, again, if a picture should prove of extra interest, and larger copies be desirable, the negative may be sent to one of the firms undertaking such work, who will supply an enlarged negative (of almost any dimensions) at the cost of a few shillings. Or, if only one or two large prints be required, the negative may be sent to a trade enlarger, who will make any sized prints from it at a low charge. Lantern slides may be made by *direct contact*, as described in chapter v. These are a few of the advantages of a small sized camera, but in our opinion there is but one size worthy the attention of any but painters or portrait photographers, and that is the one known as whole plate.

The whole-plate camera accommodates plates 6½ by 8½ inches in size, and is, without doubt, far and away the most serviceable size that is made. It is sufficiently large to produce pleasing pictures, without further enlargement; the weight of such an outfit, with six plates ready for exposure is not more than can be carried comfortably. The plates cost about 4/3 a dozen, and the photographer using such an outfit, and carrying six plates for the day's use, is more likely to bring back six pictures than is the man with the small outfit and larger number of plates.

The man with the small outfit is too prone to think "the plate only costs a penny, and I have a dozen to use during the day." The consequence often is that his plates are rapidly used, and when a really striking arrangement of scenery appears before him, he has no plate left to secure it.

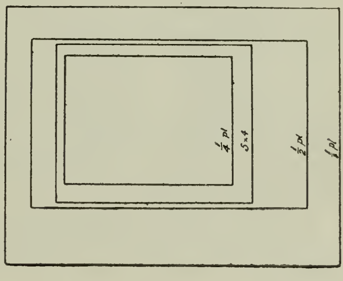
Not so with the other; he is cautious of his plates—not on account of their cost, but because he carries only six—hence each composition is very carefully considered, and no exposure made without due thought.

The pleasure of developing a large negative is infinitely greater than that of a small one, and the resulting prints are more pleasing If enlarged negatives are desired they can be as readily made from whole-plate as from quarter-plate, and enlarged prints can be made with the same facility.

Lantern slides can also be made from them by reduction by almost any trade printer. We shall treat of these subjects fully in our advanced handbook.

We have said that for artists, journalists, and landscape photographers, we only recognise the use of two sizes of cameras; let us now explain why. In the first place observe the following stock shapes and sizes of plates taken by cameras already in the market, the diagrams of which are drawn to scale. It will be observed that the 4 × 5 size varies but a little from quarter-plate, yet the cost of outfit and materials is considerably higher and the extra weight is, of course, appreciable. The half-plate size is a pretty one, but the negatives are too large for making lantern slides by contact printing, and are rarely large enough for decorative purposes, neither do they reduce nicely to lantern plate size. Such a size would be useful for artists' studies, but the weight of the outfit is far in excess of the quarter-plate, with no corresponding advantage.

The same remarks apply to 5 × 7. But when we come to the whole-plate we at once realise that here is a shape having vast possibilities, most of which we have already pointed out. We need only add that we may, of course, produce long and narrow pictures, with such an outfit by printing upon paper of the desired shape, when only part of the negative is wanted.




Further, by means of interior "carriers" it is possible to expose plates of small size (anything from quarter-plate, in fact) in a whole-plate camera, so that it is not necessary to spend money on large plates, until a fair degree of accuracy in judging exposure and development has been attained.

Going on now to the next size larger there will be observed no advantage in the 8 × 10 size, while the cost of both outfit and materials, as well as the weight, is very materially increased.

The 10 × 12 and larger sizes are in our opinion useless, unless we have servants to drag them around for us.

It will be gathered from the foregoing that the choice of camera and other apparatus will now chiefly depend upon the amount of money at disposal.

If this is small, then our advice is, by all means buy a quarter-plate outfit, but buy the best one possible.

If money is not a serious object buy the best whole-plate outfit in the market. On no account buy a cheap and nasty set.

A photographic camera in its simplest form is a dark box which forms a receptacle for a sensitive plate. The only light admitted to this box is through a lens which projects a more or less luminous image of the objects within its field.

The projected image falls upon the sensitive plate, and impresses it in a moment with an invisible image capable of development. This image is the negative (or reverse) of that seen in nature, owing to the action of light (combined with development) causing a deposit of black metallic silver.

Such deposit is greater in the parts most acted upon by light, as has been explained in previous chapters.

The modern camera consists of a dark chamber, the sides of which are made of collapsible light-proof bellows.

The front, back, and base, are rigid, and are usually made of mahogany.

In these respects all modern cameras are alike; but the better class are provided with various movable adjustments, absolutely necessary if first class work is to be done.

The principal adjustments are "rising front," "double swing back," "reversible back," and "double extension"; and the purchaser should insist upon his camera being provided with these movements, the use of which we shall describe in chapter viii. Finally, the camera should close into small compass.

Fanciful adjustments, such as "swinging fronts," are useless, and only entail the use of a bewildering number of highly polished brass screws, which prove a source of constant worry.

The bellows should be made of morocco leather, and the best ones are now usually made somewhat conical in shape. To some extent this shape is an advantage, but we must not go to extremes and have a bellows that is very small in front (lens end), or we shall find that part of our view is cut off by the intermediate ridges obstructing the free passage of the image projected by the lens.

Another point worth attention is the way the rising front works; this front is designed to carry the lens, and must be movable up and down at will. In the best forms of camera the bellows front is attached to the rising front, so that both move together, but in some forms the rising front is movable, while the bellows front is permanently rigid: this is bad, because it greatly limits the use of the rising front. The purchaser should buy his goods from a dealer whom he knows, and mention the foregoing requirements; he may then depend upon being served satisfactorily with a thoroughly reliable outfit. We need hardly advise the beginner on no account to buy second-hand "bargains," or "bankrupt stock"; such traps are often laid for the unwary, and cause much trouble, loss of money, and ultimate disgust with all things photographic.

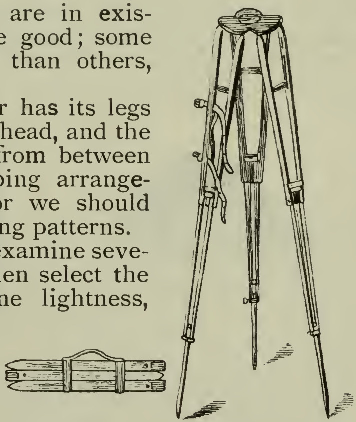
Some cameras are provided with a very convenient arrangement called a "turntable," into which the tripod legs fit. This does away with a tripod head as well as a tripod screw, but is not really a necessary adjunct.

Most cameras simply have a screw-hole lined with a brass bush at the bottom of the baseboard; by this means the camera is screwed firmly to the head of the tripod when in use.

Many varieties of tripod are in existence, and most of them are good; some are a little more portable than others, while others are more rigid.

The one we use and prefer has its legs permanently rivetted to the head, and the lower legs slide in and out from between the upper ones; the clamping arrangement is especially firm, or we should prefer one of the many folding patterns.

We advise the student to examine several patterns of tripod, and then select the one that seems to combine lightness, compactness, and rigidity; in this matter your dealer should give you valuable help. One other small attachment (and a very important one) is a circular-level, which may be fixed to the top of the camera back, near to the handle. The use of this level will be explained, though it will probably be obvious to all. The lens must be attached to the front of the camera (which is bored for the purpose), and the junction between the lens collar and the woodwork must be filled with putty, or other substance, so as to exclude extraneous rays of light.



CLOSED. OPEN.

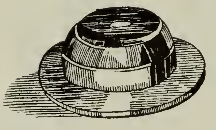
*A Folding Tripod.*

The ground glass in the focussing screen at the opposite end of the camera, must be of the finest quality, and almost entirely devoid of granularity, in order that the image may be properly focussed.

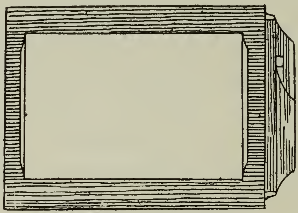
The reversing back is a simple arrangement, whereby a plate may be exposed in either a vertical or horizontal position at will, and the change should be effected almost instantly; this does away with the old clumsy method of unscrewing the camera from the tripod head, and screwing it down again in another position.

Double extension provides for the use of either short or long focus lenses, and in a whole-plate is an absolute necessity.

Most modern cameras are built to accommodate lenses of widely different foci; as a general guide a whole-plate camera should be adapted for use with lenses of from five inches to twenty inches focus—such an extension will provide for extreme requirements. Another feature to note in choosing a camera is to see that the focussing is effected from the front, *i.e.*, that the front of the camera is movable, while the back parts (containing the focussing screen) is stationary. In some cameras the focussing may be effected from the front, and the back *also* is movable; when using lenses of



*Circular Level.*



*Double Dark Slide.*

short focus this is a great advantage, as it avoids any possibility of the front of the base-board coming within the field of the lens.

The sensitive plates are carried ready for exposure in a small light-tight chamber. The plate lies flat in this chamber, and its face is covered by an opaque lid or cover, sliding in grooves. This chamber fits tightly on to the back of the camera in the same position as was occupied by the ground glass, and enables the photographer to insert the plate into the camera, and withdraw the protecting cover from the outside, without admitting light.

The lens is covered during this operation, as will be explained; of course, directly the lens is uncovered, the image falls upon the plate, until the lens is again covered, this constitutes the exposure; the cover is then replaced over the exposed plate, so that it can be removed from the camera. These chambers each carry two plates, and are known as "double plate-holders," or "double dark-slides."

We have but little to say regarding the lens in this chapter, as the principles of its action are of sufficient importance to receive consideration in a special chapter; we shall here simply content ourselves by giving a word or two of advice as to the lens best adapted to amateur requirements.

For all ordinary purposes of photography, including outdoor groups and portraits, general views, and copying work, what is known as a single landscape lens is quite good. If we wish to photograph buildings the full size of the plate, we cannot use such a lens, otherwise the chief lines will not be absolutely rectilinear; the cause will be found in the next chapter.

For such subjects we must make use of a "rapid rectilinear" lens which, being a doublet, will cost considerably more than a single lens. For interiors of rooms, where it is necessary to include a very wide angle of view, we must use a lens of extremely short focus, commonly known as a "wide-angle" lens.

A wide-angle lens should *never* be used where it is possible to do the work without it.

If only one lens can be afforded, we advise the student to buy a "rapid rectilinear" (just large enough to cover the largest plate he intends to use) which is the best general lens for all-round work that he can have. By simply removing the front combination of such a lens, it is at once transformed into a single lens of about double the original focus; that is to say, will require double the distance that was required with the double combination to intervene between lens and plate. The extension of focus (as will be explained) narrows the field of view, and consequently projects an image on a much larger scale—a valuable power in the hands of a photographer. With our own whole-plate outfit we possess only two lenses, yet we have practically a battery at our disposal. One of them is a rapid rectilinear of 11 inches focus, the back combination is 17 inches focus and the front combination (which may be used in place of the back one when necessary) is 21 inches focus.

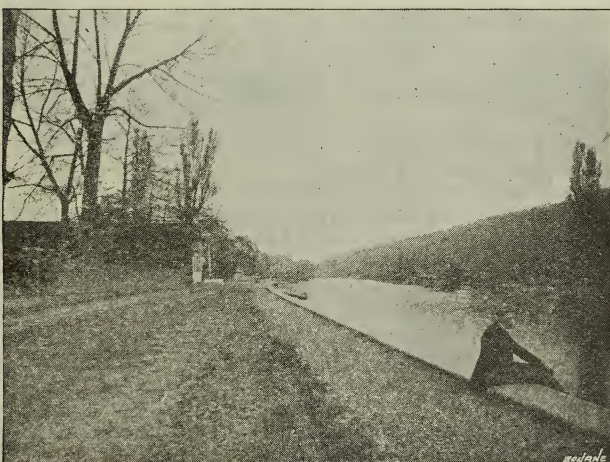
The other lens is a wide-angle doublet of five inches focus, which, by removing one combination, gives us a single lens of about 9 inches focus. It will thus be seen that from one standpoint, by simply altering our two lenses, it is possible to obtain five different renderings of the same subject. This will be made clearer to the student in the chapter dealing with lenses. We only mention it here to show what

*Taken with a 21-inch Combination of 11-inch Rectilinear Lens.*

*Taken with 17-inch Combination of 11-inch Rectilinear Lens.*

**These four views of the same object were taken**

*Taken with* 11-*inch Rectilinear Lens.*

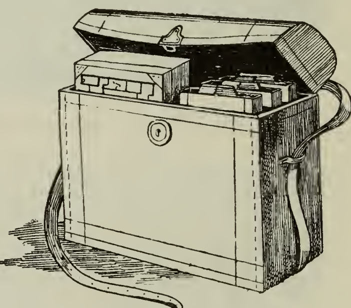


*Taken with* 5-*inch Rectilinear Lens.*

**from one standpoint, the lens only being changed.**

can be done with two lenses, and we may add that, speaking as professional photographers, we consider these lenses quite ample for general purposes.

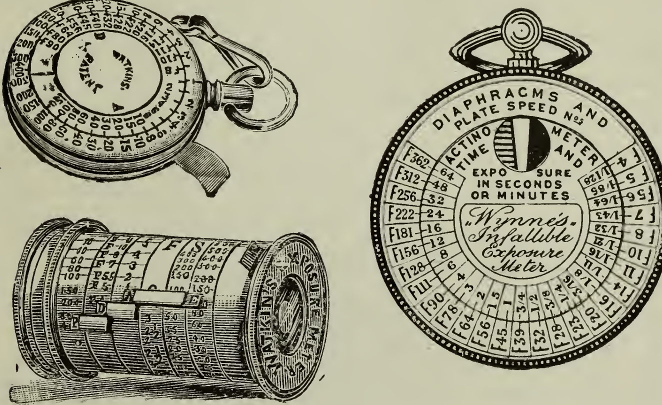
Of course a focussing cloth will be required, as by its means we exclude outside light from the surface of the focussing screen while examining and focussing the image upon it. Various materials have been recommended for this purpose, including a very thin class of waterproof cloth. While we must admit this is useful for covering the camera during a shower of rain, we cannot say we like it for focussing. It is too light and too easily blown from the head and camera during even a slight breeze. Broad cloth is very nice but is too heavy for general use, and we think that after all there is nothing equal to a liberal square of dark blue or dark green velveteen. Ours is of dark blue, and while not obtrusive in any way, it has the advantage of not being funereal in appearance. Velveteen is sold in widths of 27 inches, so three yards divided and sewn together along its length will provide us with a cloth between four and five feet square. Of course a much smaller one will be large enough for use with a quarter-plate camera.


*Carrying Case.*

A carrying case in which to pack the camera, lenses, plate holders, and focussing cloth will be necessary to complete the outfit; we have seen some cases that also accommodated the tripod, and they were very handy to carry owing to their length and thinness. Some cases are much too bulky and cause inconvenience by bumping against the legs of the person carrying them.

We have often seen two cases recommended—one for the camera and one for the plate holders—which of course means that the tripod must make a third parcel, even if one of the cases will accommodate the lenses. This plan is a good one if there are two people to carry them, but we have two such cases and find them far more inconvenient than one long case, that will take the camera and slides (end to end) together with the tripod and other apparatus. The best material for these cases is "mail-canvas," and is similar to that of which the government mail-bags are made. The case should be well lined with baize or other soft material, and should be provided with a first-class lock. This latter precaution will be appreciated if the luckless student be ever fated to leave his camera and exposed plates to the tender mercies of continental hotel servants.

Two useful additions to the outfit of a photographer going in for general work, are an exposure meter and exposure note-book. Personally we do not use a meter except on rare occasions, as we have learnt by experience to know the




*Exposure Meters.*

correct exposure for most subjects that come within our practice. But we must frankly admit that, on the rare occasions mentioned, we have found an exposure meter of inestimable service. We strongly advise beginners to procure one of reliable make, and learn how to use it promptly; when once it is mastered, it will take but a few seconds to estimate an exposure and will undoubtedly save the loss of many plates. The exposure note-books are all more or less ruled upon the same lines and contain spaces for recording the number of negatives, number of dark slide holding the plate, make and speed of plate, lens, stop, light and exposure, as well as space for remarks to assist in development.

We recommend the student to complete the record by adding notes as to the mode of development and appearance of the image, whether correctly exposed or not, and so on; in this way the note-book will become a most useful book of reference.

Before finally deciding upon the lenses he will buy, we must ask the student to read carefully the following chapter.

# CHAPTER VII.

## FACTS ABOUT LENSES

NO part of his outfit puzzles the average photographer so much as the lens, and ignorance of some of its simplest properties exists even among advanced workers. This seems to be because the elementary principles have not been carefully explained, and because the meaning of a few technical terms has not been learned.

There is a great deal of "superstition" about the lens, and many fallacies are believed about it; but its operations are based on the unchangeable laws of the universe, and the first of these is that "like causes, acting under like conditions, produce like effects." If photographers would always realise this, they would meet fewer difficulties.

To understand the principles of the lens it is well to do a little experimenting with a pin-hole; for the fundamental laws are the same in both cases.

Take your camera, screw out the lens and put in its place a piece of tin or fine card-board through which you have made a hole with a fine brad-awl or a darning needle. Go into a fairly dark room and place a lighted candle with the centre of its flame three inches from the hole (which we will now call a pin-hole). Adjust your camera so that the ground glass screen is three inches from the pin-hole, and you will be able to see on the screen an image of the candle-flame exactly the same size as the original flame, but inverted. Why is it inverted? Because light proceeds in a straight line (Fig. 1); and cannot work round corners (Fig. 2).

Fig. 1.

Fig. 2

If this is not clear at once, think it over until it becomes so. Then remember it is a *law*, applying to church steeples and maiden aunts as well as to candle flames, and that this is the reason why the lens image is inverted—no witchcraft about the lens.

Let us now put our candle in a lantern or behind a piece of tin or card-board having an opening an inch square covered with a piece of ground glass or waxed paper. When this illuminated square is placed opposite the pin-hole and three inches distant, it will throw upon the ground glass screen, if that is also three inches distant, an image exactly one inch square. Why is it exactly one inch square? Because light travels in straight lines, thus:

Fig. 3.

and not in bent lines thus:

Fig. 4.

or thus:

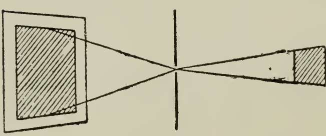


Fig. 5.

If we now move the ground glass screen to six inches distance we shall find that it bears an image occupying four square inches, or two inches by two. The reason seems obvious, for we double both the length and the breadth of the image. We shall observe moreover, that the image in this case is much less bright than it was in the previous case, Fig. 3.

In fact, it is exactly one-fourth the brilliancy, and for a very simple reason. We have done nothing to increase the amount of light passing through the pin-hole; but we have

Fig. 6.

made it cover four times as much space. This applies with lenses also, and is the basis of one of the most valuable but least understood of all the laws relating to lens work.

Let us return to our naked candle flame; still leaving it three inches, and the ground glass six inches from the pin-hole, and we shall see that the image of the candle flame is just twice as long and twice as broad as when the ground glass was three inches distant. It is also just one fourth the brilliancy of the former image.

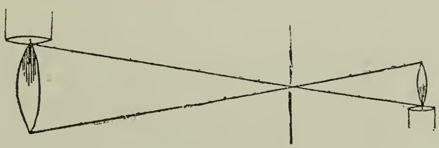


Fig. 7.

Let us now move the candle flame to a distance above the pin-hole; still keeping it three inches from the front of the camera The image will fall towards the edge of the ground glass, instead of in the centre, and we shall notice that the image

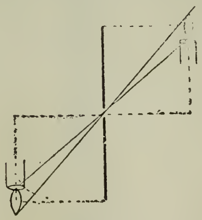


Fig. 8.

looks longer and narrower on the ground glass than it would appear if viewed by the eye placed at the position which the ground glass occupies. The reason for this is the angle at which the image falls upon the ground glass surface, and in order to obtain an image more truly approximating what the eye would see, we might have the ground glass curved, as shewn by the dotted lines. But better still if we can remove the candle to six inches, and the ground glass to six inches from the pin-hole. This will give us the image in the same relative position on the ground glass, and of (approximately) the same size, but in better proportion.

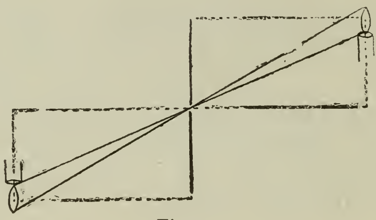


Fig. 9.

Suppose now, in place of the very small pin-hole in a very thin card, we take a hole one-eighth of an inch in diameter in a card one-eighth of an inch thick. The rays from a candle placed at A will pass through easily. If we remove the candle to B only a small pencil of rays will pass through, while by moving the candle to C, we prevent any rays from passing through, because no straight line from C can pass through the hole.

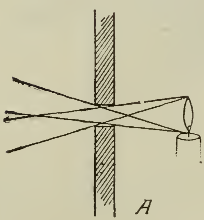



Fig. 10.

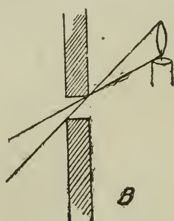



Fig. 11.

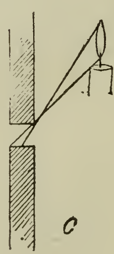



Fig. 12.

If we now make the pin-hole considerably larger, say, a quarter inch diameter, we shall find the image on the ground glass much more brilliant, but much worse defined

This is simply because light rays from the candle proceed in all directions, and while the rays proceeding through the centre of the pin-hole are making a definite image, those passing through the upper part of the hole are making another, while those passing through the bottom and the sides of the hole are all making their own images and the result is confusion.

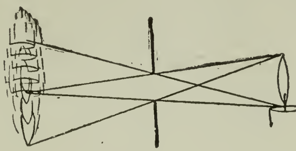


Fig. 12.

As the hole is further enlarged, the image constantly becomes brighter, and constantly more indistinct until it is simply a circular patch of light, with no resemblance to the shape of the candle flame. This would, perhaps, be more easily and clearly understood if instead of the one large hole, four or five-pin holes are made at about a quarter inch distance from a common centre. The blurring of the image will be seen easily; and the large hole acts as an infinite number of smaller ones.

If we return to our original small pin-hole and take the camera out of doors, we shall find that an image of any fairly lighted natural object toward which the pin-hole is directed will fall (in an inverted position) upon the ground glass. If we cover our heads and the back of the camera with the focussing cloth we shall see that the image, though faintly illuminated, is clear and sharp, and if we expose a sensitive plate to this image, an impression is made which can be developed into a negative. But the amount of light passing through the pin-hole is so small that it must act for a long time (*i.e.* we must give a long "exposure") in order to make a strong impression. But in photography we must face the fact that we wish to make our exposures as short as possible, especially when the objects to be photographed are in motion (say express trains or unruly children). This brings us to the problem which led to the use of lenses in photography—the desire to use a big hole, in order to pass plenty of light, combined with the necessity of keeping the image "sharp" and well defined.

The lack of sharpness when the rays passed through the large hole was seen to be due to the want of coincidence between the images formed by the rays passing through the sides, and those through the centre of the hole. We need, therefore, some means of causing the images formed by the outer rays to fall on the same same spot as those formed by the rays passing through the centre. In other words, we want a means to bend slightly inward the outer set of images. The bending of the waves of light is usually accomplished by reflection or refraction, and in camera work the latter is found more convenient. When light passes from a medium of given density into one of different density, its rays are bent or refracted, and a simple example of this is found in the use of a prism. Suppose, therefore, we make our pin-hole much larger than before, allow the centre to be open for the central rays to pass through, and fill the upper and lower part with prisms, what will happen?

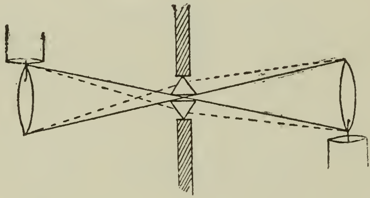


Fig. 13.

The central rays of light will pass through the centre, as before, while those through the top will be bent (or refracted) downward and those through the bottom will be bent upward, so that the three images coincide on the ground glass. We shall need another prism at the right-hand side and one at the left-hand side of the hole, to refract the rays from those directions, and then as four straight lines will not fill a circle, we shall need other prisms in corners between

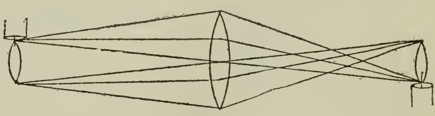


Fig. 14.

those already placed. In fact, we need an infinite number of prisms, arranged round a common centre, and this is simply a lens in a primary form (Fig. 14).

This form of lens has two main defects—its pictures suffer from spherical and chromatic aberration, the nature of which we will attempt to explain, first taking CHROMATIC ABERRATION.

If all the rays were of one color, and therefore equally refrangible, (*i.e.* equally capable of being bent) this simple lens would answer many purposes, but we know when a thin beam of light is passed through a prism the rays are divided according to their refrangibility, and instead of getting a spot of light where the rays from the prism fall, we get a long vari-colored strip of light—a spectrum. The same thing occurs with the lens, for all light is composite in its character, and its violet rays, which are more refrangible than the yellow, will be focussed, and will give a sharp image at a point nearer the lens. As the violet light rays which are dark to the eye are those which are most active photographically, while the yellow light rays (brightest to the eye) are least active we find that we have here two foci (explained later) one called the visual, and the other the chemical or actinic focus. If we place our ground glass screen (or later our sensitive plate) at the point where the visual image is strongest and sharpest, we shall find, on developing the photographic image, that it is feeble and blurred. If we move the screen (and plate) forward until the visual image is somewhat blurred, we shall find that the photographic image, on development, is better defined. This class of truly single lens is sometimes used by photographers of the impressionist school, and they find it necessary, after focussing their image on the screen, to rack in the camera back to an extent ascertained by experiment.

Spherical aberration is rather more difficult to explain. In the last diagram we shewed all the rays from (say) the tip

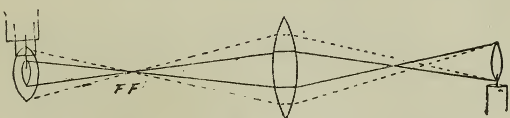



Fig. 15.

of candle-frame, coming to one point on the ground-glass, whether they passed through the centre or the margin of the lens. But this diagram was falsely drawn, merely to illustrate a point in passing; and what actually happens would be better represented by the above diagram, which is, however, grossly exaggerated. It will be seen that the rays passing through the centre of the lens pass through or focus at the point F, while those passing through the edges of the lens focus at F′, with the result that the images formed by the two sets of rays do not coincide; and, as every point in the lens gives a slightly different focus, we obtain on the ground-glass an infinite number of images, just as we did with the large pin-hole in fig. 12. The exaggeration in the diagram consists mainly in the enormous size of the lens, as compared with the size and distance of the objects. In actual work the lens would, as a rule, be much smaller (relatively). It will at once occur to the reader that by covering up the outer rim of the lens, and allowing only the centre to act, we shall have a greater sharpness of the image, just as we did when the pin-hole was small. But this image will not be so strongly illuminated.

Fortunately both chromatic and spherical aberration can be largely prevented by comparatively simple means. If, instead of using one single lens ground from one piece of glass, we make it of two pieces of glass, which differ suitably in their refraction of the violet and yellow rays, we can make the two sets of rays focus at approximately the same point. In the same way, while the form of lens we have illustrated makes the marginal rays focus nearer than the central or axial rays, a different construction would cause the axial rays to focus nearer than marginal. By combining two glasses, possessing the opposite properties in the right proportions, one will correct the other to a practically sufficient extent; and with this lens of two glasses we obtain what we desire, viz., a sharp distinct image, using all the rays that can pass through a comparatively large hole. In other words we are able, with a comparatively short exposure, to obtain an image free from chromatic and spherical aberration.

This form of lens, made from two glasses (usually a crown and a flint glass) is commonly spoken of as a "single" lens, and is also called an achromatic, or a landscape lens,—achromatic, because its chromatism (or chromatic aberration) is cured; landscape, because of its ordinary use. Even with such a lens the correction of the defects mentioned is relative, and not absolute; so we introduce a "stop" or "diaphragm" to cut off some of the rays, and use only a portion of the centre of the lens for the central rays, while the marginal rays can only pass through the margin of the lens. Thus we make a compromise, sacrificing something of our light (and rapidity of exposure) for extra sharpness of image. And as circumstances vary, so that at one time sharpness of image, and at another time shortness of exposure is the more important, the lens-makers provide a series of "stops," so that the photographer may use a large or a small one, as circumstances require.

This form of lens is exceedingly useful for all ordinary landscape work, groups, and portraits, but it has certain defects which become very apparent when we use it for copying plans, or for photographing buildings and other objects, in which there are straight lines near the edge of the picture.

CURVILINEAR DISTORTION is the chief difficulty in this direction, and though it is rather difficult to explain, we may be able to make it fairly clear by an exaggerated example. We

Fig. 16.

may say that the defect is introduced by the stop or small aperture that we provided to remedy the aberration just mentioned. This stop cuts off the rays proceeding from the corners of the house to the centre of the lens, so that the image of corners and outer lines is formed entirely by rays passing throught the outer portions of the lens, while the image of the central part (say, the top of the door) is formed almost entirely by rays passing through or near the centre of the lens. The outer part of lens deflects the rays most strongly, so that the width and height of the house become diminished in proportion to the width and height of the door which is near the centre; while the corners are deflected more strongly than the centres of the walls, because they are more distant from the lens centre.

CURVATURE OF FIELD is another difficulty with lenses. In our diagrams of the candle-flame we have represented the image as coming to a focus on a plane surface, as a flat ground-glass screen. As a matter of fact this does not happen, but the image comes to a focus on a curved field. The line C C represents such a curved field, and it will be at once seen that if the plate (or ground-glass) is placed at A, the central part of the object will be sharp, while the top and bottom of the candle-flame will be out of focus. If the screen is placed at B, the top and bottom of the image will be sharp, while the centre will be out of focus. The best effect is obtained by placing the plate between these two points.

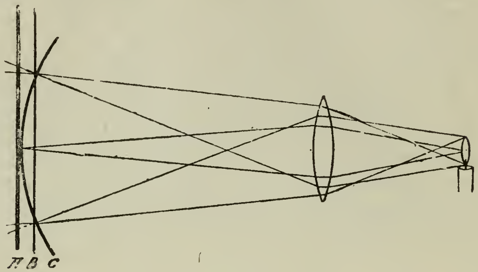



Fig. 17.

Fortunately, as in the case of aberration, this distortion and curvature of field can be largely overcome. While a single lens with the stop in front of it gives barrel-shaped distortion, the same lens turned round, with the stop behind it, will give the reverse, or pin-cushion distortion, thus:—

Fig. 18.

and by combining two such lenses and, placing the stop between them, we form a "rectilinear" or "doublet" lens, which gives straight lines right to the margin of the picture. In the same way, while a single lens of given construction gives us curvature of field in one direction, concave towards the lens, the same lens turned round will give a curvature of field convex towards itself. Thus the rectilinear or doublet form cures two distinct defects of the single lens. Here, as in all problems of practical optics, the result is relative, rather than absolute, for we almost invariably find that in gaining a given advantage we have to put up with a corresponding disadvantage; so that the whole science of lens-making is a series of compromises.

The single lens and the doublet, which is also called the rectilinear or the symmetrical, are the two main types of which all photographic lenses may be said to be modifications. As the rectilinear lens consists of two single lenses, mounted at opposite ends of a tube, it is possible to screw out one of the singles and use the other. In this case the single lens is about double the focal length of the doublet of which it forms a part, so that the rectilinear can be used for two distinctly different purposes. If the front combination is used, it will have a slight tendency to "pin-cushon" distortion, while the back will give slight distortion of the "barrel" type.

There is little more to say of the general construction of the lens, until we come to a more advanced hand-book than this, but there are one or two points in working that must be made clear.

First is the question of FOCUS and FOCAL LENGTH. We saw, with the pin-hole, that the image was, to all intents and purposes, equally sharp, whether the ground-glass was three inches or six inches distant. In this case the rays of light from the object passed through a hole so small as to be practically a point. With the lens it is different, as we have seen; for, in order to get the image sharp, we must place the ground-glass at the point where the rays from the centre and from the sides of the lens meet, or focus (see fig. 17). The distance between the centre of the plate, and the centre of the lens when in this position, is called the FOCUS, or the FOCAL LENGTH of the lens. Though this is not a scientifically correct statement, it is near enough for practical purposes, and is what is commonly used. It is not quite so easy to measure the focal length of a doublet as of a single lens, though for practical purposes it may be obtained by focussing on some distant object, and measuring the distance from the diaphragm aperture to the ground-glass. Opticians do it in a different way, and speak of the EQUIVALENT FOCUS. This means the focal length that is equal to that of a single lens giving an image of the same size as is given by the doublet.

We have seen that, with a pin-hole, the distance between pin-hole and screen greatly affects the brilliancy of the image (pages 50-51). In the same way with the lens. If we have a lens of (say) one inch diameter, throwing an image on a screen eight inches distant, the image will be just four times as brilliant as it would be if thrown on a screen sixteen inches distant. And as the brilliancy of the image directly affects the length of exposure necessary to the plate, the relative size of the lens-opening to its focal length becomes an important factor in calculating exposure. It is, therefore, very necessary to know the size of our "stops" or diaphragms, relative to focal length, and, in order to express this, we measure both. Dividing the focal length of the lens by the diameter of the opening of the stop, we place the result as denominator of a fraction, with *f* as numerator. Thus a one-inch stop in an eight-inch focus lens is *f*/8 while the same stop in sixteen-inch focus lens would be *f*/16. As, using a one-inch stop, the image at sixteen inches distance is only one-fourth the brilliancy of that at eight inches distance, it requires four times the exposure; but stops *marked with the same focal value* require a similar exposure. Or, in other words, the exposure in each case is proportional to the *square* of the *f* number. For convenience the lens-makers mark the *f* numbers on the stops,

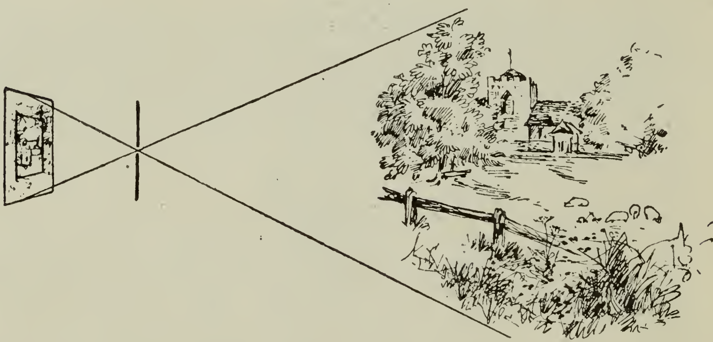


Fig. 19.

and usually arrange them so that each stop requires half the exposure of the next one smaller, or double the exposure of the next larger. They usually run *f*/8, *f*/11·3, *f*/16, *f*/22, &c.

Wide Angle and Narrow Angle. As a matter of fact all lenses are both wide-angle and narrow angle, as well as being both long and short focus at the same time. We state this apparent paradox because it is very necessary that the student should fully understand the matter, if he is to be the master, and not the slave of his instruments. Suppose we have here a lens of nine inches focus, throwing an image upon a half-plate ($6\frac{1}{2} \times 4\frac{3}{4}$ inches). We should call it a medium-angle lens. If, however, we are only using it for a quarter-plate ($4\frac{1}{4} \times 3\frac{1}{4}$ inches), we should call it a narrow-angle lens; while, if we used it for a plate twelve inches by ten, it would be a wide-angle. On the quarter-plate it would be a long-focus, while on the twelve by ten it would be a short-focus lens. The terms wide-angle, short-focus, etc., are relative, not absolute; and depend upon the focus of the lens in relation to the plate it is covering. The ordinary rectilinear lens has usually a focal length about equal to the diagonal of the plate it is intended to cover; and a lens of focal length appreciably longer than the diagonal of the plate, is called a long-focus or narrow-angle lens, for the two terms are interchangeable.

From this it might seem that long-focus or short-focus lenses can be used indifferently and interchangeably, but this notion has its limits. While it is true that any nine-inch focus lens covering a 12 × 10 plate is a wide-angle, it is also true that many nine-inch focus lenses will not sharply cover a plate of that size. A rapid rectilinear is usually constructed to work with a stop as large as $f/8$; while the wide-angle usually has its largest stop $f/11{\cdot}3$ or $f/16$. Although a wide-angle lens will always cover a smaller plate than that for which it is intended, a narrow-angle will not always cover a plate much larger than that for which it is made. And, although the wide-angle can always be used as a medium or narrow-angle on a plate smaller than that for which it is intended, it will not allow of such extremely rapid exposures as could be made with a medium, or narrow-angle lens.

All other things being equal, it is better to employ a medium-angle than a wide-angle lens; because, with the latter, the images of things near the edge of the ground-glass (or sensitive plate) are in a strained or distorted perspective, for the reason explained in figs. 8 and 9. If it is necessary to have the image of a good size, and impossible to get far away from the subject; it is often absolutely necessary to use a very wide-angle lens.

The instructions in this chapter, if once fully grasped, will give a fair working knowledge of the properties of the lens. There are many more advanced points that must be left for a later book, and some of the applications will be treated in succeeding chapters.

# CHAPTER VIII.

## HOW TO USE THE OUTFIT.

*Requirements* :—One box gelatino-bromide "Ordinary" plates (cost quarter plate 1s., whole plate 4s. 3d.) A box contains one dozen plates.

BEFORE attempting to use the outfit we have described, it will be well to carefully examine it and try a few experiments with a view of becoming used to its various movements. We therefore urge the student to restrain his probable impatience, and postpone the actual exposure of a plate until he has acquired some dexterity in setting up his apparatus and focussing an image upon the ground glass screen. He will thus ensure almost certain success with his first negative, and this will always be a matter for self-congratulation in after years.

If the student follows our advice, and buys his outfit from a dealer whom he knows to be reliable, he will have all the various movements pointed out to him and briefly explained. Such a practical demonstration—even if confined to a half-hour—will be of lasting benefit. If there is no chance of such instruction, the student must first of all carefully overhaul the camera and master its intricacies for himself. As we have already pointed out, all modern cameras are made in a portable form, and consequently fold up into small compass. We must first release the milled screws upon each side of the camera by giving them about two turns from right to left and then look carefully for the spring stud (or, perhaps, folding hooks) by which the camera is closed. This will usually be found upon the top edge of the camera near to the leather handle. Upon releasing this fastener, the camera will open from the centre.

The focussing screen (*i.e.* the ground glass) must be held in an upright position while the piece of polished wood (which is in reality the base-board) is allowed to gently fall until it is at right angles to the glass screen. When it arrives at this position it may be clamped by means of two milled screws, (A, Fig. 2) which will be found one on each side of the upright part of the camera.

The camera may next be fastened to the tripod by means of a brass screw (supplied with it) which passes upwards through the tripod head into a hole in the underneath part of the camera base-board. This screw should be turned "home" until the camera is firmly attached and immovable, then release the screw just enough to permit the camera to be swung round if required.

The tripod legs must be fully extended upon the ground (and firmly embedded therein to avoid slipping) while the camera is being placed in position.

The student will now observe that although the back of the camera is firmly fixed at right angles to the base-board, the

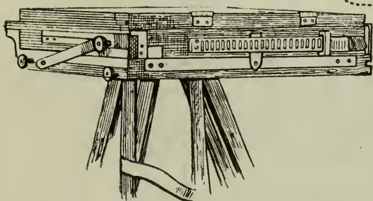


Fig. 1.—*Closed Camera attached to Tripod.*

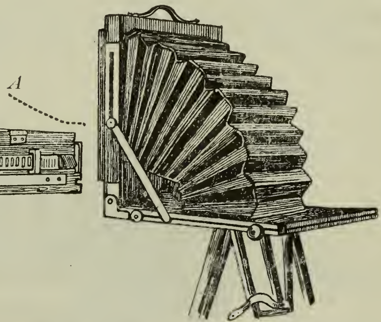



Fig. 2.—*Camera partly opened.*

front of the camera, which is to carry the lens, is still loose. This must now be brought into position, and the manner of doing this varies according to the make of the camera. In some cameras (as in Watson's and McKellan's) the front closes in a somewhat similar manner to the back, and folds face downwards on the base-board. Fig. 2 shows this pattern before the front board is raised. The front board may be lifted by inserting a finger under the end farthest from the upright back. When it has gained an upright position it must be clamped by means of its milled screws.

In some other patterns the front board will be found (together with the bellows) packed upright inside the upright back (ground glass end) of the camera. This may simply be grasped and pulled forward to the end of the base-board and clamped with two screws that will be found upon the *top* of the front board—as is the case in cameras of Hare's make.

Whatever lens the student has chosen, it will be necessary to have it fitted to the front board of the camera. In "complete sets" this is already done; but when separate articles are selected, the front board of the camera is not pierced until required. The best plan is to ask the dealer to have the lens fitted to the board, and he will see that it is properly done. Should the student live in a remote country, he may have to do the work for himself.

If he examines the front board he will find the true centre is indicated by a small dent punched in it, or else by a small cross. He must then unscrew the lens from its *flange* (or collar) and make a hole in the front board just large enough to admit the rim that will be found on the inside of the flange. The flange, of course, is to be screwed on to the board. A circle (the exact size required) should be marked on the board, and then cut out with a fret-saw or in a lathe.

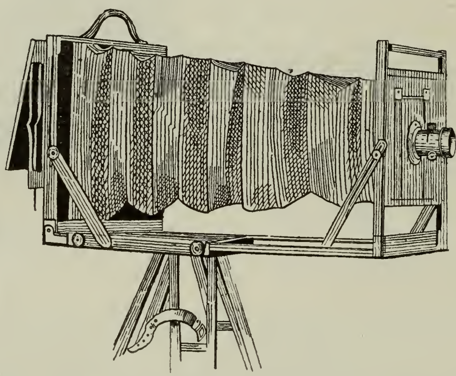


Fig. 3.—*Camera extended for use with Long Focus Lens.*

The part of the lens collar that is to come in contact with the wood-work should receive a thin coating of putty, and be then screwed as firmly as possible to the board. "Rose-headed" screws are the nicest for the purpose.

The lens collar thus becomes a permanent part of the camera, into which the lens may be screwed whenever it is required for use, or from which it may be removed before closing the camera. The extended camera, with lens in position ready for use, is shown in fig. 3.

The student having several times attached the camera to the tripod, and removed it until he can do it readily and almost mechanically, may now attach the lens and take the apparatus into the open-air to learn the use of the swing back (and other movements), and try his skill at focussing.

Let us first examine the plate-holders, and then adjourn to the dark-room and load them with sensitive plates.

We advise the student to *study* the plate holders, and ascertain just how they are to be opened and closed, before attempting to handle them by the dim light of the dark-room. The most generally-used plate holder in England is known as the "book form"; this is hinged at one end, and the two sides, when folded together, are fastened with brass clips. At the end--opposite to the hinges—are two pieces which

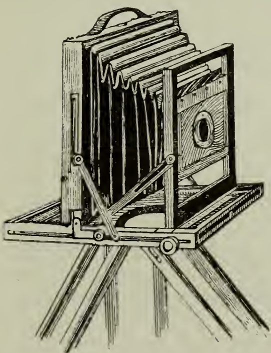


Fig. 4.—*Camera arranged for use with Short Focus Lens.*

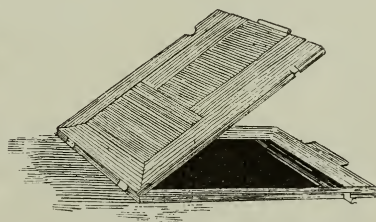


Fig. 5.—*Book-form Double Dark Slide.*

extend beyond the end of the holder, sufficiently far to be grasped between the fingers and thumb. These are the ends of the shutters which protect the plates from light, until we wish to expose them in the camera. The shutters usually have a clip of some kind attached near to the projecting ends, which prevents them from being accidentally withdrawn. Let us now find this clip and release it, and then pull the shutter out as far as it will come; it cannot be *entirely* pulled out from the book form. Now close it again, and test the other side; fasten the shutters again, and undo the other clips so that the holder opens on its hinges. The inside holder is painted a dull black, and is provided with a central metal partition which (in the best makes) is also hinged at one end. In some holders this partition is quite loose, but such loose pieces are only a thorn in the flesh, and should be discountenanced.

Supposing, then, the student has purchased a holder with a properly hinged central partition, he will notice that it lies closer to one side than to the other, and that it is held in position by means of two small clips or "turn buttons." He will also notice a rebate (or ledge) beneath it. The sensitive plate is to rest face downwards against this rebate, and we advise the student to load the holder with a piece of plain glass of the correct size, and then fix it in place by fastening over it the central hinged partition. Then place another plate of glass in the rebate upon the other half of the holder, and close the holder, clamping it together upon the outside.

If the student now withdraws one of the protecting slides he will see the glass plate, and understand at once the entire principle.

To complete this preliminary lesson, it only remains to undo the fastenings of the focussing screen, which is *(or should be)* hinged like a door to the camera, when he will notice a couple of grooves which permit him to slide the plate holder into the space formerly occupied by the screen. This must next be done a few times, pushing the plate holder "home," until it engages with a spring fastener (provided on all cameras), which will hold it in position. The protecting slide must next be withdrawn while the plate holder is still fixed to the camera.

If the student now removes the lens, and looks into the camera through the hole in the front board, he will see that the plate of glass is now exposed upon the inside of the camera, immediately opposite the place to be occupied by the lens.

The student must familiarize himself with all these movements, and then he may replace the lens, empty the plate holder, and load it in dead earnest with sensitive plates. And now, before we open the box of bromide plates, we must bear in mind that we are about to deal with a substance far more sensitive to light than any we have yet handled. The slightest ray of white light will cause a deposit upon the plates that cannot fail to injuriously affect the brilliancy of the negatives we are about to make. Let us therefore redouble our precautions to exclude all extraneous light, and be careful that our lamp only transmits light that will not injuriously affect our work. The lamp should be glazed with one sheet of ruby glass, covered with one sheet of "canary medium," or "canary fabric"; or, if the student has a preference for yellow light, it may be glazed with one sheet of yellow glass, covered with two sheets of canary medium, It is safe to handle some bromide plates by light transmitted through one sheet of yellow glass, and one sheet of canary medium; but we do not advise a beginner to court failure by trying such experiments at too early a stage of his studies. Experiments will be interesting and helpful to him after he has succeeded in doing good work, and will then not be likely to discourage him. We shall have more to say about bromide plates when we deal with their development; in the meantime the plate holders may be filled with sensitive plates, which are packed in the same way as the lantern slide plates dealt with in a former chapter.

The sensitive side of a bromide plate is far more easily determined than in the case of lantern plates, owing to its slightly dull appearance, The sensitive surface must be lightly brushed with a camel hair brush and then put (film downwards) into the holders, so that the opaque partition rests against the glass side; the sensitive side will then be towards the movable protecting slide.

Fasten each plate-holder as you finish loading it and, before opening the dark-room door, be sure and shut the box of plates.

Before taking a negative of any subject, we must set up the camera opposite to it (with the lens pointing towards it) so that the image falls upon the focussing screen. The camera must be adjusted in a level position and then the image must be drawn to a focus. To do this, the student must remove the cap from the lens and put his face within about a foot of the ground glass. He must then cover both his head and the camera with the focussing cloth, and hold it closely together in such a way as to exclude all light except that which coming through the lens, appears upon the screen in the form of a more or less indistinct view of the scene towards which the lens is directed. This image will be upside down, as explained in Chapter VII.

In order to secure a clearly defined image it is necessary to move the lens farther from, or nearer to, the ground glass until it arrives at the position giving a true focus. The student will probably fall into the common error and attempt to look *through* the ground glass in his search for a visible image, but in order to see it he must look *upon the surface* of the glass. It is well to try the first experiments in focussing with the *full aperture* of the lens, *i.e.* without any "stops" or diaphragm; this will help the student by admitting plenty of light and rendering the image more brilliant.

Let us now suppose that the front part of the camera (carrying the lens) is extended as far as it will go, without using the second extension which is actuated by the milled focussing screw. It is just possible that the lens is too far from the screen to give an image of correct focus, so we must release the clamping screws and move the lens-board nearer to the ground glass, at the same time keeping the head under the focussing cloth and closely observing the appearance of the image. If this does not become quite clear and distinct, we must return the lens to its original position and clamp it. We must next resort to the milled screw and turn it towards the lens; this will bring the "double extension" into action, and move the lens still farther from the focussing screen. As the image is gradually seen to become sharper and better defined, it must be watched closely until it finally begins to go out of focus again. At this stage the focussing screw must be turned in the opposite direction until some object in the centre of the screen is at its sharpest possible focus. It will be well for the student to move the lens back and forth till this one particular object is absolutely sharply defined. Upon now turning his attention to the marginal objects he will notice that they are all more or less blurred, or out of focus. The student must now try and divide his attention between the central object and an object in one of the margins of the screen while he very gradually turns the focussing screw first one way and then another: He will now observe that, by the time the marginal point is sharply focussed, the central object is slightly blurred. He must now focus (as nearly as possible) an average between these points and then try the effect of using a "stop." Insert the stop, marked (say) *f*/11, in the place provided for it in the lens; or, if the stops are not so marked, insert the one having the largest opening but one. Then (without disturbing it in any way) again carefully examine the focussing screen. Owing to the action of the stop (which, of course, intercepts a certain amount of light) the image will appear much less brilliant than before, but the general focus will be more clearly defined. The marginal and central objects will appear almost equally sharp, but the student had better try the effect of again using the focussing screw. After racking the lens back and forth several times (letting it slightly pass the point of extreme definition each time) he may try the effect of using a still smaller stop.

By the time he has tried several experiments with each stop, he will note that the smaller stops reduce the luminosity of the image, while they increase its definition. When working with a very small stop, the student will note that he may move the lens back and forth a considerable distance without seriously affecting the definition; thus he becomes able to bring marginal objects into focus, without disturbing the focus of the central ones. We do not intend to attempt to treat photography as an art—that is not within the scope of a simple text-book—but we may mention here that the student will, in the course of his advanced studies, find an enormous field for artistic expression in this power of suppressing or accentuating focus, by means of large or small stops.

We want our student to learn to secure a perfectly focussed image; when he can do that with certainty, and develop his negatives without stains, dust specks, or blotches, he may wander from this book and turn towards artistic photography.

We will suppose that the student has secured a sharply defined image upon the ground glass; he must now examine the circular level which is (or should be) permanently screwed on the top of the camera near the focussing screen. If the bubble is in the centre, all is well, and an exposure may be made. But it is extremely unlikely that the camera has remained absolutely level while the student has been experimenting with it; therefore it must again be levelled. If, after levelling the camera, the image is still in focus, we may expose a plate. First clamp the camera by tightening the screw which passes through the tripod head, then replace the "cap" (or cover) upon the lens so that no light can pass through it; then unfasten the focussing screw and turn it back without shaking the camera.

With the same care to avoid shaking the camera, slide the plate holder (numbered "1" and "2"), with number "1" towards the camera, into the grooves made to receive it. When it has engaged with the spring catch it should be covered with the focussing cloth, so that no direct sunlight can have access to the junction between camera and plate holder. With a firm movement, the protecting slide may now be withdrawn, and, when the camera is perfectly steady, the cap may be removed from the lens for sufficient time to properly impress the plate. With regard to the actual time of exposure, there is no absolute rule to guide the beginner; all depends upon so many factors. For instance, we have to consider the quality of light, speed of plate (whether "ordinary," "rapid," or instantaneous"), size of stop in the lens, and the class of subject; these are all provided for in the commercial "exposure meters." As we desire the student to work under the least harrassing conditions, we shall try to reduce these considerations to a minimum. First of all, therefore, we advise the use of an "ordinary" plate, a small stop (about *f.*/16), an outdoor subject, a good light and a full exposure.

We do this because an "ordinary" plate (being much slower than one of the "instantaneous" class) allows more latitude in exposure; a small stop (admitting less light than a large one) allows a certain amount of latitude also; while an outdoor subject and a good light is far easier for a beginner than anything else. We recommend a liberal exposure, simply because we do not believe it right to urge a beginner to attempt instantaneous work. We might just as well try to teach a child to run or ride a bicycle before he can crawl on all fours.

The frequency with which beginners attempt to do rapid work is a most fruitful cause of failure and disgust, and we regret that so many dealers urge beginners to buy "shutter outfits."

A beginner, with no knowledge of photography, is naturally tempted with the apparent simplicity of such an outfit; he need only "push the button" or "press the bulb," and the thing is done. Let us here offer a stern protest against such a mistaken idea; a beginner should not touch a shutter, or have anything to do with one, until he has thoroughly mastered this text-book. When he has accomplished that, he may turn his attention to shutter work with some probability of success.

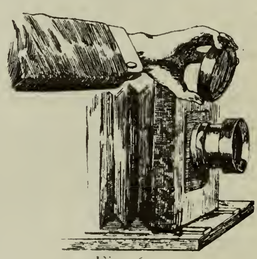


Fig. 6.
*Exposing the Plate.*

To return from this digression, let us suppose that all is ready for exposure. We will presume that the subject is a landscape view, lighted from the side with bright sunlight, the stop in the lens is *f.*/16, the plate an "ordinary" one. Let the exposure be two seconds. In taking the cap from the lens, it is well to gently and gradually move it forward until it is *almost* free, then (without jerking, or shaking the camera) lift the cap upwards, free from the lens and towards the top of the camera.

In this way we avoid the chance of the lens cap coming within the field of the lens and obstructing the view. *Directly* the cap is free from the lens it must be moved completely out of the way, otherwise diffused light will penetrate into the camera and fog the plate within. The lens must be uncovered for only two seconds, then the cap must be firmly replaced, and the protecting slide of the plate holder again pushed in to cover the surface of the plate. The plate holder may then be removed and taken to the darkroom for the plate to be developed; or it may be kept until all the plates are exposed. The plates may be kept after exposure for almost any length of time before development without deterioration. There is no fixed limit; but in our own experience we have kept exposed plates in all climates for six months, without ill effect.

We intend to treat of the development of negatives in a future chapter, devoted especially to the subject; in the meantime we have to say a few words concerning some probable faults in adjusting the camera, and how such faults may be recognised.

In order to make these faults sufficiently conspicuous, we must ask the student to set up his camera opposite a rather high building, and focus it upon the ground glass screen. For this purpose (as we do not intend to expose a plate) it will be well to use the lens at its full opening—without any stop—so that we may have a brilliant image to look at. Now, in order to include the entire building upon the screen it will be necessary to tilt the camera a little so that the lens is directed upwards, rather than exactly level (fig. 7). This will naturally throw the focussing screen (while it is clamped at right angles to the base-board) out of the truly upright position—as will be seen by the plumb line shown in the sketch. The question is: how will this affect the image on the screen?

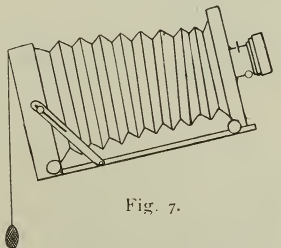


Fig. 7.

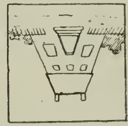


Fig. 8.

If the student will carefully examine the ground glass he will find that none of the upright lines are truly perpendicular, all of them are (owing to the rules of perspective) converging towards the top of the building, which will be found at the *bottom* of the screen. The effect is shown in fig 8.

This unsightly convergence may be eliminated by one simple movement: the levelling of the focussing screen, which is done by means of the swing back.

To bring it into action, we must release the tension of the milled side screws (which hold the back of the camera at right angles to the board) and then push the top of the focussing screen towards the lens until the bubble of the level is in a central position; or a plumb line, as shown in the sketch (fig. 9) may be used; this will indicate directly the screen is "plumb," or upright. When the screw is in its correct position, the screws must again be clamped and the image examined on the screen.

The student will now observe that the upright lines are all perpendicular, but the focus of the image is not equal all over the screen, this is because one part of the screen is nearer to the lens than another.

We can equalise this focus only by very careful adjustment of the focussing screw and the use of a small stop. We advise the student to try several experiments in such focussing, and count the time well spent when he has learnt to set up his camera opposite a high building and focus it correctly on the screen within twenty minutes. When the screen is correctly adjusted, the lines of the building will all appear truly upright on the screen, as shown in fig. 10.

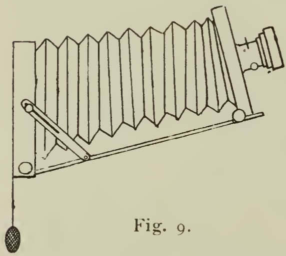


Fig. 9.

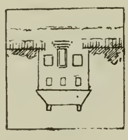


Fig. 10.

It sometimes happens (though not often, unless with a very careless worker) that the back of the camera is set up "out of plumb" in the other direction (*i.e.* sideways) as shown in fig. 11; it is best to remedy this defect by moving the tripod legs—which is easily done if the tripod be properly set up. A variety of opinion seems to exist as to the best way to set up the tripod—many writers favouring the method of having one leg beneath the *front* of the camera and two at the back.

Although at first sight, this may seem the simplest plan, owing to the ease with which the student may approach the focussing screen, we cannot say we favour it at all.

We much prefer to adjust the tripod so that one leg falls exactly beneath the centre of the focussing screen. The camera may then be almost instantaneously levelled by slightly moving this one tripod in one direction or another.

Furthermore, we do not find it cause any inconvenience whatever. In fig. 11 we show the back of the camera with its side adjustment out of plumb; the dotted line shows how easy it may be set right by one movement of the back leg of the tripod.

Sometimes—especially in photographing buildings—there appears to be too much foreground and not enough sky (fig. 12); this may usually be remedied without using the swing back.

The simplest plan is to use the "rising front" (as shewn in fig. 13), which is operated in various ways according to

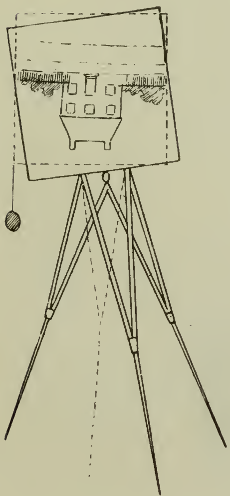


Fig. 11.

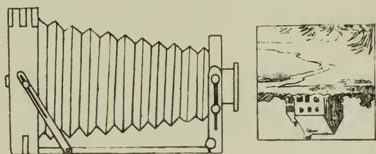


Fig. 12.

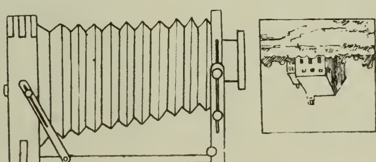


Fig. 13.

the make of the camera. In some the rising front (which carries the lens) is clamped by screws which must be eased a little while the lens board is lifted upwards. The student should examine the image on the screen while he moves the lens, and note the effect. When it is raised enough it may again be clamped in position.

When photographing high buildings, we advise the student to raise the lens front *before* tilting his camera; in this way he will diminish the necessity for using the swing back, and may possibly obviate it altogether.

In some other cases—especially in open landscape---it may be desirable to secure more foreground than appears when the camera is absolutely level. In this case he may *lower* the lens front, by pushing it downwards.

If it becomes necessary to tilt the camera (front downwards) he must still level the focussing screen by pulling it away from the lens and clamping it directly it is perpendicular.

Remember the golden rule: *Always see that the focussing screen is truly perpendicular before exposing a plate.*

# CHAPTER IX.

## STOCKING THE DARKROOM.

HITHERTO we have mentioned only the chemicals that were absolutely necessary to perform the simplest operations, and have even gone so far as to countenance the use of ready-prepared developer. The reason for doing so was that the student need not burden himself with a lot of useless paraphernalia in case he should not care to prosecute a more advanced search into the mysteries of photography.

If, however, he has been enthusiastic enough to buy a decent outfit, we may safely rely upon him being willing to fit out his workroom with a proper assortment of chemicals and apparatus.

We shall give what we consider a sufficiently full list of materials for making negatives, and modifying them by various methods of after treatment, as well as for silver printing. When the student goes on to other methods of printing, he will find it necessary to add a few items to his collection. First of all we advise the student to reserve one shelf especially for stock chemicals, and to avoid keeping any mixtures upon the same shelf.

All dry chemicals should be stored in 4 oz. or 8 oz. wide-mouthed glass-stoppered bottles; liquids should be kept in 8 oz. or 10 oz. narrow-mouthed glass-stoppered bottles, except where otherwise stated.

The following is a useful list:—

### DRY CHEMICALS.

| | | *Approximate cost.* s. | d. |
|---|---|---|---|
| Hydroquinone ... ... | 1 ounce ... | 1 | 0 |
| *Sodium Sulphite ... ... | 1 lb. ... | 0 | 6 |
| *Sodium Thiosulphate ("Hypo") | 7 lbs. ... | 1 | 0 |
| Sodium Hydrate (caustic soda) | 4 oz. ... | 0 | 8 |
| Sodium Acetate ... ... | 2 oz. ... | 0 | 2 |
| Sodium Carbonate (washing soda) | 4 oz. ... | 0 | 1 |
| Potassium Bromide ... | 1 oz. ... | 0 | 2 |
| Potassium Cyanide ... | 2 oz. ... | 0 | 4 |

*Stored in a stoneware jar.

*Dry Chemicals (continued).*

| | | Approximate Cost s. d. |
|---|---|---|
| Potassium Carbonate | 4 oz. | 0 2 |
| Iodine | 1 oz. | 1 2 |
| Mercury Bichloride | 1 oz. | 0 4 |
| *Alum (ground) | 1 lb. | 0 2 |
| Potassium Ferricyanide (red prussiate of potash) | 2 oz. | 0 6 |

*Liquids.*

| | | |
|---|---|---|
| Sulphuric Acid | 4 oz. | 0 4 |
| Acetic Acid | 4 oz. | 0 8 |
| Hydrochloric Acid | 4 oz. | 0 2 |
| Pure Alcohol | 8 oz. | — |
| Methylated Alcohol | 16 oz. | 0 6 |
| Uranium Nitrate Solution | (= 20 grs. per oz.) | 0 6 |
| Gold Chloride Solution | (= 1 gr. per oz.) | 2 0 |
| Ammonia | 4 oz. | 0 4 |

*Apparatus, &c.*

| | | |
|---|---|---|
| Red Litmus Paper | 1 book | 0 2 |
| Blue ,, ,, | 1 book | 0 2 |
| Filter Papers | 100 | 1 0 |
| Glass Funnel, 6 inch | 1 | 0 8 |
| 2 oz graduate | 1 | 0 6 |
| 4 oz ,, | 1 | 0 10 |
| 10 oz ,, | 1 | 1 2 |
| Minim ,, | 1 | 0 6 |
| Chemical Thermometer | | — |
| 2 oz Dropping Bottle | | 0 6 |
| Scales and Weights | | 2 6 |

Granitine Porcelain Trays of various sizes.

All the chemicals named in the foregoing list can be obtained from any reliable dealer in photographic supplies, with the exception of the solutions of gold chloride and uranium nitrate; these must be prepared by the student. Gold chloride is usually sold in hermetically sealed glass tubes containing 15 grains of chloride of gold and sodium; but the contents of most of the tubes are only equal to $7\frac{1}{2}$ grains of pure gold chloride. To make the stock gold solution we must put a few ounces of distilled water in a graduate, and then drop in a tube of gold chloride; crush the tube with

*Stored in a stoneware jar.

a glass rod, stir up the mixture (which will at once become a bright yellow), and add enough water to make 7½ ounces in all.

Uranium nitrate (or uranyl nitrate) is, like gold chloride, extremely deliquescent, and soon becomes liquid if left exposed to air; for this reason it is best to keep it as a standard stock solution of known strength. To make it, add 120 grains of uranyl nitrate to four ounces of distilled water; stir until dissolved, and then make up the bulk to six ounces with distilled water. Each ounce of this solution will contain twenty grains of the nitrate.

A lead-lined sink, such as was mentioned in Chapter IV., is almost a necessity in the dark room; but, for the convenience of those who have mechanical ability, and prefer to make their own fittings, we give particulars of a convenient sink described by Mr. F. W. Cooper in the May 1896 issue of *The Photogram.* After a few preliminary remarks as to the convenience of the arrangement, the writer says:

"The following materials will be required:—

| No. | | Description | in. | in. | ft. in. | | Cost about. *s. d.* |
|---|---|---|---|---|---|---|---|
| 1. Cross pieces | 2 | pieces of deal | 3 × | ¾ × | 3 6 | planed | 0 6 |
| 2. Legs ... | 4 | ,, | 2½ × | 2½ × | 2 6 | ,, | 1 0 |
| 3. Stays ... | 4 | ,, | 3 × | ¾ × | 1 4½ | ,, | 0 7 |
| 4. Shelf ... | 1 | ,, | 6 × | ¾ × | 3 6 | ,, | 0 4 |
| 5. Top bar | 1 | ,, | 2 × | ¾ × | 3 6 | ,, | 0 3 |
| 6. Table top, &c | 7 | ,, | 6 × | ½ × | 1 8 | ,, | 1 2 |
| 7. Tank bottom | 2 | ,, | 6 × | ½ × | 1 6 | ,, | 0 8 |
| 8. Tank sides | 2 | ,, | 3 × | ¾ × | 1 4¼ | ,, | 0 5 |
| 9. Lid battens | 2 | ,, | 2 × | ½ × | 1 4 | ,, | 0 2 |
| 1lb. nails, 1½in., 2in., 3in. mixed wire (French) ... | | | | | | ... | 0 2 |
| 2 buckets (one a little larger than the other) ... | | | | | | ... | 1 8 |
| 1 yard best rubber tube, ⅜ bore ... ... | | | | | | ... | 0 8 |
| 1 small ⅜ gas tap ... ... ... | | | | | | ... | 0 6 |
| 4 sqr. ft. of 4 lb. sheet lead } see below. | | | | | | | |
| 1 ft. ¾ lead pipe } | | | | | | | |
| 1 ft. 6 in. ¾ lead gas pipe ... ... ... | | | | | | ... | 0 3 |
| 1d smallest size copper tacks or zinc tacks ... | | | | | | ... | 0 1 |

The price of lead and outlet pipe is omitted because the best way is to take the frame, when complete, to a plumber, and get him to put a lead trough to the place made for it, and to fix a piece of lead pipe as shown in sketch.

See that all the timber is sound and free from large knots; many people have spare wood at hand that can be cut to sizes named and thus save the cost of purchase.

After all the material has been cut to sizes mentioned, planed, and the edges made square, proceed as follows:—

Place the two pieces No. 1 on edge, not flat, parallel to each other and with 1ft. 4½in. between the two, then nail one of the seven boards (No. 6) at each end, leaving 1in. overlapping at front and back; now nail another of these seven boards alongside those already fixed at each end, this will leave a space of 1ft. 6in. between the two pairs, next fix the two pieces (No. 8) just under the boards last mentioned, as shown at A, fig. A, and nail through the side pieces; these form sides for the lead trough, the ends, of course, being formed by the cross pieces (No. 1).

Turn the frame over and nail the three boards (No. 7) over the hole to form bottom of tank, now fasten the two battens (No. 9 on list) across the three remaining pieces of No. 6 lot to form a lid for the lead tank when not in use. These battens should be 1¾in. from the edge at each end

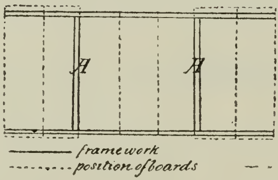



Fig. A.

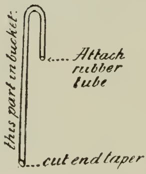



Fig. B.

(see sketch, No. 2) so as to hold the lid in place and prevent its slipping backward or forward by fitting just inside tank at each end; the woodwork of top is now complete.

Take the four pieces (No. 2) which form the legs and place them parallel on floor or bench 11½in. apart (inside measurement) and 4in from top, nail one of the four pieces (No. 3) across; nail one piece of same lot across 12in. from bottom, leaving a space of 11in. between the top edge of each. Do the same with the other two legs—see sketch No. 2. Next get someone to help you to place the top in position on the legs, the upper ends of legs should fit exactly to each end of the cross pieces. Put one or two nails in each corner, then nail No. 5 across the two top side pieces, and No. 4 across the two bottom side pieces to form a shelf—the woodwork will now be complete.

Bore a hole 1½in. in diameter in the righ-hand back corner of bottom of tank frame and then interview your plumber. Instruct him to make a lead tank of 4lb. lead (that is 4lbs. to 1 sqr. foot, about 4 sqr. feet will be required) to fit your frame, it should be 1ft. $4\frac{1}{2}$in. × 1ft. 6in., and 3in. deep outside measurement, with a 1ft. piece of lead pipe $\frac{3}{4}$in. bore soldered in position to pass through the $1\frac{1}{2}$in. hole at back; the reason for making this hole so large is to allow a little adjustment, and also that the lead round top of pipe can be pressed into it, to prevent anything from lodging there. When the lead is in position fasten along the top edges with small zinc or copper tacks about 2in. apart. This tank may be made of tin, iron, or any other suitable material, but lead is by far the best, as none of the chemicals used in photography are likely to have any effect on it, of course excepting concentrated acids, which are not likely to be poured down the sink. The lead tank complete should not cost more than 6s. or 7s., but that all depends upon the conscience of the plumber who makes it. The next job is to string or wire the shelf from the piece above to form a rack for dishes; thin galvanised iron or copper wire is best. This work is easily done and very convenient, as the dishes do not contaminate each other when so placed, and are always at hand when required. The wires should be about $1\frac{1}{2}$in. apart or as broard as the dishes in use, fasten them in position with small tacks or staples top and bottom, or wood partitions may be used instead of wire if so desired.

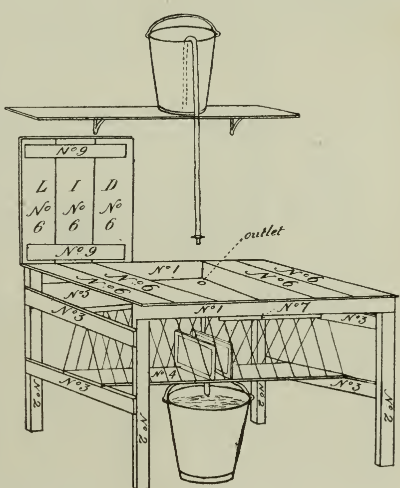


Fig. C.

The water supply can be from a tap fixed above the tank, and the outlet can discharge on to a gulley below if the darkroom is permanent, but where the photographer does not wish to go to this expense, or where it is likely there will be a removal to another house now and then, a very satisfactory and cheap method is to procure two buckets, one larger size for the waste and a smaller one to contain the water to be used, which is put on a shelf above, or hung from the ceiling, or in any position that may be convenient so that it is above the head. A piece of $\frac{3}{8}$ lead gas pipe bent as in fig. B with a piece of rubber pipe attached to the required length, and a small tap at the end, will form an excellent water supply. To use—fill the bucket, place bent lead tube in position with the rubber tube and tap hanging over the tank, and turn tap on, then suck the top until water is drawn over the highest point of tube, that is at top of bucket. When tap is on, the water will continue to flow until the bucket is completely empty; the lead tube must reach to the bottom of the bucket and have the end cut as shown in fig. B. The whole arrangement is shown complete in fig. C; it is merely a simple syphon, but very effective, less trouble, and costs less than a metal tube and tap soldered into bucket. A small rack for dishes should be fitted in the sink; it can easily be made out of

7 pieces of wood, $\frac{1}{4}$in. × $\frac{1}{4}$in. × 1ft. 4in.
3 " " $\frac{1}{2}$in. × $\frac{1}{2}$in. × 9in.

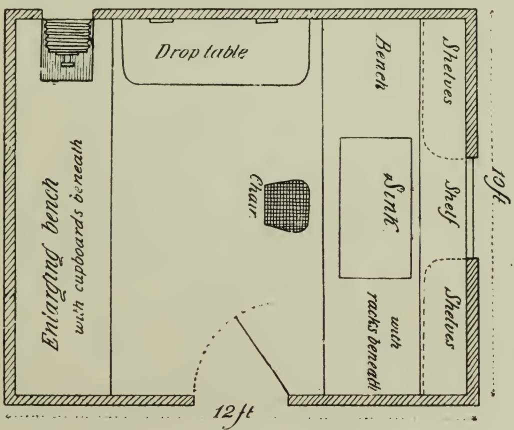

Fig. D.

put together as in fig. D; this is very useful and keeps the bottom of dishes dry and out of the mixture of chemicals which are sure to accumulate in the sink when in use. When the lid is placed in position over the sink and a clean newspaper put on as a tablecloth, mounting or any other such work can be done with ease and comfort."

It will be noticed that Mr. Cooper's arrangement makes allowance for the non-existence of a water supply, the suspended bucket providing an efficient substitute. It will, of course, often happen that a beginner cannot secure the entire use of even a small room for photographic purposes, and may often have to be content with the use of a cupboard under the stairs. We shall, however, deal only with the fittings of a fair-sized apartment, leaving the occupants of smaller rooms to adapt themselves to circumstances.

A room 12 by 10 feet in size will give ample space for a permanent daylight enlarging apparatus in addition to the development sink and the ordinary fittings of a dark room; the accompanying sketch plan will give a general idea as to the interior fixtures. The enlarging bench should be firmly built of stout boards upon good substantial legs; or, if the room be small, it may be arranged as a drop-table and held in position, when required for use, by stout brackets hinged to the walls. In either case it should be fitted with a good sized "easel" (or drawing board), provided with vertical and horizontal adjustments similar to those on the front board of a camera; and the bench itself should be marked every three inches with lines at right angles to its edge, for convenience in estimating the sizes of enlargements. A drop-table (shewn in dotted lines) at one end of the room will be found very convenient for cutting paper or filling dark slides, and should be kept scrupulously clean and dry.

The other side of the room should be fitted with a long bench 2 ft. 6 in. in width, having a lead-lined sink in its centre. This, by preference, should be countersunk so that its top edge is about an inch below the surface of the bench; when not in actual use it can then be covered by a well-fitted top, which will thus provide extra bench room. The window just over the sink should have a sliding shutter excluding




all light, or filling the room with white light, at will; this will be a great convenience when mixing developers, &c., or while toning. Plenty of shelving should be placed upon each side of the window, and it would be advisable to reserve one set for chemicals and the other set for "stock solutions" and oddments. One broad shelf should be placed just below the window, right in front of the sink, for the developers and graduates actually in use while at work; the centre of this shelf should be reserved for the lantern, which should always be used for development in preference to the constantly changing light of day.

The fixing bath should be placed exactly beneath the sink, and the whole space occupied by the sink should be boarded off from bench to floor upon each side, so as to avoid the possibility of hypo being splashed into the adjoining spaces. One of the other spaces should be divided into racks for storing development and toning trays, and the other space should contain a well-made cupboard for storing dry plates, mounts, and apparatus in security against dust and damp. It would be convenient to have a couple of drawers fitted above the cupboard, just beneath the top of the bench, for storing various things (such as cutting shapes, and so on) in use.

As it will be quite possible for an amateur to use such a room for printing as well as development, it would be well to provide a spring blind of canary fabric to draw over the window while cutting up P.O.P. paper, or trimming prints. We advise a spring roller, because the blind will then be out of the way of splashes when not in actual use.

A small window (about 10 or 12 inches square) at one end of the enlarging bench, should be fitted with a series of "kits," or carriers, to take all sizes of plate from $\frac{1}{4}$ pl. up to 10 × 8, or 12 by × 10; this, also, should have a sliding shutter. A reflector should be fitted outside this window at an angle of 45° in order to throw the light from the sky upon the surface of the negative undergoing enlargement.

Should the room be large enough to permit of the enlarging bench being a permanent fixture, instead of on the drop-table principle, we should strongly advise the student to let it form the top of a long cupboard or series of cupboards and drawers. Plenty of bench room and plenty of cupboards will be found most useful; in fact the benefits of accommodation of that kind cannot be over-estimated. If it is possible to provide cupboards in that space, we should then reserve one of the lower compartments of the development bench for washing tanks, large bottles of stock solutions, jars of hypo, alum, &c.

In addition to the articles we have named many more may be added, according to the inclination or purse of the student; some are luxuries, some mere fads, but none actually necessary for the present.

# CHAPTER X.

## DEVELOPMENT OF NEGATIVES.

### Causes and Cure of Failures.

AS stated in a previous chapter, we prefer the hydroquinone developer for most subjects, and we give herewith a slightly modified formula suited to nearly all classes of subject. The modification consists merely of an extra solution forming an alternative accelerator for special subjects where excessive density is required.

At this stage it will be well for the student to prepare his own solutions, which can easily be done if our directions be *accurately* followed. It must be remembered that specific directions as to the *order* of mixing are of decided importance and materially affect the result.

For instance, if a formula directs separate solutions of sodium sulphite in water, and of hydroquinone in alcohol, to be ultimately mixed, it would be manifestly absurd to mix the alcohol, water, sodium sulphite, and hydroquinone indiscriminately together, and expect a similar result; yet such absurdities are often perpetrated, and then the author of the formula is blamed.

Another point to be borne in mind is the different values of weights used: thanks to the absurdity of the British system, all chemicals are sold by *avoirdupois* weight ($437\frac{1}{2}$ grains [16 drams] = 1 oz.), but photographic formulæ are usually compounded by apothecaries weight (480 grains [8 drams] = 1 oz.) For this reason we give our formulæ in *grains* (or parts) wherever possible, in order to avoid the possibility of error due to the different value of drams, &c. Sometime, perhaps, we shall have established throughout the land a proper decimal system which will remove one legitimate cause of the ridicule directed towards us by foreigners.

Let us now make up a stock of developer suitable for all classes of work. The ounces in the case of liquids are, of course, fluid ounces.

A.

| | | | |
|---|---|---|---|
| Hydroquinone... | ... | ... | 160 grains |
| Citric Acid ... | ... | ... | 60 ,, |
| Potassium Bromide | ... | ... | 30 ,, |
| Sodium Sulphite | ... | ... | 960 ,, |
| Alcohol ... | ... | ... | 1 ounce |
| Water, to ... | ... | ... | 20 ,, |

Dissolve the citric acide, bromide, and sulphite together in about fifteen ounces of water; dissolve the hydroquinone in the alcohol, and then add it gradually to the other solution with frequent shaking; finally, add the rest of the water to make the entire bulk up to twenty fluid ounces.

B.

| | | |
|---|---|---|
| Potassium Carbonate | ... | 1,440 grains |
| Sodium Carbonate ... | ... | 1,440 ,, |
| Water, to ... ... | ... | 20 ounces |

C.

| | | |
|---|---|---|
| Sodium Hydrate (sticks) | ... | 160 grains |
| Water, to ... ... | ... | 20 ounces |

D.

| | | |
|---|---|---|
| Potassium Bromide ... | ... | 480 grains |
| Water, to ... ... | ... | 10 ounces |

For producing delicate negatives full of detail (having a correctly exposed plate) we must use equal parts of A and B. If we wish to secure much contrast, that is, a negative that will give extremes of light and shade, we must use equal parts of A and C. For general purposes we recommend the use of carbonates as the accelerator, as in B.

Let us now suppose that we have an exposed plate ready for development. We must first see that we have ready a clean fixing bath made of

| | | | | |
|---|---|---|---|---|
| Hypo | ... | ... | ... | 4 or 5 ounces |
| Water | ... | ... | ... | 20 ,, |

We must also see that the ruby lantern is in good condition, and that no stray white light is creeping into the development room. Take a clean white porcelain tray (9 × 7 inches for whole plate, or 5 × 4 for ¼ plate) and place it near enough to the lantern to be comfortably visible. Then remove the exposed plate from the holder, dust it lightly with a broad camel-hair brush, and place it face upwards in the tray. Mix 1½ ounces each of A & B, and flow it in an even wave over the plate, and then rock the tray gently in order to keep the solution moving over every part of the plate. Then put

60 drops of D into the empty graduate, and place it within easy reach.

After the solution is seen to be evenly flowing, it is well to cover the tray with a cardboard lid to protect the plate from even the ruby lamp during the early stage of development; the lid may be raised occasionally to see if the image is making any appearance. A visible image should appear within a minute if the plate has been correctly exposed; in this case we may continue development with the same solution until finished. The chief trouble with beginners is the fact that they almost invariably stop development too soon; remember that it is infinitely better to *over* develop than to not carry development far enough. In the former case we can always reduce the density, but in the latter it is difficult—well-nigh impossible—to remedy the deficiency by any method of intensification.

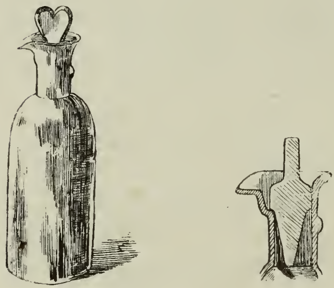
As a general rule, it will be well to carry development until when we look *at* the negative there appears little or no trace of the original image; the plate should look almost uniformly black except at the extreme edges, which were protected by the rabbets of the dark slide. Upon lifting the plate and looking through it at the ruby lamp there should be considerable density, but the outlines of the picture should be visible.

In a properly exposed plate, the highest lights (such as the sky) should show first, followed by the half-tones, and finally the shadow details; but if the plate has been over-exposed, we shall see quite a different effect upon first applying the developer. An over-exposed plate upon being flowed with developer will show no sign for a few seconds; then, all at once, the sky will appear, followed almost immediately by a general "flash" of the whole plate. Directly these signs appear, pour the developer again into the graduate (which contains 60 drops of D), and return it at once to the plate, and continue the rocking.

In this case we must (in order to save the negative) carry development much farther than is apparently necessary, bearing in mind that we can *always* remedy over-development; we shall then have a plate from which a good negative can be made by using a reducer, as will be explained in the next chapter.

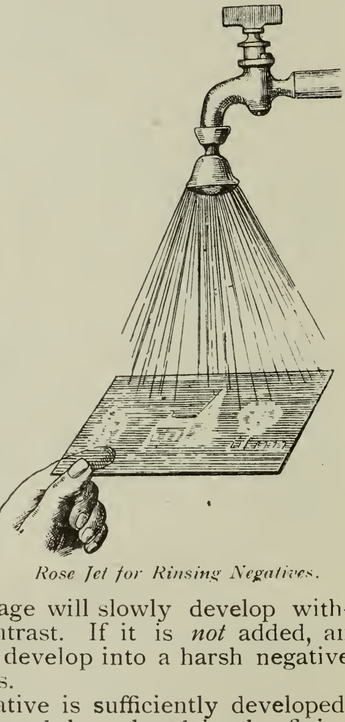
And now let us see what effect D has upon the developer: Bromide of potassium is a powerful "restrainer," and prevents the less exposed parts of the image acquiring density in the same proportion as those more exposed. If we did not use it the probabilities are that the shadows would rapidly acquire density (of a kind), while the high lights (owing to too much light action) have not the power of gaining density in proper proportion.

The bromide permits the high lights to gain density at the same time that it holds the shadows in check. Thus, no matter if the plate has become fogged all over before the bromide was used, we can still go on developing the image in proper proportion directly bromide is present, and by a subsequent operation we can remove the veil of fog.



*A Handy Dropping Bottle.*

On the other hand, should no image become visible after two or three minutes, we must add water to the developer (about an equal bulk), and a few drops (about 5 per ounce) of Rodinal. Rodinal is a ready-prepared and powerful developer, sold by all dealers in photographic goods.



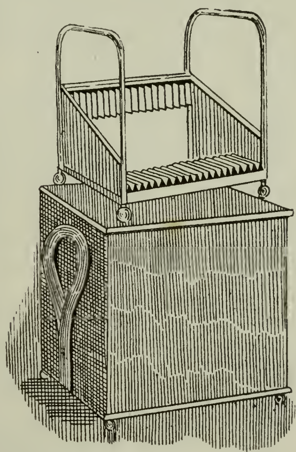
*Rose Jet for Rinsing Negatives.*

After this addition the image will slowly develop without acquiring too much contrast. If it is *not* added, an under-exposed plate would develop into a harsh negative without detail in the shadows.

In any case, when the negative is sufficiently developed, it should be rinsed in water, and then placed in the fixing bath until quite fixed. An unfixed plate has a creamy appearance upon the *glass* side ; this is due to bromide of silver that must be dissolved in the fixing bath.

By-and-bye (say in 15 minutes) this white deposit will disappear, leaving the plate clear ; but we must leave the plate in the fixing bath for *at least* five minutes *after* the plate is apparently fixed. If we omit to do so, the plate will contain a salt of silver that is soluble in hypo, but not in plain water; this salt becomes yellow in daylight, so that the negative would soon be useless.

After well fixing the plate, it must be washed in running water for an hour, or else in several changes of clean water in a dish; it must then be held film upwards beneath a stream of water, and gently wiped with a wad of wet cotton wool to remove any sediment left from the washing water. It may then be placed to dry, the best position being on a shelf, glass side towards the wall and film outwards; the plate should stand on end with a piece of blotting paper beneath to prevent dirt climbing up the negative by capillary attraction. A capital drying arrangement that we use is a series of nails driven in a wall, so fixed as to permit one end and one side of a negative to rest upon them, while a corner of the negative is downwards; of course the plate is put with its *glass* side next the wall.



*Washing Tank for Negatives.*

On no account must heat be used to dry a gelatine negative, or the film will melt and leave the glass.

A negative may, however, be quickly dried, thus: Immerse it in a tray containing enough alcohol to cover it to the depth of an inch. After ten minutes immersion remove it and stand it on edge on blotting paper. In a few minutes it will be surface dry, and may then be held about two feet from a fire and *fanned* rapidly until quite dry. The film is liable to melt in patches unless the fan is used.

We will conclude this chapter with A FEW FAILURES IN NEGATIVES; THEIR CAUSE AND CURE.

*Foggy negatives.*—These have a dirty foggy appearance without density or contrast. *Causes*: Over-exposure; white light in camera or dark room; defective ruby lamp; developer contaminated with hypo; developer too warm or containing too much accelerator (sodium or potassium carbonate or hydrate) without bromide. *Remedies*: Obvious.

*Weak clear negatives.*--If placed in contact with white paper, such negatives are perfectly clear in the shadows; general thinness of deposit. *Cause*: Not sufficiently developed. *Remedy*: They may be slightly improved by intensification: see chap. xi.

*Too dense, with clear shadows.*--*Cause*: Under exposure and development with an unsuitable developer. Should be developed with less hydroquinone (or pyro), no bromide, and add water. *Remedy*: Re-development (see chap. xi.).

*Flat negatives, full of detail.*---They look "all over alike" without contrast between high light and shadow; much detail in the shadows, but no printing strength. *Cause*: Over-exposure, or correct exposure and too weak developer. *Remedy*: Intensification.

*Too much density.*—*Cause*: Developer too strong or too warm. *Remedy*: Reduction (see chap. xi).

*Round transparent spots.*---*Cause*: Air bubbles settling on the plate at the moment of flowing the developer. By careful flowing they may be avoided, or they may be removed by passing a piece of clean cotton wool over the surface of the plate during development. *Remedy*: Spotting (see chap xi).

*Transparent specks, not circular.*---*Cause*: Dust on the plate during exposure and development. Always keep the plate holder free from dust, and always dust the plate lightly before putting it in the holder, and before development. *Remedy*: Spotting.

*Yellow negatives.*---*Cause*: These do not occur in hydroquinone development; they are due to discolored pyro developer, or to insufficient (or decomposed) sodium sulphite in pyro developer. *Remedy*: Immersion in a clearing bath.

*Iridescent stains.*---*Cause*: Developer too strong in alkali; dirty fixing bath. *Remedy*: Slight immersion in reducing bath (see chap xi) and swabbing with pad of cotton wool.

*Mottled appearance.*---Sulphur deposited from fixing bath. This sometimes happens with an old fixing bath containing alum, or through immersing plate in alum bath, and insufficiently washing it before fixation.

*Brown patches.*---These are visible in a few days after fixing, and are quite brown when viewed by transmitted light; if looked at on the *glass* side by *reflected* light the places look opalescent. *Cause*: Insufficient fixation; plates should be left in the fixing bath *at least* five minutes after all the visible creaminess has left the plate when examined on the glass side. *Remedy*: None.

*Crystallization and fading.*---The film of negative is covered with crystals more or less moist, and the image rapidly fades; the film, if touched with the tongue, has a sweet metallic taste. *Cause*: Insufficient washing after fixation. *Remedy*: Wash thoroughly. If the film shows any tendency to frill (or leave the plate), as it probably will, it must at once be immersed in two parts of methylated spirit and one part of water for fifteen minutes, and then be again washed. It may then be intensified if considered necessary.

*Fine transparent lines.*---*Cause*: Using too stiff a brush to dust the sensitive plates; only soft camel-hair should be used for the purpose.

*An indistinct reversed image.*---An indistinct image with the right and left sides reversed from their correct position. *Cause*: Plate inserted in dark slide wrong way about; that is, with the *glass* side next to the draw-shutter, and the film inwards. Thus the negative has been taken *through the glass.*

# CHAPTER XI.

## THE AFTER TREATMENT OF NEGATIVES.

NO matter how carefully a negative has been developed, occasions sometimes arise when a little after treatment will prove a decided benefit. For instance, let us suppose that a negative has been correctly exposed but not sufficiently developed; it is no uncommon occurrence, especially when working with a different brand of plates from that generally used. Some plates are deceptive in appearance during development and, after all detail has come up, seem to be sufficiently dense for printing purposes, when in reality they lose much of their apparent vigor in the fixing bath.

The result is a clear plate full of detail but devoid of density, such a negative as would print in a few minutes, but give a weakly print that would be quite incapable of toning to a pleasant color.

A negative of this kind can be readily brought up to full printing density by after treatment called "intensifying."

Let us consider the principle of the action. We have seen that a silver print on paper is formed by various shades of silver deposited by the action of light, and we know that immersion in a bath of gold causes it to change to a purple color, more or less, according to the depth of the print; this is commonly known as "toning" and, as previously pointed out, is due to the affinity between the gold in solution and the silver in the print.

Intensification is somewhat analogous; in the thin negative (full of detail and lacking density) we have an image composed of more or less silver. Now, if we put such a negative in a specially prepared bath, we can cause another metal to become deposited upon the silver in direct proportion to the amount of silver already there. Thus, it stands to reason, we add to the *density* of the deposit and give to the negative the necessary printing quality. All the extra density that will generally be required can be given by means of mercury and silver cyanide, and in our opinion it is a far better method than the common plan of following the mercury with ammonia. The silver cyanide method is as follows:

*Mercuro-Silver-Cyanide Intensifier.*

| | | | | |
|---|---|---|---|---|
| A.—Mercury perchloride... | ... | ... | ... | 60 grains |
| Potassium bromide ... | ... | ... | ... | 60 ,, |
| Water to ... | ... | ... | ... | 20 ozs |
| B —Silver nitrate | ... | ... | ... | 120 grains |
| Potassium cyanide (pure) | | ... | ... | 120 ,, |
| Water to ... | ... | ... | ... | 20 ozs |

The solutions must be kept in separate bottles, and should be made up at least a day before required for use, being frequently shaken until dissolved. A sediment will be found in the bottle containing B, but this should *not* be removed. When required for use, the clear solution should be decanted from the sediment, and, after use, returned to the bottle and well shaken.

These two solutions will, with proper care and cleanliness, serve to intensify many negatives, and will keep indefinitely. The negative before intensification *must* be well washed for at least an hour to free it from hypo, otherwise stains will be the inevitable result. If the negative has been dried, it must be well soaked in clean water until the gelatine film is swelled, and then be immersed in some of solution A contained in a clean tray; a black vulcanite tray should be reserved exclusively for this solution, as the change is more readily observed in a black dish than a white one. After immersing the negative, it is necessary to gently rock the tray to keep the solution moving over the plate, back and forth. If the plate has been properly washed, a gradual change will take place, and the image will begin to turn white (due to the deposit of mercury upon the silver), so that it will be distinctly visible as a positive, while the black portions will be supplied by the vulcanite tray showing through the clearer parts. The action should be allowed to proceed until the image when viewed from the *glass* side appears white; the negative must then be removed and well washed for about twenty minutes.

After it is washed, it must be placed in a clean porcelain tray and flowed with some of solution B, applied as in development, and rocked in the same way. This again blackens the image and adds considerably to its density; as soon as the image shows no sign of whiteness upon the *glass* side, the action has penetrated throughout the film and is complete. The negative must then be once more washed and put away to dry.

A negative is sometimes so extremely thin and ghostly as to render anything but the most drastic treatment unavailing; in such cases (and in those only) we recommend the use of uranium, which changes the color of the deposit to red, and effectually stops the passage of light. Do not use it on a negative requiring but slight increase of density, otherwise it will yield nothing better than "soot and whitewash" prints.

The following is the formula:

*Uranium Intensifier.*

| | |
|---|---|
| Uranium nitrate ... ... ... | 10 grains |
| Potassium ferricyanide ... ... | 10 " |
| Water ... ... ... ... | 10 ounces |

When dissolved add—

| | |
|---|---|
| Glacial Acetic acid ... ... | 4 drams |

This intensifier must be used as soon as mixed, as it will not keep. It is a good plan to keep the uranium nitrate in a solution of a known strength, say 80 grains per ounce.

The well washed negative must be immersed in the solution and rocked until it acquires the desired color; it changes rapidly from black to chocolate brown, and then on to red. The clear parts of the negative become yellow in this bath, but a few minutes washing under a "rose" jet will remove the stain, and the negatives may then be dried. The color leaves the negatives entirely if washing be prolonged, and a flow of water on one particular part of the negative removes the intensification from the place, so care must be observed to wash evenly and *just enough* to clear the yellowness from the shadows.

Very dense negatives are often caused by over development, and they are frequently so dense as to require several days' exposure to sunlight, to obtain a print. This is a fault that is easily remedied as follows: Dissolve about twenty grains of potassium ferricyanide (red prussiate of potash) in an ounce of water, and add it to three ounces of fresh hypo fixing bath of usual strength; this forms the reducer. If the negative is dry, it must be well soaked in water, or in the fixing bath, and then put in a white tray and covered with the reducing solution. The dish *must* be rocked to prevent uneven action, and it must be borne in mind that this solution acts with great rapidity; examine the plate frequently, and, when *nearly* thin enough, remove it to a tray of clean water and wash it thoroughly. Thus it is possible to make a quick printer of a negative that was previously as dense as a brick wall. The action that takes place in the reducing bath is simply this: The potassium ferricyanide becomes converted into potassium ferrocyanide, and the metallic silver of the image (practically unaffected by hypo) becomes simultaneously converted into silver ferrocyanide, which is soluble in hypo. The hypo attacks the silver ferrocyanide and converts it into sodium ferrocyanide and silver sodium thiosulphate. In other words: as fast as the insoluble silver is converted into a soluble salt, it is dissolved in the hypo and removed, thus effecting *reduction of density*.

If reduction takes place too slowly, use more red prussiate; if too fast, use less.

A more strictly scientific method of reduction, and the only one that is practicable with negatives possessing great contrast (*i.e.* great density, and a little detail in the shadows), is that of re-development. By this method we first convert the metallic deposit into a chloride, thus: Mix fifty grains of potassium bichromate in ten ounces of water and add two and a-half drams of hydrochloric acid. The negative must be immersed in this solution and rocked until the deposit becomes bleached throughout and the image looks quite white on the glass side. The plate must next be washed for 10 or 15 minutes and covered (in daylight or otherwise) with a weak developer, when the image will gradually darken; the action must be carefully watched, or the original density will be acquired. As soon as the negative appears sufficiently dense, the plate must be immersed in a clean fixing bath until the remaining white deposit of silver chloride (visible on the glass side) is dissolved, it must then be well washed.

The advantage of this plan (especially with negatives of great contrast) lies in the fact that the shadow detail (having been first re-converted into metallic silver by re-development) is not attacked in the hypo, whereas the extra density of the high lights (being still in the state of silver chloride) is dissolved in the hypo.

Flat foggy negatives, the result of over exposure and careless development, can usually be remedied by intensification; but in most cases it is advisable to first reduce them slightly in the ferricyanide and hypo bath in order to remove the foggy deposit from the extreme shadows. If this is not done, intensification rarely gives the desired contrast, owing to the fact that the foggy deposit becomes intensified in the same proportion as the image.

Another defect that will often be noticed is that known as "halation." This is most apparent around the windows of interior, and around the tops of trees and buildings where sky forms the background.

This defect appears most frequently upon poor thinly-coated plates, and is due to the light having passed completely through the film and thence been reflected back to the sensitive surface. After development it shows as a dense black deposit forming a halo and partly obscuring the objects surrounded by it. It may be removed by simple friction, thus: Stretch a piece of wash-leather tightly over a finger and moisten it with alcohol, place the *perfectly dry* negative film upwards on a solid bed---such as a piece of stout plate-glass---and then rub the dense portion vigorously with the leather and alcohol. Use *plenty* of pressure and gradually extend the field, so as not to leave too decided a mark. The leather will soon become black with silver, and the negative correspondingly reduced; this method is also useful in other cases requiring local reduction.

The prevention of "halation" is better than its cure, and we advise beginners to use either "anti-halation" or thickly-coated plates, or, better still, an ordinary plate backed with caramel and burnt sienna.

The mixture is made by mixing one part of dextrine, two parts of burnt sienna and three parts of caramel (burnt sugar) with as little water as possible to make a very stiff paste; then thin it down with methylated spirits. It should not be very thin or sloppy, but about the consistency of a starch mountant.

The plate is placed face downwards on clean blotting paper, and a little of the backing composition is applied to the glass side and distributed by "dabbing" with a soft pad of linen, or by rolling with a roller squeegee. Very little is required to prevent all possibility of "halation," and it is washed off easily with a damp sponge before development.

Pinholes, and other clear marks due to dust and other causes, should be spotted out before prints are taken from the negative. A mixture of moist water colors (indigo and vermilion) applied with the tip of a round sable pencil is the best thing to use for this purpose. We do not intend to treat of retouching in this book, as that comes more within the range of advanced work, and there are several books devoted exclusively to the subject; all we need say is that "retouching" is principally done in lead pencil upon the negative film, which is previously rubbed with a "medium" (or varnish) in order to give it sufficient "tooth" to take the pencil.

# CHAPTER XII.

## WEIGHTS AND MEASURES, VARIOUS USEFUL FORMULÆ.

---

THE METRIC (DECIMAL) SYSTEM; FOR ALL PURPOSES.

*Weights (Used for all solids.)*

| | | | | |
|---|---|---|---|---|
| 1 Milligram | = 1-1000th gram | = | ·001 | grams |
| 10 Milligrams | = 1 Centigram | = | ·01 | " |
| 10 Centigrams | = 1 Decigram | = | ·1 | " |
| 10 Decigrams | = 1 Gram (= the unit) | = | 1 | " |
| 10 Grams | = 1 Dekagram | = | 10 | " |
| 10 Dekograms | = 1 Hectogram | = | 100 | " |
| 10 Hectograms | = 1 Kilogram (or kilo) | = | 1,000 | " |
| 10 Kilograms | 1 Myriagram | = | 10,000 | " |
| 10 Myriagrams | = 1 Quintal | = | 100,000 | " |
| 10 Quintals | = 1 Millier, or Tonneau | = | 1,000,000 | " |

The gram is the unit of weight, and is the exact weight of one cubic centimeter of distilled water.

The metric solid measure has exact equivalents in the metric fluid measure; the fluid equivalent of one gram being 1 cubic centimeter (= 1 c.c.). The cubit centimeter and the gram bear the same relation to each other as the English minim and grain, with the additional advantage of being divided or multiplied (without possibility of complication) by tens, hundreds, or thousands, etc.

*Measure of Volume (Used for all fluids).*

| | | | | |
|---|---|---|---|---|
| 1 Milliliter | (= 1-1,000 liter) | = | 1 | c.c.* |
| 10 Milliliters | = 1 Centiliter | = | 10 | " |
| 10 Centiliters | = 1 Deciliter | = | 100 | " |
| 10 Deciliters | = 1 Liter (= the unit) | = | 1,000 | " |
| 10 Litres | = 1 Decaliter | = | 10,0C0 | " |
| 10 Decaliters | = 1 Hectoliter | = | 100,C00 | " |
| 10 Hectoliters | = 1 Kiloliter, or Stere | = | 1,000,000 | " |

---

* 1 c.c. is the general way of writing 1 cubic centimeter.

The liter (= 1,000 c.c.) is the unit of the decimal fluid measure, and weighs 1,000 grams. One c.c. equals 17 minims English. The metric system has been adopted by many nations, the English excepted. In America its use is optional, but is legalised by Congress.

European formulæ are expressed in grams and cubic centimeters; these may be made up in any quantity by counting the amounts as "parts"—either grains or drams (apothecaries or fluid). The better plan, however, is to buy a set of metric weights and cubic centimeter graduates and mix the formulæ at once without calculation or confusion. Without doubt, the metric system is the only one for scientific use.

---

## English Weights and Measures used in Photography.

### *Apothecaries' Weight.*

By which photographic formulæ are generally compounded.

| | | | |
|---|---|---|---|
| 1 grain | = | the unit | |
| 20 grains | = | 1 scruple | |
| 3 scruples | = | 1 dram | (= 60 grains) |
| 8 drams | = | 1 ounce | (= 480 grains) |
| 12 ounces | = | 1 pound | (= 5760 grains) |

The measure employed for liquids is as follows:

| | | | |
|---|---|---|---|
| 1 minim | | the unit | (= 1 grain |
| 60 minims | = | 1 dram | |
| 8 drams | = | 1 ounce | (= 480 minims) |
| 20 ounces | = | 1 pint | (= 9600 minims |

---

### *Avoirdupois weight, by which chemicals are sold.*

| | | | |
|---|---|---|---|
| 1 grain | = | the unit | |
| 27 11/32 grains | = | 1 dram | |
| 16 drams | = | 1 ounce | (= 437½ grains) |
| 16 ounces | = | 1 pound | (= 7,000 grains) |

---

### *Pyro-soda Developer.*

An excellent pyro-soda developer can be made in three solutions as follows:

| | | |
|---|---|---|
| *Pyro.* | Sulphuric acid, C.P. | 60 minims |
| | Water, .. | 40 ounces |
| | add Pyro .. | 480 grains |
| *Carbonate.* | Sodium carbonate .. | 6 ounces (= 2880 grs.) |
| | Water, to .. | 40 ounces |
| *Sulphite.* | Sodium sulphite .. | 6 ounces (= 2880 grs.) |
| | Water, to .. | 40 ounces |

For normal exposure take equal parts of each solutions. For over exposures add a few drops per ounce of ten per cent potassium bromide solution. Bear in mind the following points regarding this developer. Pyro is the developer and does the work, sulphuric acid being simply a preservative; sodium carbonate is the accelerator that forces pyro to do the work; potassium bromide is a restrainer that prevents the work being done too quickly; sodium sulphite keeps the work clean.

Sodium carbonate opens the pores of the gelatine and enables the pyro to work vigorously, but too much carbonate causes fog and clogs up the half-tones of the negative with detail. Too much pyro gives too much contrast; too little pyro gives a weak negative lacking contrast. Sodium sulphite prevents discolouration and gives bluish-black negatives, too little causes yellow negatives.

Therefore: for normal development of correct exposures use equal parts of pyro, carbonate and sulphite; but if yellowish negatives are required reduce the amount of sulphite.

*In over-exposure* use pyro 2 parts, sulphite 2 parts, carbonate 1 part, bromide (10 per cent. solution) from 10 to 30 drops per ounce.

*In under-exposure* use pyro 1 part, carbonate 2 parts, sulphite 1 part, water 1 part, and allow plenty of time for development.

Should pyro-developed negatives be much discoloured after fixing and washing, they can be cleared by a few minutes' immersion in the following

### *Clearing Bath.*

| | | |
|---|---|---|
| Alum | .. | 1 ounce (= 480 grains) |
| Sulphate of iron | .. | 3 ounces (= 1440 ,, |
| Water | .. | 20 ounces |

When dissolved, add slowly

| | | |
|---|---|---|
| Sulphuric acid | .. | 120 minims |

They must then be again well washed.

---

### *Metol Developer.*

| | | | | |
|---|---|---|---|---|
| *A.*—Metol | .. | .. | .. | 154 grains |
| Dissolved in water | .. | | .. | 35 ounces |
| Add sodium sulphite | .. | | .. | 1543 grains |
| *B.*—Potassium carbonate | .. | | .. | 515 ,, |
| Water | .. | .. | .. | 12 ounces |

For normal exposures take three parts of A to one part of B and add a few drops of a 10 per cent. solution of potassium bromide.

If a very soft, delicate negative is required, use 6 parts of A, 1 part of B, and 2 parts of water; of course, a longer time must be allowed for development.

---

### *Eikonogen and Hydroquinone Compound Developer.*

| | |
|---|---|
| *A.*—Eikonogen .. .. .. | 240 grains |
| Hydroquinone .. .. | 60 „ |
| Sodium sulphite .. .. | 720 „ |
| Potassium bromide .. .. | 8 „ |
| Water, to .. .. .. | 30 ounces |

The sodium sulphite should be dissolved first; the other ingredients may then be added and dissolved in a thin glass flask by heat.

| | |
|---|---|
| *B.*—Potassium carbonate .. .. | 480 grains |
| Water, to .. .. .. | 10 ounces |

For normal exposures, use three parts of A to one of B.

---

### *Acid Fixing Bath.*

This bath combines the following advantages: It remains clear after frequent use, does not discolour the negatives, forms no precipitate upon them, and hardens the gelatine to such a degree, that the negatives can be washed in warm water, provided they have been left in the bath a sufficient time.

Prepare two solutions.

| | |
|---|---|
| *A.*—Hyposulphite of soda .. .. | 4 ounces |
| Water .. .. .. | 15 „ |

| | |
|---|---|
| *B.*—Water .. .. .. | 5 ounces |
| Sulphuric acid .. .. | 30 minims |
| Sulphite of Sodium crystals .. | 240 grains |
| Chrome Alum .. .. | 180 „ |

After the ingredients are dissolved pour B solution into A.

DURING THE WINTER ONE-HALF THE QUANTITY OF A IS SUFFICIENT.

The plate should be allowed to remain in the bath five to ten minutes after the bromide of silver appears to be dissolved. The permanency of the negative and freedom from stain, as well as the hardening of the film, depends upon this.

Wooden boxes with vertical grooves to hold a number of plates, will be found both convenient and economical for fixing.

When the bath becomes weakened by constant use, it must be replaced by a new one.

---

### *Toning Bath for Prints.*

We recommend the following bath for prints on gelatino-chloride or albumenised paper.

#### *Stock Solution.*

| | |
|---|---|
| Chloride of gold * .. ... | 15 grains |
| Acetate of soda .. .. .. | 480 grains |
| Water, to .. .. .. | 15 ounces |

Dissolve the acetate of soda in ten ounces of water, then break the tubes of gold in a glass graduate and pour some of the solution over them, stirring up with a glass rod; add this to the bottle of solution and pour some more over the broken tubes until all the gold is extracted; then add water to make 15 ounces. Store this bottle away from strong light, and label it "Stock toning solution, gold = 1 gr per oz."

To make the toning bath, mix

| | |
|---|---|
| Stock toning solution .. .. | 1 oz. |
| Water .. .. .. | 20 to 30 oz |

Test with blue litmus paper; if the paper becomes red, the solution is acid, and must have a little bi-carbonate of soda added to it, sufficient to prevent blue litmus paper from becoming red: a few grains should be enough. The temperature of the bath should be not lower than 65° F, nor higher than 75° F. The bath may be used again and again, for months, if strengthened with stock solution before use.

---

### *Combined Toning and Fixing Bath.*

This is commonly called known as "The Lazy Man's Bath;" it is convenient and always ready for immediate use. It gives nice tones, fixes the prints at the same time, and necessitates no previous washing.

*The 15-gr. tubes of gold and sodium contain only $7\frac{1}{2}$ grs. of gold chloride

Prints toned in this bath are rarely, if ever, permanent; it is very wasteful, and we do *not* recommend it. It is made thus:

| | | |
|---|---|---|
| A.—Sodium tungstate | .. | 180 grains |
| Ammonium sulphocyanide | .. | 300 „ |
| Sodium thiosulphate (hypo) | .. | 6 ounces |
| Water | .. | 20 „ |
| B.—Gold Chloride * | .. | $7\frac{1}{2}$ grains |
| Water | .. | 4 ounces |

When quite dissolved, pour solution B, a little at a time with constant stirring, into solution A; more water may be added if the bath tones too quickly.

This will give rich purple tones upon prints from plucky negatives. Prints must be deep in color, and are to be immersed *without* previous washing; they change to a dirty yellow and gradually work back again to purple. They must be well washed *after* toning.

Some combined baths contain alum and acetate of lead; but, as they are infinitely worse than the foregoing, we refrain from inflicting them on beginners. Lead tones are beautiful in the extreme *while they last*, but they can be obtained without the use and waste of gold.

As a warning to avoid lead, we give a formula that will yield exquisite results for a time. All we ask is that a beginner will *not* try it until he has mastered the separate toning and fixing baths. He will then be interested in toning some prints with lead, and exposing them for a week to strong daylight and the open-air. When he sees the result, he must recollect that we did *not* advise the use of the bath. The following is the formula:

*Lead Toning and Fixing Bath.*

| | | |
|---|---|---|
| Lead acetate | .. | 280 grains |
| Hypo | .. | 4 ounces |
| Water | .. | 20 „ |

Print deeply and do not wash before toning.

---

*Varnish for Negatives.*

| | | |
|---|---|---|
| Shellac | .. | 960 grains |
| Sandarac | .. | 600 „ |
| Camphor | .. | 10 „ |
| Alcohol (methylated) | .. | 20 ounces |

Filter before use.

* The 15-gr. tubes of gold and sodium contain only $7\frac{1}{2}$ grs. of gold chloride.

The negative should be made distinctly warm, but not hot; a pool of varnish must then be poured upon its centre, while the plate is held by the lower left hand corner between the thumb and finger. After distributing the varnish over the plate, the surplus must be poured into a separate bottle kept for the purpose. The lower right hand corner should be held downwards on a piece of blotting paper (to absorb the drop that will collect there) until set. When set, the plate should be evenly heated until hardly bearable to the back of the hand, it may then be set away until cold.

---

### *To remove varnish from a negative.*

It is sometimes necessary to remove varnish from a negative in order to modify it by intensification or reduction.

This is best done by placing the negative (varnish upwards) in a tray and covering it with methylated alcohol, to each ounce of which is added about twenty drops of liquid ammonia. Wipe the film occasionally with a wad of cotton wool and, when the varnish has apparently disappeared, transfer the negative to a tray containing water and ammonia in the same proportions. Finally, well wash in plain water.

---

### *Cold Varnish for Negatives.*

This varnish may be applied to a cold negative, and will dry in a few minutes. It is sometimes sold as "crystal" varnish.

| | |
|---|---|
| Gum dammar .. .. .. | 90 grains |
| Benzole .. .. .. | 1 ounce |

The film will not be hard enough to bear printing under 24 hours, unless the plate be heated after the film has set. If made quite hot (after the varnish is set) it will be ready for printing when cold.

The following is preferred by some workers:

| | |
|---|---|
| Amyl acetate .. .. .. | 1 part |
| Petroleum benzine .. .. .. | 1 „ |
| Alcohol .. .. .. .. | 3 parts |
| Ether .. .. .. .. | 3 „ |

Celluloid, enough to give the desired consistency. Old celluloid films cut into strips answer the purpose admirably.

The celluloid swells and dissolves slowly, and requires frequent shaking during several days. Filter through cotton before use.

### *Matt, or ground-glass, Varnish.*

This is for applying to the *glass* side of negatives, and *must* be applied while the glass is perfectly cold, otherwise it will dry brilliant. It sets with a matt surface similar to ground-glass, very suitable for working upon with lead pencil. It is also useful for making focussing screens and backing for window transparencies

| | |
|---|---|
| Gum sandarac .. .. .. | 90 grains |
| Gum mastic .. .. .. | 20 ,, |
| Methylated ether .. .. .. | 2 ounces |
| Benzole (pure) .. .. | ½ to 1½ ,, |

The benzole determines the nature of the grain; the greater the proportion, the coarser the matt surface.

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### *Retouching Medium.*

The following is the best formula of which we know:

| | |
|---|---|
| Sandarac .. .. .. | 10 parts |
| Camphor .. .. .. | 1 ,, |
| Castor oil .. .. .. | 2 ,, |
| Venice turpentine .. .. .. | 1 ,, |
| Alcohol .. .. .. | 60 ,, |

Apply a little of the medium to the negative film (either varnished or unvarnished) by means of a piece of soft cambric stretched over the finger. It should be rubbed in small circles until nearly dry; in a few minutes it will be in a fine condition to receive black lead pencil. The pencil work can be fixed when finished by heating the plate.

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### *Dead-black Varnish.*

This is useful for many purposes, such as for coating the lens flange or inside woodwork of camera.

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|---|---|
| Japanner's oil gold size .. .. | 1 part |
| Lampblack .. .. .. | 1 ,, |

Rub together in a mortar, or on a slab, then add—

| | |
|---|---|
| Turpentine .. .. .. | 8 ounces |
| Methylated spirits .. .. .. | 4 drams |

# GLOSSARY OF TERMS.

*The following list includes the principal photographic terms used in the first chapters of* EARLY WORK.

ACTINIC.—By "actinic light" in photography is meant the active rays capable of affecting a photographic dry plate; white light, or white light transmitted through a blue or violet glass, has actinic power, but red light has not. Red light is inactive, or "non-actinic."

BACK OF NEGATIVE.—When one speaks of the "back" of a negative, the glass side is always meant. The film side (on which the image is formed) is called the "front," or film side.

EMULSION.—A photographic emulsion is a thick, semi-fluid mass composed of gelatine or collodion, containing silver compounds in suspension. The emulsion, when spread on glass and dried, forms the sensitive film of the modern dry plates.

FACE SIDE.—The film side of a negative is sometimes called the "face," or film side, and sometimes the "front," to distinguish it from the back or glass side.

FRONT OF NEGATIVE.—See FACE SIDE.

GRADUATE.—A graduated glass used for measuring liquids.

LIGHT-TIGHT.—A common term in photography, used to indicate anything through which light cannot leak. Thus, if the chinks around the door of a dark room admit s ray white light, it is not light-tight; but by pasting black paper over the crevices the room becomes light-tight. The same definition applies indiscriminately to cameras and plate boxes.

NON-ACTINIC.—Rays of light incapable of affecting a photographic plate are usually termed "non-actinic" or inactive. Red and yellow light are more or less non-actinic, hence their use for illuminating the dark room.

TONE.—The general definition of this word in photography is "color." The "tone" of a silver print is formed by the deposition of violet gold or platinum black. The act of depositing precious metals upon the silver image is commonly called "toning."

TRIM.—To "trim" a print is to cut the edges true by means of a knife and a sheet of glass; an untrimmed print is one with its edges rough and unfinished. All prints must be carefully trimmed before they are mounted upon cardboard.