PREFACE.

Within the whole range of human endeavor there has been no more brilliant accomplishment than that which has, in the course of scientific evolution, given to the world the beautiful and marvelous science of photography, and in a form so simple that the students of the art, with the exercise of a little patience, application and ordinary intelligence, can more than share the laurels which in all ages have graced the brows of those illustrious masters of brush and palette, whose towering genius has transmitted to the civilization of our day an enduring record of every emotion of the human heart: of its hopes and fears, its joys and sorrows; its ambitions and despair; its love and hate; its faith, its glorious charity, its splendid courage and lofty heroism; all told in language of form and color, of lights and shades, which, yielding to the magic touch of inspiration, send forth down through the long vista of the centuries, their messages of love.

From all the great galleries of the world gaze down upon us in silent splendor the ideal creations of great artists; likewise the shadows of departed celebrity who once trod the real stage of life's weird drama. And in vivid realism there glides in panoramic beauty before our enraptured vision the cloudless suns and orange groves, the snow-capped Alpine peaks and violet valleys of fair Italy, whilst imposing temples, massive amphitheaters, giant monuments and palaces, which once echoed the lascivious notes of the lute, as the proud sons of the haughty Roman Empire reveled in the pleasures of Bacchanalian feasts, invoke our admiration for the genius which has preserved for us all these grandeurs of hoary antiquity.

With the fullest measure of recognition for the inestimable boon which the artists of the past have conferred upon our race, and a generous acknowledgment of our debt of gratitude to them and which is the highest tribute to their virtue and talent which we can lay at their feet, the fact can no longer be ignored that the art which has crowned them with a halo of enduring glory has been supplanted by another ART AND SCIENCE COMBINED, and one which is not only a science in itself, but an indispensable auxiliary to every other science, art, trade and profession. THIS CANNOT BE SAID OF ANY OTHER SCIENCE.

Not only is photography a ranking profession which invites the best scientific talent within its fold, both as a consideration of advantage in the battle of life, in the sense of emolument and professional distinction, but it offers to the amateur of artistic taste a field of scientific research, coupled with healthful and delightful recreation, which the nature of o other profession can possibly provide.

The rapid evolution within the last few years in the manufacture of photographic apparatus has placed it within the power of every one to acquire this most interesting and fascinating art.

With the advent of the hand camera all obstacles to the pursuit of photography as a pastime have been removed; for the hand camera is a portable instrument of simple construction and for its successful operation requires only an intelligent comprehension and faithful compliance with the instructions given in this work.

There is no more deplorable truth engraven upon the tablets of human experience than the appalling disproportion of the successes in life to the failures. With the cause—whether environment of the individual, lack of opportunity, violation of ethical laws, imperfect economic conditions, or whatever it may be—I am not here concerned; but the fact is irrefutable, and is borne out by universal experience and the consensus of thought, that the successful man is he who invites opportunity and opens his arms and heart to Fortune when the fickle goddess stands before him shaking her silver locks in his face.

The value in life of a useful application of leisure moments can never be too forcibly urged, and some of the most notable instances of success are to be found amongst those who, whilst following distasteful occupations, gradually acquired a profession which enabled them to contribute to the sum of human happiness and enshrine their names in enduring honor and fame. Among these, a great French physician studied his profession under the hall lamp while serving as a waiter in a Parisian restaurant, and the remarkable life of the blacksmith astronomer is not very ancient history.

But there is no profession which offers such opportunities as photography; first, because the avenues for its application are many-fold, and then again its simplicity, with reasonable diligence, insures rapid progress from the embryonic stage of the amateur to the highest plane of perfection attained by the full-fledged operator and expert. The professions and many lines of commercial business in which photography has become a necessity and the sciences to which it is now an indispensable aid and adjunct are too numerous to mention here; but a few citations may tend to impress my readers with the importance of this science par excellence.

In the practice of law it is a leading factor in the presentation of a certain character of evidence. In surgery, as exemplified in the X-ray, its performance is the marvel of the century. In every department of engineering it is employed to record the progress of the work. In engraving and printing it has become a prime requisite. In the service of the police it is the mute agent which restores the missing to loving friends, and it brings the malefactor to the bar of justice. In every branch of commerce, on land and sea, the speechless camera heralds the steady progress of industrial development. It makes all the peoples of the earth familiar with the lives and habits of each other. It carries to the Icelander the warm scenes of the tropics, with their sunny skies and luxuriant flora, and to the simple children of the Amazon it portrays the rugged, rock-ribbed shores of Labrador and the vast fields of ice and monster bergs, which rear their crystal peaks high into the dreary silence of the Arctic circle.

To the microscopist it is his chief dependence for accurate registration. But not until we consider its relation to astronomy, that queen of sciences, does the transcending value of photography blaze out, like a flashing meteor in the sky. With the modern telescope it penetrates the depths of space, and in one night obtains plates of the constellation of the Pleiades more rigidly accurate than patient astronomers have been able to obtain in a score of years without its aid. It wrests from the solar mass the secrets of ages, and records the stupendous convulsions and explosions which occur upon its surface and preserves the immutable data of this wonderful phenomena for generations yet to come that they may be brought, through the instrumentality of photography, into that relation with the celestial bodies which will enable the coming higher man to solve the great problems of human life.

T. STITH BALDWIN.

Chicago, November, 1902.

Note.—The thanks of the author are extended to Mr. O. W. Hodges of the M. A. Seed Dry Plate Company, and to the Eastman Kodak Company for much valuable data taken by permission from books of their publication.

TABLE OF CONTENTS.

CHAPTER I.

Apparatus Required.

CHAPTER II.

Hand Cameras. Kodaks.

CHAPTER III.

Viewing Cameras.

Features of Cameras.—The Swing Back. The Reversible Back. Rising and Falling Front. The Rack and Pinion. The Focusing Screen.

CHAPTER IV.

Photographic Lenses.—Fixed Focus Lenses. Diaphragms or Stops. Definition of terms applied to Lenses.

CHAPTER V.

Photographic Shutters. Shutters for Portrait Work.

CHAPTER VI.

The Plate Holder. The Film Holder. The Cartridge Roll Holder. The Tripod. The Focusing Cloth. The Carrying Case.

CHAPTER VII.

The Developing and Printing Outfit—The Ruby Lamp. The Developing Tray. The Toning Tray. The Scales. The Graduated Glass Measure. The Printing Frame.

CHAPTER VIII.

Dry Plates. Cut Films. Cartridge Film.

CHAPTER IX.

Operation of the Camera.—Loading the Film Camera. Loading the Roll Holder. Loading the Plate Holder.

CHAPTER X.

70 **Landscape Photography.**—Lighting and Composition. Exposing. Architectural Subjects.

CHAPTER XI.

78 **Portrait Photography.**—Portraiture at home. Illustrations. Out Door Portraiture. Portraiture in the Studio. Lighting.

94 CHAPTER XII.

Photographing Interiors.—Lighting. Approximate Time Needed for Exposures.

CHAPTER XIII.

99 **Flash Light Photography.**—Preparation of the Flash Light. Taking the Picture. The Powder. Portraits. Groups. The Background. Using Flash Cartridges. Using Flash Sheets. Secondary uses of the Flash Light.

CHAPTER XIV.

109 MISCELLANEOUS BRANCHES OF PHOTOGRAPHY.

Snapshot Photography.—Photographing Moving Objects. Copying. Reducing. Enlarging. Stereoscopic Photography. Trick Photography. X-Rays and their uses. Moving Picture Machines and Motion Photography.

CHAPTER XV.

Development and Completion of the Negative. —Equipment and arrangement of the Dark

Room. The Choice of a Developer. Developing a Negative. Recognition and Correction of Under and Over Exposure. Intensifying a Negative. Reducing a Negative. Drying Negatives. Varnishing Negatives. Retouching. Storing Negatives. Defects in Negatives and their Remedies. Developing Cartridge Films. The Chemistry of Development. General Information.

CHAPTER XVI.

163 **Printing.**—Production and Finishing of Prints on Gelatine, Collodion, Developing, Blue Print and Sepia Papers. Vignetting. Mounting. Glace Prints.

CHAPTER XVII.

Platinum Printing.

CHAPTER XVIII.

Carbon Printing.

CHAPTER XIX.

Contact Printing with Bromide Paper.

CHAPTER XX.

Bromide Enlargements.

CHAPTER XXI.

Lantern Slide and Transparency Making. Uses of Lantern Slides.

CHAPTER XXII.

The Gum Bi-Chromate Process.

CHAPTER XXIII.

The Sensitizing and Use of Plain Papers.

CHAPTER XXIV.

Useful Formulae. Weights and Measures.

271 CHAPTER XXV.

Helpful Hints.

CHAPTER I.

THE APPARATUS REQUIRED.

Cameras adapted for the amateur's use are divided into two classes: Hand cameras and viewing cameras. These classes are again subdivided into many styles and varieties of instruments. Before it is practicable to enter intelligently into a practical photographic training the amateur should provide himself with the necessary apparatus and he should, therefore, select one or the other of these two classes of instruments. This selection of an instrument should invariably be determined by the character of the work which the embryo photographer has in contemplation, i. e., whether his object is to provide himself with agreeable diversion and recreation or with a scientific art which may be employed as a profession to insure permanent occupation and revenue.

Upon the selection of the first instrument much depends, and while advising the novice in this respect certain considerations should be borne in mind as tending to his ultimate success and these are his personality, tastes, environment and financial ability. Yet one rule can safely be laid down. If the camera is to be used by the traveler or by anyone not having access to a dark room, a film camera should be used. An exclusively plate camera is suitable for gallery work and viewing.

For the amateur's use it is well to have an instrument that will use film as well as plates.

Films in light-proof rolls weigh only one-twentieth as much as glass plates and the necessary plate holders; they are non-breakable, are as easy to develop as plates and in rapidity and quality equal the best plates made.

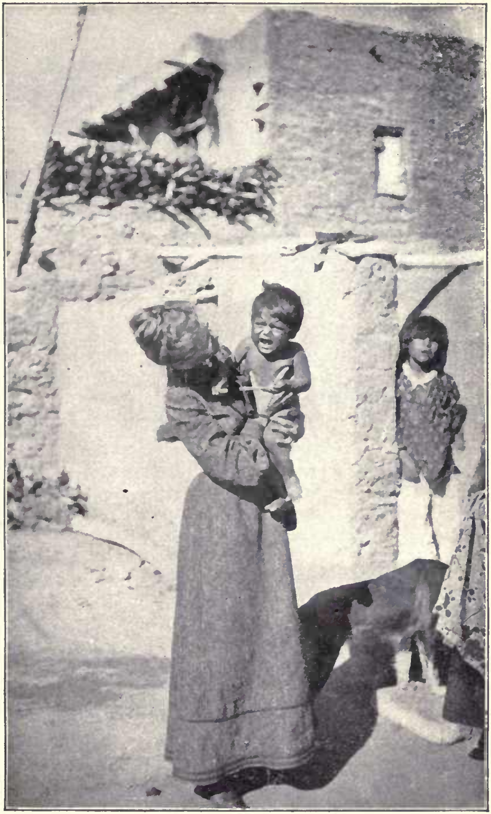
In every kind of amateur photographic work, where it is not desired to make a negative larger than 5x7, transparent film is rapidly becoming more popular and its use is increasing daily. The reasons are obvious. Film is a thin, light, rollable and non-breakable substance. Plates are heavy, fragile glass. To the tourist, where the transportation problem is to be faced, the use of film frequently means success versus failure. Films and plates are, nevertheless, more nearly alike than those not familiar with the subject would imagine. Indeed, they are identical, except in the support upon which the sensitive material (emulsion) is coated.

When this emulsion is coated on glass we have "plates." When coated on a thin, flexible support it is called "film."

Neither the glass nor this flexible, transparent material does more than furnish a support for the emulsion which is to take the picture. When exposed in the camera, the results are identical, and when the pictures are made they are indistinguishable.

Whatever style of instrument the amateur may select he will require the following articles to complete his working apparatus:

Camera, complete with Plate Holder, Lens and Shutter and a Developing and Printing Outfit, consisting of Developing and Toning Trays, Graduated Measuring Glass, Printing Frame, Ruby Lamp, and if he should select the Viewing Camera, the above list must be augmented by the addition of a Tripod and Focusing Cloth.



A MOKI REBELLION, ARIZONA, ON THE SANTA FE.
Photo by W. H. Simpson, Chicago.

Chemicals for making the developing and toning solutions and paper and dry plates will also be required, particulars concerning which will be treated elsewhere in this work. The articles mentioned in the above list may be purchased separately or they may be bought in the form of a complete equipment. In addition there are many other pieces of apparatus, such as washing appliances, drying racks, plate lifters; but they are not absolutely essential, and their purchase may be deferred until the beginner has achieved some progress and feels justified in making the additional outlay. The cost of photographic apparatus varies considerably, according to quality, but as the cost of the plates and papers used in both cameras of good and inferior quality is the same, it is more economical in the end for the beginner to provide himself with the best apparatus that he can afford.

CHAPTER II.

HAND CAMERAS.

As indicated by its name, a "hand" camera is one that is intended primarily to be used when held by the hands, and, therefore, except on rare occasions, such an instrument does not require a tripod as in the case of the view camera. As it is practically impossible to hold a camera in the hand with sufficient steadiness to give an exposure of more than about the tenth-part of a second, all hand cameras are provided with a shutter so as to insure quick exposure.

The most popular size for a hand camera is 4x5, though instruments of this kind are made to take much smaller pictures; some users are not satisfied with so small a picture as 4x5, and prefer a 5x7 instrument or even 6½x8½ or 8x10. As a rule, a 4x5 or 5x7 camera will be found quite large enough for all ordinary amateur work. It is not many years ago that a hand camera was regarded as a toy rather than as an instrument for serious picture-taking; but this opinion no longer exists, owing to the development of this most useful instrument from the original crude box to the present perfect apparatus.

A hand camera is even better than its prototype on a tripod, in depicting street scenes. In this class of work a tripod camera, erected in a busy thoroughfare, would not only obstruct traffic, but might in the case of some operators be objected to as rendering them disagreeably conspicuous. With a hand camera the amateur can stroll about when and where he will and take a shot here and a shot there, without attracting undue notice or inconveniencing anybody. For cyclists, too, a hand camera is most convenient, as it is compact, easily carried, and can be used at a moment's notice during a ride.

Hand cameras may be divided into four classes, as follows:

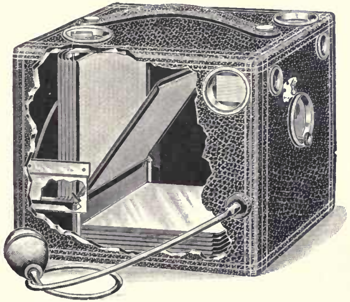


FIG. 1. MAGAZINE CAMERA.

Class 1. Magazine Cameras. (See Fig. 1.)—Those in which a number of plates or cut films are stored in a chamber or magazine, the plates being changed after each exposure by means of mechanism. These are known as Magazine Cameras.

In this class the plates are usually placed in metal carriers, and as a rule each camera holds twelve plates. Several forms of hand cameras are made on this principle. This class of camera possesses the advantage of enabling the user to make several exposures in quick succession, and in many cases this feature is a decided convenience.

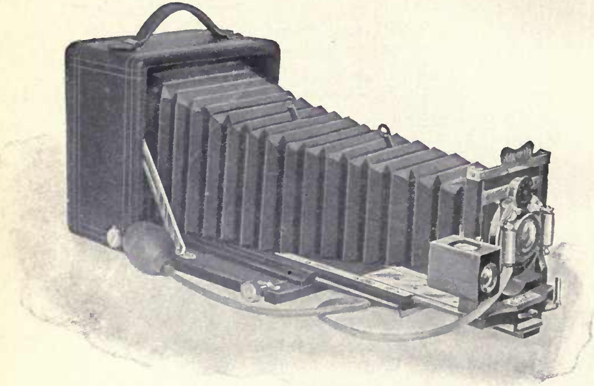


FIG. 2. FOLDING FOCUSING CAMERA.

OK

Class 2. Folding Focusing Cameras. (See Fig. 2.)—Those which are so constructed that when not in use are self contained in a neat leather covered box, but when desired, by pressing a concealed button one side of the box is caused to be lowered, forming a bed upon which the camera front containing the lens and shutter is drawn out, rendering the instrument adaptable for instant use. This style is known as the Folding Hand Camera. They are provided with ground glass screen, tripod sockets, and focusing scale and can be used either as a Hand Camera or upon a tripod as a regular Viewing Camera. In them can be used either dry-plates, sheet films or films in rolls, the various holders required being interchangeable.

A camera of the class of style 2, with plate holders, is specially suitable when a varied range of work is to be done, as plates of different speeds can be carried in the holders and a fast or slow plate can thus be selected according to the needs of the subject to be taken. A plentiful supply of plates is not always a blessing to the hand camera worker, for he is then often tempted to spend a plate on a subject of little or no interest, whereas, if only a smaller supply of plates was available greater care in the selection of the view would be expended.

FIG. 3. FIXED FOCUS BOX CAMERA.

Class 3. Fixed Focus Box Cameras. (See Fig. 3.)—Those known as Fixed Focus or Box style, in which the plates are contained in plate holders.

The cameras in this class are usually provided with space for three double plate holders, taking six plates. In some instruments there is space for carrying all three holders in the body of the camera while in others there is only room for one holder, the other two being carried in the pocket. (See Fig. 3.)

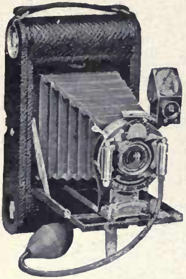


FIG. 4. NO. 3 FOLDING POCKET KODAK WITH B. & L. AUTOMATIC SHUTTER.

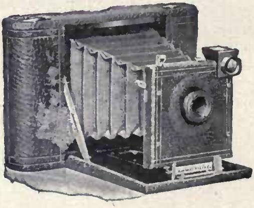


FIG. 5. FOLDING POCKET KODAK.

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Class 4. Kodaks. (See Figs. 4 and 5.)—Cameras in which flexible films in rolls are used instead of glass plates, the film being wound on spools or rollers. The action of winding up the exposed portion of the film unwinds a fresh portion ready for the next exposure.

The cameras in class 4 appeal perhaps most strongly to the tourist and holiday-maker as they enable material for a large number of exposures to be carried with very little weight. There are some most excellent instruments of this kind on the market, which are well worth attention. Many styles are made in such compact form as to permit of their being carried in any ordinary coat pocket. These are known as Folding Pocket Kodaks.

ON SLATE RIVER. GOGEBIC.

By courtesy C. & N.-W. Ry.

With a focusing camera the operator is enabled to compose or arrange his view on the ground-glass focusing screen; but in a strictly hand camera this process is performed by means of a little appliance termed a view finder.

All hand cameras using rectangular shaped plates should be provided with either two view finders or a reversible finder, to enable the operator to compose both horizontal pictures and vertical pictures. Many hand cameras are of the "fixed-focus" type. This means that everything beyond a certain distance (usually about 7 to 9 feet) from the camera is in correct focus on the plate, and for the majority of snap-shot pictures a camera of this kind will do all that is required.

If the amateur wishes to go in for portraits and figure studies, however, he should obtain a camera with a focusing arrangement so that nearer subjects can be successfully taken. Apparatus of this kind is described under class 2. This focusing can be performed by examining the picture on a focusing screen and then racking the camera in or out until it appears perfectly sharp, or by judging or measuring the distance at which the subject is placed from the camera and then racking the camera front out until it is set for that distance, as indicated on a small graduated scale termed the focusing scale.

With portraits and figure studies the focusing adjustment is specially required so as to enable the figures to be taken of sufficient size.

On the cheaper kinds of hand cameras single lenses are usually fitted, and, for landscape work such lenses are suitable, but one with a rapid rectilinear lens is to be preferred, if the extra cost can be afforded.

The shutters supplied with hand cameras are extremely varied in design. The shutter should be both set and released from the outside of the camera, and the latter operation should be performed without the necessity for undue movement or pressure. It should be capable of being adjusted for various speeds, and should have an indicator to show the various speeds at which it works. The range of adjustment should be from about one-tenth of a second to not less than one-fiftieth, and the shutter should also be capable of giving time exposures if necessary. When it is desired to give a time exposure with a hand camera, it is usual to rest the instrument on a convenient fence or post, or else on a tripod. A further point with regard to the shutter is that it should not uncover the plate when being set. For ordinary snap-shot work a shutter speed of about one-twenty-fifth of a second is generally sufficient. The higher the speed of the shutter, the greater the danger of under-exposure.

As far as possible, all the movements should be accessible from the outside of the camera and the various working parts should be easily accessible for cleaning, adjustment, and repair. A numerical indicator should be connected to the plate-changing mechanism, in the case of Magazine Cameras, to show how many plates have been exposed, and it should be possible to remove the exposed plates at any time without interfering with those which may still be unexposed.

It is now almost a universal practice among Hand Camera makers to furnish their apparatus' complete with lens, shutter and plate holder, thus saving the prospective purchaser the trouble of selecting each item separately.

CHAPTER III.

VIEWING CAMERAS. FEATURES OF CAMERAS.

Size of the Outfit.—Camera manufacturers have adopted a series of standard sizes for their instruments. Very large cameras may be left

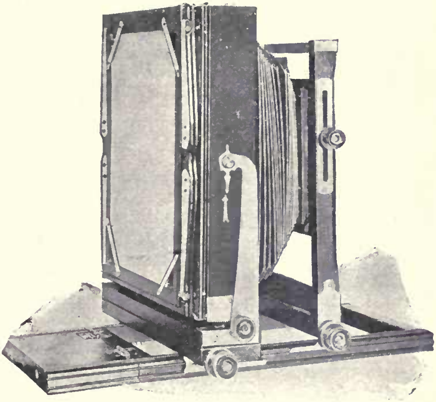


FIG. 6.

out of the question, as unsuited to the general requirements of amateur workers, and the following sizes may be considered as those from which a selection should be made. The figures given are the dimensions of the largest picture which each camera is capable of taking:

5x7-in., 5x8-in., 6½x8½-in., 8x10-in.

Of the foregoing sizes there are two the use of which largely preponderates. These are 5x7 and 6½x8½. If the reader wishes to keep both his initial and working expenses as low as possible, he should content himself with the smaller of these two sizes. When he has gained some experience and is fairly proficient, he may perhaps feel tempted to employ a 6½x8½ camera. All things considered, however, a 5x7 instrument is the best size for the beginner to commence with. By a simple contrivance known as a "kit" smaller pictures can be taken with a 5x7 or larger camera, so that if the reader wishes to experiment in a small way at the start, it is a very easy matter for him to do so.

The Points of a Good Viewing Camera.—A knowledge of the features which a good camera should possess will be of service to the reader when selecting an instrument. Since the camera has to be carried about from place to place it should be as light as possible, and it should fold up into a small compass. These qualities, however, should not be obtained at the sacrifice of rigidity, for it is upon the firmness of the camera and its support, that the sharpness of the resultant picture largely depends. The front of the camera should be provided with a rising and falling adjustment, so that the lens may be moved above or below the level of the center of the plate, though it should be exactly opposite this point when in its normal position.

The bellows should be made of leather or bellows cloth, and may be either parallel or tapering in shape. The latter kind is known as a "conical" bellows, and is generally preferred on account of the saving in weight which their use allows. (See Fig. 6.) When a conical bellows is fitted, the purchaser should satisfy himself that if the back of the camera is moved close up to the front, as is the case when using a short-focus lens, no part of the picture on the plate is cut off.

It is essential for good work that the camera should be provided with what is termed a "swing-back," and the amateur will also find it of great advantage to have a camera with a reversing back, that is a back which will fit in both a horizontal and a vertical position. As will be seen from the foregoing list of standard sizes the plates are made oblong in shape, and the reversing back enables the plate to be used either vertically or horizontally, as required.

With a 6½x8½ camera, sufficient adjustment should be provided to enable an extension of not less than 16 or 17 inches to be made. The woodwork of the camera should be of well-seasoned mahogany.

Features of Cameras.—In the foregoing pages the terms: swing-back, view-finder, etc., have been used and the reader will derive a full comprehension of a definition of the meaning of these terms from the following detailed explanation:

The Swing Back.—In making pictures of buildings or of any subject other than purely landscape ones, the sensitive plate should be in a perfectly perpendicular plane with the subject in order to obtain good results. The purpose of a swing-back is to keep the place always absolutely perpendicular. (See Fig. 7.) To include the top of a tall building or church spire, or secure more of a subject than can be obtained with the camera in its normal position, it is often nec-

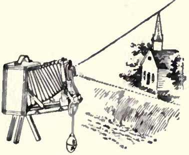


FIG. 7.

essary to tilt it, and under such conditions, with a rigid back, the lines of the resulting photograph will converge more or less at the top, as the plate will be at an angle with the subject. If, however, the back of the camera is made to move or "swing" independently, then, even though the camera is not level, the sensitive plate can be placed parallel with the subject and straight lines secured—or, in photographic parlance, there would be no distortion, but a perfect rectilinear effect. A swing-back is not absolutely essential for hand work and in fact is not used to so great an extent with 4x5 cameras as with larger sizes. Nevertheless it will be found very convenient for tripod exposures, and indispensable under conditions noted above.

The Rising and Falling Front.—The purpose of a rising and falling front is to shift the lens

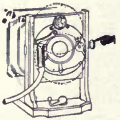


FIG. 8. RISING AND FALLING FRONT.

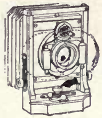


FIG. 9. DOUBLE SLIDING FRONT.

above or below the center of the sensitive plate—its normal position—in order to include more or less foreground. (See Figs. 8-9.) It will also be found an aid in securing the upper part of a building or similar subject, which could not be covered by the lens if at the center.

The Reversible Back.—A reversible back camera, to the casual observer, does not differ in appearance from the ordinary type, but it has decided advantages. The back frame which carries

DELAWARE WATER GAP.

Taken by an amateur during a trip over the Lackawanna Railway lines.

the sensitive plate can be placed either upright or horizontal at will—without changing position of the camera—a decided advantage, especially when making tripod exposure. Fig. 10 shows the camera back with a plate in a horizontal posi-

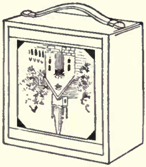


Fig. 10.

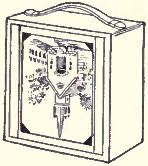


Fig. 11.

tion; a portion of the subject being cut off. By reversing the back the plate will be vertical, as in Fig. 11—the whole subject included, and often a more artistic effect obtained.

Rack and Pinion.—This is a metal roller device working in a milled track used on the bed for moving the front of camera, to which lens and shutters are attached, backward or forward, until the proper focus is obtained.

In the cheaper apparatus this is accomplished by means of a lever or hook; but this method is inconvenient as compared with the use of the rack.

The View Finder is in reality similar to a miniature camera, consisting of a lens and reflecting mirrors. Its purpose is to give an exact reproduction, in miniature size, of the view as it will appear on the negative. Finders are made in various forms, adaptable to use upon either folding or non-folding cameras, as the case may be.

The Ground Glass or "Focusing" Screen.—At the back of a tripod camera there is a frame in which is fixed a sheet of ground glass. This glass is termed the "focusing screen." On this the picture to be taken is arranged and focused. When the camera is first set up and pointed at the object to be taken, the picture will probably appear very indistinct and fuzzy. The amateur may be surprised also to find that the picture appears upside down on the glass; but this is the natural result of the action of the lens, and is a peculiarity to which he will soon get quite accustomed. The front of the camera is then moved in or out by means of a rack and pinion movement until the picture appears sharp on the ground glass.

CHAPTER IV.

LENSES: DIAPHRAGMS OR STOPS.—DEFINITIONS OF TERMS USED IN DESCRIBING LENSES.

Lenses.—The next member of a complete photographic apparatus to receive attention is the lens. Lenses of many names, mystifying in the extreme to the novice, are advertised; but these may be divided into five classes, four of which are in general use. The fifth (the Tele-Photo) is at present but little understood. The four in general use are: First, the Single Lens (single combination): second, the Rapid Rectilinear Lens (Double combination); third, the Wide Angle Lens (Double combination); fourth, the Portrait Lens (Double combination).

FIG. 12. PLANO-CONVEX.

FIG. 13. MENISCUS.

Single Lenses are made in two forms, meniscus (see Figs. 12-13) and plano convex. The meniscus form is always employed except in the cheapest class of cameras. These lenses are always mounted behind the diaphragm which controls the amount of light to be admitted through the lens.

A Single Combination lens, as its name implies, contains but one "combination," a combination being two or more glass elements cemented together with Canada balsam. The chief advantage which the single lens offers to amateur workers is that it is considerably lower in price than the other types and is used in cameras making pictures 4x5 inches or less in size. For landscape photography and for figure studies, a good single lens will prove very satisfactory. To the amateur, however, who wishes to do as great a variety of work as possible with one lens, the single type has a great disadvantage in that it is entirely unsuited for taking any subject where straight lines have to be included, such as in photographs of buildings, copying drawings, etc.; for in such cases it distorts the straight lines into a more or less curved form, hence this type of lens is not suitable for making pictures larger than 4x5 inches.

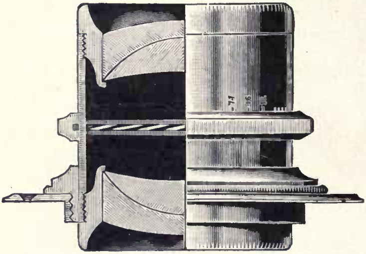


Fig. 14.

A Rapid Rectilinear or Double Achromatic Lens is composed of two single achromatic lens combinations mounted one in each end of the lens tube, placed face to face. (See Fig. 14.)

When a stop is placed in front of a single lens the image produced is "barrel shaped," and when the stop is placed back of the lens the image is "pin-cushion" shape. The stop in the rectilinear lens being placed between the two combinations is, of course, in front of the back, and back of the front combinations. It is very evident, then, that the distortion of the one would be counteracted by the distortion of the other, and hence the result—a straight line. This defect of the one being counteracted or corrected by the defect of the other permits of a large aperture being used in comparison with that of the single lens, hence the name Rapid Rectilinear.

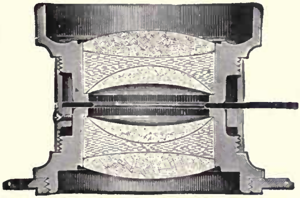


FIG. 15.

Undoubtedly the best kind of lens for all-round work is the rapid rectilinear, as the pictures taken with a lens of this type are absolutely free from distorted or curved lines.

A further advantage of this lens over the single lens is that it is much quicker in working. A rapid rectilinear lens may be used with good results for any of the following classes of work:

Landscape, architectural subjects, copying, portraits, groups, and figure studies. It is also very suitable for instantaneous and snap-shot pictures.

Rapid rectilinear lenses are made in many grades and of many types, and are marketed under various names, such as Rectilinears, Anastigmats, Symmetricals, etc., the double Anastigmats being the highest grade.

The Stigmatic and Anastigmatic Lenses (See Fig. 15), of which there are a number of different series manufactured, are a new form of lens of comparatively recent invention. They are certainly of the highest plane to which the photoraphic optician has obtained. They are made of the new Jena glass and the various series are composed of from two to eight lenses.

They are of convertible form and they may be used with either front or back combinations separately. By so doing three different focal lengths are obtained and the possessor of these lenses has in reality three lenses combined in one.

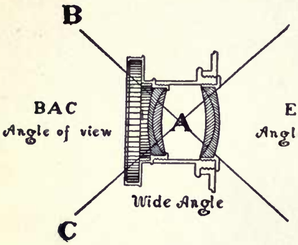


FIG. 16.

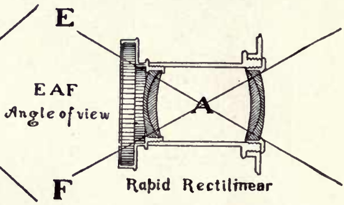


FIG. 17.

The Wide Angle Lens is very similar in form and the same in principle as that of the Rapid Rectilinear; the chief difference being that the lens combinations are mounted closer together and the curvature greater in the same focal length of lens.

Fig. 16 represents one of the most common forms of wide angle lenses. It will readily be seen by the construction of the lens-mount that it will permit of a very wide angle of view to pass through to the plate, while in the Rapid Rectilinear (Fig. 17) the angle would be cut off by the length of the barrel.

It must not be understood that because one is the possessor of a wide angle lens he will be able to obtain the angle desired on any size of plate he may wish to use. A wide angle lens is so called because its angular capacity is large in proportion to its focal length. But if we have a lens of, say, six inches focus, with an angular capacity of 100 degrees and a 4x5 plate be used, it will readily be seen that we do not utilize the full capacity of the lens, and hence only a comparatively nar-

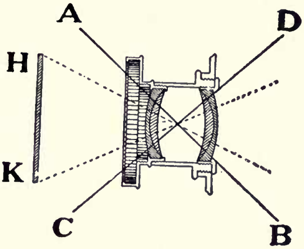


FIG. 18.

row angle of view is obtained. In Fig. 18 the lines ab and cd indicate the angular capacity of the lens. A 4x5 plate being used, the base line, or 5 inch side, H K represents the angle obtained, which is less than half the capacity of the lens.

A wide angle lens is intended for use in confined positions, and for photographing high buildings in narrow thoroughfares, for interiors of small rooms, and for similar work, it is almost indispensable. A disadvantage attaches to its use, however, in the fact that the perspective of the view so taken appears exaggerated and displeasing to the eye; but since there is no means of taking many subjects except by the aid of such a lens, this alteration in the appearance of the perspective must be accepted.

The Portrait Lens.—A Portrait Lens may be considered one of the crowning successes of the photographic optician. Although invented a number of years ago, no photographer's outfit of the present day would be considered complete without one. They are specially designed for very short exposure and are from four to six times as quick working as the ordinary rapid rectilinear lens. They cover a very small plate in proportion to their focal length and consequently possess a narrow angle. The image produced is very soft and pleasing to the eye and the most artistic results in portraiture are produced with them. The lenses of the back combination are separated by an air space which, together with their extremely large apertures, produce the fine soft effect.

Lenses of this type are intended for Portrait work only and they are of little use for any other class of work.

The Tele-Photo is a distinct type of lens of which a brief description is given on account of its distinction from the other lenses and its usefulness in the production of long-distance views. It is composed of two individual combinations; a collective or positive combination and a dispersive or negative combination. The office of the collective lens is to collect as many as possible of the rays of light which are reflected from the object to be photographed, and to focus them within the radius of

MINNEHAHA FALLS.
Taken by an amateur during a vacation trip over the Chicago, Milwaukee & St. Paul Ry.

the dispersive combination, which projects an enlarged image upon the plate. In this manner a large image of a distinct object may be obtained with a comparatively very short bellows draw. They are very useful in photographing distant mountain scenery, vessels far out at sea and various animals for the study of naturalists, pictures of which it would be impossible to obtain at close range.

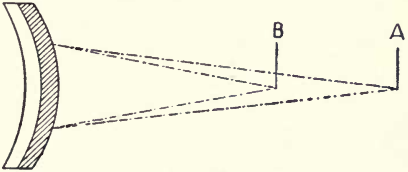


FIG. 19.

Fixed Focus Lens.—The repeated mention of this lens in catalogues and advertisements has created an impression that it is some distinct kind of lens, with the extraordinary power of focusing all objects near and far in one plane. There is no inherent quality in any lens that makes it "fixed focus"; it is such when it is immovable and that is all. Any lens can, therefore, be made "fixed focus" but the extent to which it will focus all objects in one plane depends upon its length of focus and size of stop or diaphragm used, and upon that only.

The reason for this is that the rays of light from near and far objects do not focus at the same point. For instance, we will assume that B, in Fig. 19, is the point at which objects one hundred feet distant will focus and that A is where objects 10 feet distant will focus. Now the distance between A and B will vary in ratio to the focal length of the lens. In a lens of 3 inches focus it is ascertained mathematically to be 3-16 of an inch and in one of 12 inches focus, 1¼ inches. Hence if using a 3 inch focus lens the sensitive surface is placed between A and B the object at 100 feet and beyond (all objects beyond 100 feet come practically within one focus) and objects 10 feet distant will none of them be more than 3-32 out of focus, which, with the size of stop ordinarily used for snap work, creates so slight a blurring of the image that it cannot be detected. Experience has shown that the limit of focus for a lens which is to be employed for snap shot work with the focus fixed is under 5½ inches; in other words that a 3¼x4¼ plate is about the largest that can be used to advantage under such circumstances. It is probably true that for cameras of this size and under, nothing can be gained by having the focus adjustable and that, on the other hand, better average results will be obtained with a fixed focus, owing to the fact that there is no adjustment that will allow the lens to be put out of focus by a mistake in measuring distances.

Diaphragms or Stops.—All lenses are provided with "diaphragms" or "stops," for the purpose of regulating the size of the aperture through which light can pass. There are three kinds of diaphragms fitted to lenses, viz.: Waterhouse diaphragms, Iris diaphragms and rotary or wheel diaphragms. A Waterhouse diaphragm is a small piece of sheet metal, having a circular hole made in the center. This is inserted in a slot cut in the brass lens mount and blocks out all the light except that which passes through the hole. A set of these is provided, having different sized holes. An Iris diaphragm consists of a set of thin plates overlapping one another and fixed inside the lens mount. These are so arranged that when a circular ring that is fitted to the outside of the mount is rotated, the plates move in or out and so vary the size of the opening in the center, the action being very similar to the action of the iris of the human eye. A Rotary diaphragm takes the form of a circular disc, with several different sized holes therein. This is pivoted on the lens mount, and as it is rotated one or the other of the various holes comes opposite the center of the lens opening.

The two former kinds of diaphragms are those most commonly used, and for general convenience the Iris pattern is greatly preferred. It has the advantage of being in one with the lens mount, so that it cannot be mislaid or left behind as is the case with the Waterhouse type. An Iris diaphragm is a little more expensive, but its extra quality justifies the investment. Rotary diaphragms are often used for hand camera lenses.

A volume might be written on the subject of stops, but a few lines will suffice to give the amateur an idea of why they are necessary, and how they should be used.

The best part of a lens is its center, i. e., those rays of light which pass through the lens at or near the center will be correctly refracted and will therefore give the image clear and sharp on the ground glass, while the rays which pass through the outer edges of the lens will not make such a clear and distinct image. It can thus be seen that the smaller the stop opening the sharper the picture, because the outside rays will be cut off. But it will be discovered that with a small diaphragm or stop opening the light is to a great extent cut down. If the beginner has a camera with focusing glass it will be well for him to focus on some object on the ground glass, using the largest diaphragm and carefully noting the lines to see if they are sharp. Then let him put a smaller stop in position, noting the increase in sharpness and the decrease in light. The better the lens the larger the stop opening which can be successfully used, and consequently the "faster" the lens. Suppose one lens of 8-inch focus is employed and that in a given light a clear, sharp picture is made in 5 seconds with a stop one inch in diameter, while with another lens of same focal length a stop only one-half inch in diameter must be used in order to get a sharp picture. How would they compare in speed? Nine people out of ten will jump at conclusions and say that the lens with the half-inch opening must be given 10 seconds. In this case the first impression is not correct. Four times the time or 20 seconds must be given because the area of the one-inch stop is four times that of the half-inch stop. A simple little rule can be deduced from this, and if the correct exposure with one stop is known the correct exposure for the others can readily be ascertained. The time variation between two stops is inversely as the square of their diameters.

With most single-lens cameras there are stop-openings of three sizes, the largest, for ordinary snap shots, the second (which has about 2-3 the diameter of the largest), for snap shots on the water and in tropical or semi-tropical climates or for time exposures indoors, and the smallest, ordinarily used for time exposures out of doors—never for snap shots.

With the double lenses there is a greater number of stop openings and they are arranged upon what is known as the Uniform System, commonly abbreviated to "U. S."

Of course when in a general way it is said that the speed of a lens depends upon the diameter of the stop opening it is not meant, for instance, that a Pocket Kodak stop opening must be as large as the diaphragm in the lens of an 8 x 10 camera in order to have the same speed, but it must be as large in proportion, and that proportion is based upon the length of focus (the distance between lens and plate) of the lens. The proportionate size or the "value" of the stop opening is designated by *f*, and is the quotient obtained by dividing the focal length of the lens by the diameter of the stop. For instance: a lens of 8-inch focus with a stop one inch in diameter gives $8 \div 1 = 8$. Hence, 8 is the *f* value of the stop and would be designated: *f* 8. Suppose the stop is ¼ inch in diameter, then $8 \div \frac{1}{4} = f\,32$.

For convenience the Uniform System of marking stop openings has been adopted by nearly all manufacturers of Iris diaphragms and the following table will help the amateur to understand the meaning of these markings by giving the *f* value for each one:

U. S. 4	= *f* 8
U. S. 8	= *f* 11.3
U. S. 16	= *f* 16
U. S. 32	= *f* 22.6
U. S. 64	= *f* 32
U. S. 128	= *f* 45.2

The convenience of the U. S. system is at once apparent when it is understood that each higher number stands for an opening having half the area of the preceding opening. Between each number, therefore, the time is doubled. If stop No. 16 is used twice is given or if No. 32 four times the time of the table, while with stop No. 4 only one-half the time of the table would be given.

Ordinarily the appended table is a good one to follow in the use of the stops with a rapid rectilinear lens, but there are some exceptions:

No. 4.—For instantaneous exposures in slightly cloudy weather and for portraits. Instantaneous exposures on dark, cloudy days should not be attempted.

No. 8.—For all ordinary instantaneous exposures when the sun shines.

No. 16.—For instantaneous exposures when the sunlight is unusually strong and there are no heavy shadows; such as views on the seashore or on the water, or in tropical or semi-tropical climates: also for interior time exposures.

Nos. 32 and 64.—For interiors. Never for instantaneous exposures.

No. 128.—For time exposures outdoors in cloudy weather. Never for instantaneous exposures. The time required for time exposures on cloudy days with smallest stop will range from ½ second to 5 seconds, according to the light. The smaller the stop the sharper the picture.

If the smallest stop is used for instantaneous exposures, absolute failure will result.

The No. 4 stop is not to be used when absolute sharpness is desired, as the opening is so large that few lenses will have a good "depth of focus" with it—i. e., only the objects at the exact distance focused will be sharp, those nearer by or farther away being more or less "out of focus."

Sharpness is extremely desirable in a picture; but what is called "roundness" and "atmosphere" is perhaps fully as important. What is meant by these rather vague terms is sometimes puzzling to the beginner and they are, perhaps, best explained as referring to that quality in a picture which gives the proper idea of both distance and perspective—that quality which is the opposite of the silhouette; which makes every object appear in proper relation to every other object and gives life and character to the picture. "Atmosphere" and "roundness" are somewhat lost by using too small a stop. The largest opening which will give a sharp picture should therefore be used.

DEFINITIONS OF TERMS USED IN DESCRIPTION OF PHOTOGRAPHIC LENSES.

Achromatic.—White light passed through a prism or a single lens will be separated into colors, the same as those of the "rainbow." These colors are called Chromatic. A lens that is so corrected that it does not separate the light into colors is called Achromatic. This correction is made by placing together two lenses, one a converging and the other a diverging lens; these two lenses together are called a single combination. A double combination consists of two of these combinations in the same lens system or same lens barrel.

Anastigmatic (See Stigmatic).—Indicates that the lens would not reproduce a perfect point, but has been corrected and made to do so.

Angular Capacity.—All that a lens can take, the diagonal of the largest plate it will cover.

Aperture.—The entire surface of the lens.

Bi-Concave.—A lens with both sides curved in is called Bi-Concave. It is thinner in the center than at the edges.

Bi-Convex.—A lens with both sides curved out is called Bi-Convex. It is thicker in the center than at the edges.

Combination.—Single, Double (See Achromatic).

Convergent.—Lines or rays of light coming together at a point are called Convergent.

Concave.—The inner side of a curve.

Convex.—The outer side of a curve.

Definition.—The markings which go to make up a picture. Good definition shows all the markings; poor definition shows only a part of them.

Degree.—One of the 360 parts into which a circle is divided.

Diaphragm.—Any instrument or device used to cut down the amount of light passing through a lens is called a diaphragm or stop.

Diffusion.—A separation or a breaking up—mixing together. Diffusion of focus, a separation of the rays of light so as not to produce a sharp focus.

Distorted.—Drawn out of the proper shape.

Divergent.—Separating. Lines proceeding from a point within a half circle are called divergent.

Elements.—Each separate lens which goes to make up a lens combination is called an element of that lens.

Ellipse.—A flattened circle.

Focus.—The point where convergent lines or rays of light cross, after passing through the lens, is called the Focus.

Intensity.—The size of the opening of a lens admitting the light to the plate is called its working intensity.

Lens-Mount.—The casing into which a lens is fastened is called the Lens-Mount.

Objective.—A lens or lens combination.

Plano-Convex.—A term used to indicate that one face of a lens is flat and the other convex.

Plano-Concave.—Indicates that one face of a lens is flat and the other concave.

Posterior.—Farthest toward the rear, as the back lens.

Ray.—A single line of light coming from a point.

Rectilinear.—Indicates a straight line. A lens is said to be rectilinear when it will produce straight lines anywhere on a plate.

Stop.—(See Diaphragm.)

Stigmatic.—From stigma, a point. A lens is called stigmatic, when it will reproduce perfect points, or both horizontal and perpendicular lines, sharp all over the plate at the same time.

Simple.—Composed of one only.

Tele-Photo.—From Tele,—afar off, and Photo,—an abbreviation of photograph. A Tele-photo lens is a lens specially constructed for photographing objects a long distance away.

AMERICAN FALLS FROM GOAT ISLAND.
Courtesy of Michigan Central Ry.

CHAPTER V.

SHUTTERS.

If the reader wishes to take photographs of moving objects, a shutter must be obtained. For all ordinary work requiring exposures of ½ second and upward, such an article is not absolutely necessary.

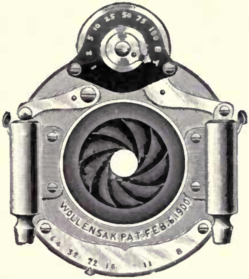


FIG. 20.

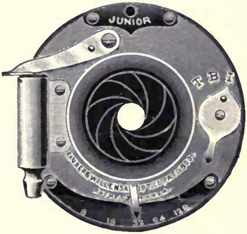


FIG. 21.

The shutter is usually attached to the lens, and in its most simple form may consist of a piece of wood or metal, in which an opening is cut, and which slides up and down in a frame supported by the lens. As the opening in the slide passes in front of the lens, the exposure is made, the duration of which depends on the size of the aperture and the speed at which the slide is moving. In most shutters of this type, the motion is obtained by allowing the sliding piece to fall by its own weight when released, though the speed thus obtained may be considerably increased by using an extended India rubber band to exert a pull. In more expensive forms of shutters, such as the Thornton-Pickard, roller-blinds are used with excellent results, the shutter being set by simply pulling a cord and the release being made by squeezing an India rubber bulb attached to a closed tube, this action releasing the spring mechanism which actuates the blind. The characteristics of a good shutter are as follows:

It should be light and not unwieldly in shape. It should work quietly and without imparting vibration or jar to the camera. It should be adjustable for various speeds and for time and instantaneous exposures. It should be certain in its action and it should enable the operator to effect the release without taking his eyes off the object to be photographed. A good, though not absolutely essential feature, is that the shutter should be capable of being set without the necessity of covering the plate during the operation. If the shutter does not admit of this being done, the difficulty can easily be overcome by setting the shutter before drawing the slide of the plate. When photographing children or animals, the best results are obtained with a shutter which works as noiselessly as possible.

Excellent forms of shutters are those supplied with Iris diaphragm and which are provided with the mechanism for making instantaneous time and bulb exposures. There are several forms of these now on the market and all are provided with both finger and pneumatic bulb release, and work automatically for instantaneous exposures from 1-100 to one second or over. Figs. 20 and 21 are illustrations of most popular forms.

Portrait Shutters.—In doing portrait work in the studio with the special portrait apparatus the lens used is generally a regular portrait objective and is too large in diameter to permit of its being fitted to any of the ordinary forms of shutters which are applied to viewing lenses.

To overcome this difficulty and to permit of instantaneous work being done with lenses of this type, special portrait shutters, known as Lens Board Shutters (see Fig. 22) have been devised. These are designed to be fitted to the

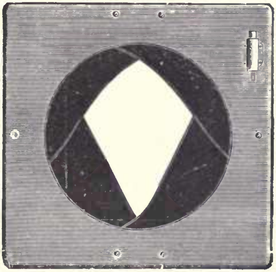


FIG. 22.

back of the lens board of the camera, directly behind the lens. Because of their large size, however, they are adaptable for use only in cameras having large lens (front) boards.

Portrait shutters are also made to fit over the tube of the lens at the front but as this form is cumbersome their use is generally confined to cases where the photographer possesses a camera with too small a lens-board to permit the use of a lens-board shutter and a lens too large in diameter to be fitted with a diaphragm shutter.

CHAPTER VI.

THE PLATE HOLDER — THE ROLL HOLDER—THE TRIPOD—THE FOCUSING CLOTH—THE CARRYING CASE.

The Plate Holder. (See Figs. 23-24.)—The plate holder holds the plate for exposure and fits the camera-back between the ground glass screen and the camera body. It is not placed in position until after the picture has been focused on the ground-glass screen. Then when the plate holder is inserted and the slide drawn, the sensitive side of the plate

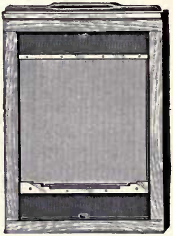


Fig. 23. Fig. 24.

Adjustable Plate Holder.

occupies exactly the same position as the ground-glass screen. Plate holders are generally made to hold two plates back to back, with a fixed opaque-division piece of sheet metal or cardboard in between. This prevents the light which falls on one plate during exposure from injuring the plate behind.

When an exposure has been made on one of the plates the holder is removed from the camera, until it is necessary to make the next exposure. It is then replaced in a reversed position, thus enabling the second plate to be used.

Most cameras as sold are provided with one double plate holder, but it is advisable to purchase at least two extra, so that when a day's photographic outing is made, enough plates for six pictures can be taken. If three holders are bought, they should be numbered consecutively on both sides—1 and 2, 3 and 4, 5 and 6, so that the exposures may be recorded as made and the plates subsequently identified in the dark room.

The Cut Film Holder.—This holder is identical in external appearance with the plate holder. It, however, differs somewhat in internal construction.

Cut films being much thinner than glass plates and being flexible the inner arrangement of the holder for them is made to suit their peculiarities.

In loading holders with cut films and in exposing films in the camera the directions are exactly like those given for dry plates.

The Cartridge Roll Holder. (See Fig. 25.)—This is a special holder in which is used film wound upon spools and known as film cartridges. These cartridges are light-proof and dust-proof and can be loaded into the roll holder and taken from same in broad daylight, thus rendering access to a dark room unnecessary for these operations. The cartridge roll holder is intended for use with hand cameras and when applied to a plate camera is interchangeable with the plate holders and cut film holders ordinarily used with the apparatus.

The application of a roll holder to a plate camera converts the instrument into a combination plate and film camera, a most useful and desirable apparatus.

The Tripod. (Fig. 26.)—In choosing a tripod the great point to study is rigidity, and also worthy of consideration, though of lesser importance, is the question of compactness and portability. The fewer the joints in a tripod, the

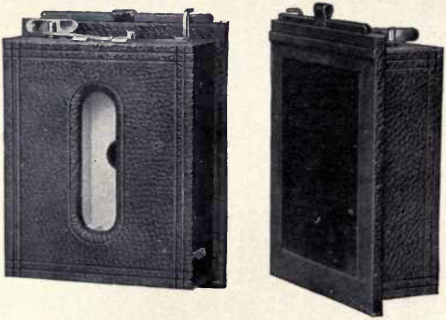


Fig. 25.

more rigid it is likely to be, and for this reason a two-fold is likely to be better than a three-fold one, though the latter can be packed into a more convenient form for carrying. The tripod is provided with a top or head, of either triangular or circular shape, and to this head the baseboard of the camera is attached by means of a thumbscrew.

Of all the pieces in the amateur's kit, there is not one which is so liable to get lost or left behind as this tripod screw, and therefore it should be attached by means of a string or light chain to the tripod head. The tripod head should be covered with felt or leather, as the camera can then be screwed down without receiving scratches or other damage.

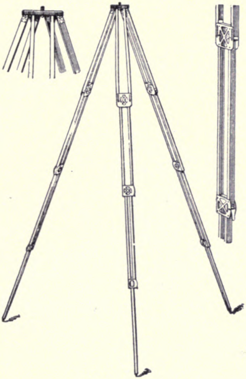


FIG. 26.

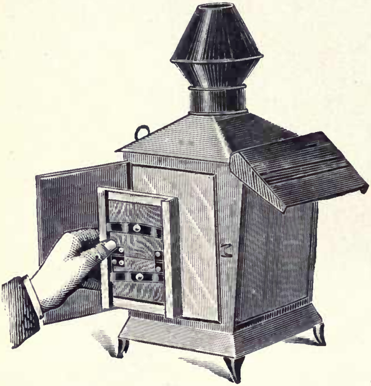
Focusing Cloth.—A focusing cloth will be required to shut out the light from around the ground glass screen when focusing, to enable the operator to see his subject on the glass to advantage. A focusing cloth may be of gossamer, rubber or ladies cloth and be purchased ready-made.

Carrying Case.—Having collected the various pieces of his outfit, the amateur will require a case to carry them. For ordinary traveling, a canvas case is sufficient, but if the case is to contain the entire apparatus, it should be provided with a broad strap and grip handle.

CHAPTER VII.

THE DEVELOPING AND PRINTING OUTFIT.

The Ruby Lamp.—As will be explained in another chapter, the sensitive plates upon which the photographs are taken must not be allowed to re-



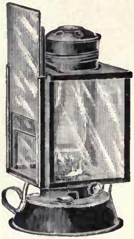


FIG. 28.

FIG. 27.

ceive the faintest trace of white light or daylight except that which reaches them when the exposure is made in the camera. They are, however, practically unaffected by a deep ruby-colored light, and, therefore, the operation of opening a packet of plates to fill the camera, and the later operations of developing and fixing, must either be carried on in perfect darkness or by the aid of a lamp fitted with ruby-colored glass. An alternative method, when the above operations are performed in the daytime, is to cover the window of the room used for this purpose with a ruby cloth or fabric, but as this will be referred to again in the chapter on development, I will at present only consider the question of lamps. The cheapest form of ruby lamp has a metal top and bottom, the body being made of a square metal frame, covered with ruby cloth or fabric. The top and bottom portions of this lamp can be taken off, and the body folded up flat, so that the whole thing can be packed in a shallow cardboard box. The light is obtained by placing inside the lamp a small night lamp or the end of a candle. This form of lamp is very useful for changing plates or for occasional developing when traveling, but it is hardly substantial enough for everyday work. It is better to buy a lamp with a good metal body and fitted with a burner for oil. It should be capable of holding a fair supply of oil and the device for raising the wick should be accessible from the outside of the lamp. (See Figs. 27-28.)

Although the color of the glass in the lamp may be red, it does not necessarily follow that the light which passes through it does not affect the plate to some degree. In order to determine whether or not the light is actually safe, the following plan may be adopted: Place a plate in the plate holder in the usual way. Then close the holder and draw the slide so that four-fifths of the plate are exposed to the rays of the lamp. Leave the slide in this position for, say, two minutes. Then push the slide in so that only three-fifths of the plate are exposed, and leave for another two minutes. Then again push the slide in so that only two-fifths are exposed, and leave for four minutes this time. Then push the slide so that it leaves only one-fifth of the plate exposed, and leave this open for another ten minutes. Thus one portion of the plate has not been exposed at all, the next has had two minutes' exposure, the next four minutes, the next eight minutes and the last eighteen minutes. The plate should then be developed in the ordinary way, as explained in Chapter on Developing, and it will be readily seen by comparison with the appearance of the exposed part how far the light has affected the remaining portions of the sensitive surface. The actual time that a plate is exposed to the light of the lamp during an ordinary case of development is not above, say, two minutes, so that if this exposure to the lamp produces no injurious effect the light may be regarded as fairly safe. The process of developing and fixing of course takes longer than two minutes, but all careful workers make a point of keeping the plate carefully screened from the direct rays of the lamp, except when a close scrutiny of the image is necessary.

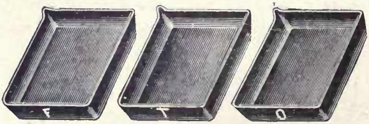


FIG. 29.

Developing Trays.—The smallest number of dishes which will be required for developing the negative is two, one for the developing solution and one for the fixing solution; but an extra dish should be procured, however, as in some instances an alum bath is required. These dishes are made in various materials, such as porcelain, fibre and rubber. It does not matter very much which of these materials is selected. Fibre dishes are, perhaps, as cheap as any, and they are also very light. The dishes chosen may be purchased stamped with the letters T, D and F, which mean: Toning, Fixing, Developing. (See Fig. 29.) This will make it easy to always keep the same dish for the same purpose—a precaution which should invariably be adopted.

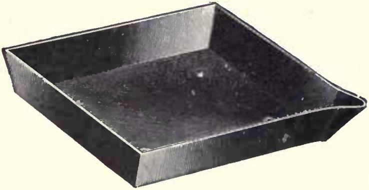


FIG. 30.

Toning Trays.—The dishes employed for toning should be deeper than those used for developing, as it is usual to tone a number of prints together in the same dish, and there should be plenty of room for the prints to be always kept on the move. Perhaps rubber or fibre dishes are the best for this purpose, and to facilitate manipulation of the prints the dishes should preferably be a size or two larger than those used for development. (See Fig. 30.) Two dishes will be required, one for fixing and one for toning. In thus stating the number of dishes required it is assumed that the amateur will be able to obtain the use of some large sized domestic dishes, which are very useful for washing plates and papers. If this cannot be done, a few large trays for this purpose should be purchased.

Scales. (See Fig. 31.)—For the purpose of weighing out the various chemicals employed in mixing solutions, the amateur will require a small pair of scales. The chief point to be considered is that the pan in which the substance to be weighed is placed should be made of glass. Glass is preferable to brass in that it is not likely to have any contaminating effect on the substance placed therein, and also it is much easier to keep clean.

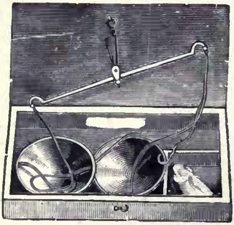
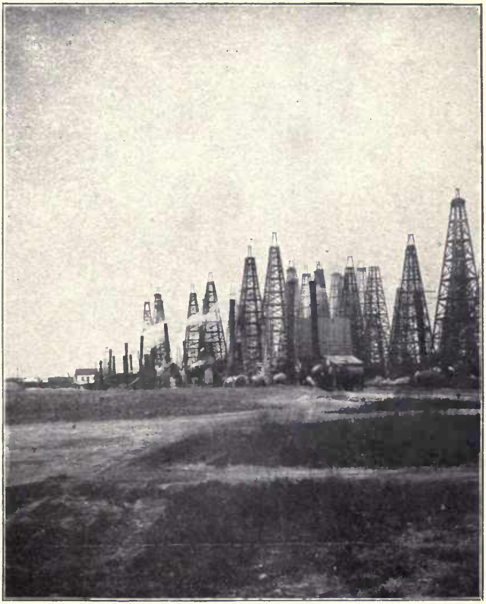


FIG. 31.

Graduated Glass Measures.—These are required for measuring and mixing solutions, and two of different capacities should be obtained. Usually a two-ounce measure and a four-ounce measure are all that will be required.

FIG. 32.



OIL FIELDS OF BEAUMONT, TEXAS, ON LINE OF SOUTHERN PACIFIC RAILROAD.

Printing Frame.—When a plate has been exposed and developed, it is termed a negative, and from the negative thus produced, paper positives, or "prints," are made by placing the sensitive surface of a piece of prepared paper in contact with the negative and exposing it to daylight. To facilitate this operation a "printing-frame" is employed, made something like an ordinary picture frame, but with a removable back. The back is pressed down by springs, and thus keeps the paper in close contact with the negative. In most printing frames the back is made in halves, so that one-half can be raised occasionally during the printing process, to ascertain what progress the printing is making. (See Fig. 33.) Printing frames are generally made of some hardwood, and that portion of the frame whereon the negative rests should be perfectly flat, otherwise the pressure of the springs may cause the glass to fracture.

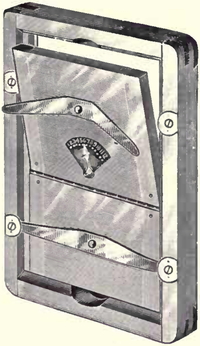


Fig. 33.

CHAPTER VIII.

DRY PLATES — SHEET FILMS — FILM CARTRIDGES

Dry Plates and Celluloid Films.—A photographic plate depends for its action upon the fact that the salt known to chemists as bromide of silver, when associated with some organic matter such as gelatine, has conferred upon it by even a momentary flash of light the property of turning to metallic silver when subjected to the action of certain chemicals. That is to say, when a piece of glass, coated with bromide of silver and gelatine, is exposed in a photographic camera, all those portions upon which the light has fallen are, in some subtle manner, which no one understands, changed in nature, so that when treated with a chemical solution, called the "developer," they are darkened, while those parts which have not been affected by light remain in their pristine whiteness.

It should be pointed out here that red light has little power over a photographic plate. White light is composed of all the colors of the rainbow, mixed in certain definite proportions, and also of a certain amount of light which is invisible—light which is of such deep red color that to our eyes it appears simply black, and the light which is so highly violet, as it were, that we cannot see it at all. The violet rays and the ultra violet rays have the greatest effect upon the photographic plate, and the power of the rays diminishes as you get farther away from the violet end of the spectrum, until—except under certain conditions, which will be explained later on—you come to the yellow, orange, red and infra red, where the effect is almost nil. A photographic plate is not materially affected by red light, and this peculiarity gives the photographer an opportunity of conducting all those operations which would otherwise have to be gone through in the dark, by the aid of a light with which he is able to see what he is doing.

The photographer should decide at the outset upon one brand of plates and stick to it until he has mastered the initial stages of his art. He should not blame the results of his own faults upon the plate-maker and try his luck with another brand, for that leads to confusion.

Each different kind has its peculiarities, which must be studied to be understood, and this understanding will never be arrived at by changing from one brand to another in the hope of finding one upon which a careless photographer will be able to produce a good negative. The nomadic photographer—and most amateurs come under this head, for, in the practice of their art, they wander about the country in search of the picturesque—should decide upon a popular make of plate that he is reasonably sure he can procure in any out-of-the-way town.

When the photographic student sees for the first time a certain make of plates advertised under the name of "Orthochromatic," he is quite at a loss to understand what particular peculiarities are implied by this curious title. Nor will he be much enlightened if he be told that the alternative name for precisely the same thing is "Isochromatic." The former word signifies "correct color," while the meaning of the latter is "equal color," and as photography up to the present is quite independent of color of any description, it being unable to reproduce any of the various tints and shades of nature by a direct photographic process—it is difficult to see just where the application of these words comes in.

The idea that these adjectives are intended to convey when applied to a photographic plate, is that it is capable of reproducing colored objects in their correct tone-relation to one another. Everybody knows who has had a photograph taken that ordinary photography is not able to do this. Not only does it translate all color into sober monochrome, but the tints which it chooses in representing any given hue are generally of a very different shade from that which we would select as being of equivalent light-value. A lady who goes to the photographer to have her portrait taken, in a bright red dress, finds, to her dismay, when the proofs come home, that, as far as that garment is concerned, she appears to be in deepest mourning, while her peacock-blue bonnet is represented as being nearly white.

But if the photographer who has to depict so trying a subject were to use isochromatic plates the red dress would appear of an equivalent shade of gray instead of black, while the blue, instead of appearing white or nearly so, would be of a somewhat lighter shade of grey—in fact, the colors would be reproduced just as a painter would show them if told to translate the subject into black and white.

This result is brought about by treating the plates in the course of their manufacture to a staining process with one of the yellow aniline dyes which gives to the bromide of silver emulsion a much lighter degree of sensitiveness to yellow and red light. Still, the most highly color-sensitized plates are far more susceptible to the action of what are generally called the actinic rays—those which form the blue and violet portions of the spectrum—and before such plates can be made to yield correctly-toned photographs, this super-activity of the blue and violet rays must be reduced to a proportionate potential by filtering out a great number of them and allowing only a suitable quantity to pass. A piece of what we call yellow glass only appears to us to be yellow because it has the power of stopping all the rays of which light is made up, except those which produce the effect which we describe as yellow, and from these rays, which are the only ones to reach our eyes, we get the impression that the piece of glass is yellow.

Now, if a piece of pale yellow glass, or stained gelatine be placed in the lens of the camera in such a way that all the light has to filter through it, a large proportion of the blue and violet light coming from the objects being photographed will be absorbed, and a very much smaller quantity will reach the photographic plate, while the red and yellow rays will pass unobstructed. Then, if a plate be used which has been rendered sensitive to the yellow rays in the manner already mentioned, a photograph will be produced in which the various colors of nature will be represented by different shades of grey of a tone-value which will appear to be equivalent to the tone-values of the original colors.

This process refutes the charge that photography cannot produce colors in their equivalent shade of monochrome. By its aid all branches of photography are improved. Landscapes are rendered in a far more life-like and natural manner, for the bright green trees do not appeal in the old photography. But it is more in photographing flowers or copying paintings that the funereal aspect which was characteristic of orthochromatic process appears to best advantage; for in these the colors are of a more lively nature and of a kind to aggravate the faults of the ordinary photography.

The introduction of a yellow screen into the lens prolongs the necessary exposure to light to about twice to four times the time it would otherwise require, because it filters out many of the more active rays. This is one thing which is to be borne in mind when using the process, and the other is that the plates, being far more sensitive to red light than those of the ordinary kind, very much greater care is required in handling them in the dark-room. Only a very small amount of light of the deepest ruby color obtainable must be allowed to reach the sensitive surface at any time until after development is completed, and this necessity for working in such deep gloom is certainly a great drawback to the process. But where paintings and flowers have to be photographed, or it is desired to reproduce special effects in nature where the colors are of a kind to be spoiled if ordinary plates are used, the disadvantages of the process are well worth braving.

Celluloid Films are coated with the sensitive emulsion, as well as glass plates, and in many cases the traveling photographer will do well to employ them, for they have some advantages over plates. They are much lighter, and a gross of cut films occupies but little more space than a dozen glass plates. Glass plates and celluloid films can in many cases be procured from the same makers and may be treated exactly alike, both as regards exposure and development.

These films are put up in two forms, viz.: Cut (or sheet) films and film cartridges.

The cut films are exactly like dry plates, except that as a support for the sensitive emulsion a sheet of celluloid is used instead of glass. These films are cut into standard sizes and are put up one dozen in a package in exactly the same manner as dry plates. They are used by means of cut film holders and are loaded into the holders and exposed in the camera in exactly the same manner as are dry plates.

Film Cartridges.—These are adaptable for use only in that class of hand cameras generally described as Kodaks and in cartridge roll holders.

FIG. 34.

It is upon the film cartridge that the success of the Kodak system is based. It is this that has made pocket photography practical and has made it possible to do away with the dark room in unloading the camera.

A wooden spool with a flange on each end, between which flanges is wound a long strip of black paper, is the simple principle of the film cartridge. (See Fig. 34.) Attached to the inner side of the black paper is a strip of film; the film strip, however, is several inches shorter than the paper strip, and when all is wound on the spool no light can touch the film.

When all the exposures in the cartridge have been made the exposed cartridge is removed in daylight without danger of injury.

The black paper running the full length of the film, extending beyond each end and threading into the "carrying spool" and into the "winding reel," takes all the tension. There is no strain on the film (which is carried along by the black paper), and there are no joints of film and paper to give way under the pull of the winding reel.

Cartridge films are procurable containing either two, four, six or twelve exposures, or "double-two." The "double-two" cartridges, as the name implies, contain film for four exposures, but are so wound that two exposures may be made and then removed in daylight and the remaining two exposures threaded up for further use; or, if preferred, the operator may make the entire four exposures with a single loading, and he has the option, until making ready for the third exposure, of handling the film in either way.

Exposures with cartridge film are the same as given for plates and cut films. Development of the negative is practically the same as instructions given for developing plates. However, some special instructions in regard to handling them are necessary, and these appear in Chapter on "Developing."

CHAPTER IX.

LOADING THE FILM CAMERA AND ROLL HOLDER — LOADING THE PLATE-HOLDER—FOCUSING.

Let it now be assumed that the embryo photographer has provided himself with the various component parts of his equipment and is anxious to begin active operations. The first step is to

Get Acquainted with the Camera.—"How shall it be loaded?" This is the first question which suggests itself to ninety-nine people out of one hundred, and the answer is, "Do not load it—at least, not until its workings are fully understood."

The shutter should first be tried and worked several times for both time and instantaneous exposures, until perfect familiarity with its action is obtained. Careful note of the diaphragms or stops should be made, and the fact will be disclosed that with the largest opening the greatest quantity of light will pass through the lens in a given time. This will demonstrate why the larger openings for snapshots and the smaller ones for time exposures are used. Having mastered the shutter and the focusing arrangement, if there is one on the camera used, and having obtained a slight idea of the conditions necessary for successful picture taking, the instrument may be loaded.

Camera (or Plate Holder) Loading.—With a kodak or cartridge roll holder this operation is performed in daylight and is very simple. The film is put up in light-tight rolls, and extending the full length of the strip of film and several inches beyond each end is a strip of black paper, which, in connection with the flanges on the spool, forms a light-proof cartridge.

After inserting the spool and threading up the black paper the camera is closed and the key turned until the black paper has been reeled off and the sensitive film brought into place in the focal plane. The black paper runs with and behind the film, and at proper intervals is marked in white with the number of the section of film, 1, 2, 3, etc. In the back of the camera is a small red window, through which the figures appear as the key is turned. These figures show just how far to turn the key and how many exposures have been made. After all the exposures have been made a few extra turns of the key entirely covers the film with black paper, and the camera may be unloaded in daylight.

It is all very simple, and with each camera is a manual for the guidance of the student. The amateur must bear constantly in mind, however, that the black paper must be kept tightly rolled about the film all of the time until it is in place and the camera closed, for should the film be exposed to daylight for even a hundredth part of a second its ruin would be accomplished.

Loading with Plates.—Assuming that the amateur is operating a plate camera, and has decided upon the brand of plates or films he will use, he should be reminded that the treatment for sheet films is precisely the same as that for plates, concerning loading and exposures, and the following instructions will therefore apply to both unless otherwise stated. The first thing to do is to place the plate or film in the plate-holder. Remember, the plate is very sensitive to light—sensitive in a way that few beginners can understand or calculate. Very great care should be taken that the dark room is safe, that no extraneous light is allowed to enter, for if it does all future efforts will be useless. The best test is for the operator to shut himself up in a dark room until his eyes have become accustomed to the gloom, and if he then detects no light filtering into the room he may consider it "safe," but if any rays or gleams are observed entering under the door or through crevices around the blocked up window the apertures should be tightly closed.

The lamp by whose light the operations are to be conducted must not necessarily be considered "safe" because it is glazed with red glass, but it must shed a particular quality of red light and not too much of it.

First dust out the inside of all the plate-holders, for every grain of dust that settles on the plates will leave a little white speck upon the finished negative. Then, as far away from the red light as practicable to see, open the packet of plates. Every pair will be face to face, with a piece of card at the edges to prevent them from actually touching one another. If there is any doubt as to which is the face, remember that the shiny side is the plain glass—or celluloid film, as the case may be—and that, of course, is the back. Put them in the plate-holder, one in each side. The sensitized side of the plate has to face the lens of the camera, so that the plate must be placed in the plate-holder with the dull side next the slide.

All the holders having been charged in this manner and securely closed before leaving the shelter of the dark room, the photographer is ready for work, and for a beginner the subject should be a landscape or something of that character, as portraiture is the most difficult branch of photography.

Focusing.—Before proceeding to compose the picture or to make the exposures it is necessary for the amateur to learn what this much used word "focus" signifies. The term focus means bringing the rays of light forming the picture through the lens to a point where they are shown clear and distinct upon the ground glass or similar surface. In a scene or image slightly out of focus the lines will be blurred and run into each other, appearing to the naked eye somewhat like a house seen in the distance through a very heavy fog. With a fixed focus camera the lens is constructed and adjusted in the camera by the manufacturer so that all objects that come within the range of the lens will be in focus where the plate-holder is placed. The adjustable focus camera is constructed with a ground glass screen at the back of the camera and between it and the lens is a flexible bellows which can be operated to bring the lens and ground glass nearer together or farther apart as the case may require. For instance, where the objects to be photographed are close at hand, the lens and ground glass should be extended; for objects farther away the lens and ground glass should be brought nearer together. In making this adjustment it is necessary to examine the image or picture on the ground glass to determine when it is clear and sharp. The image will appear to better advantage if the light is excluded between the eye and the ground glass screen. This is accomplished by putting the camera on a tripod and placing a cloth over the

AN APACHE INDIAN BABY, ARIZONA, ON THE SANTA FE.

Photo by W. H. Simpson, Chicago.

head and camera, excluding the light; this is commonly called a "focusing cloth." The operation is called focusing. (See Fig. 35.) In order to get as sharp a negative on the plate as appears on the ground glass it is absolutely necessary that the plate, when inserted in the camera box, be placed exactly the same distance from

FIG. 35.

the lens to the ground glass as it was at the time of focusing. The squares of ground glass in frames and plate-holders are supposed to be accurately adjusted in harmony with each other to produce this effect; where such is not the case, as sometimes happens, it will be necessary to have the register between the two accurately readjusted.

CHAPTER X.

LANDSCAPE PHOTOGRAPHY—ARCHITECTURAL SUBJECTS.

Lighting and Composition.—The next progressive step in the amateur's experience is the arrangement or composition of his picture. Into this the proper lighting of his subject enters as a most important factor.

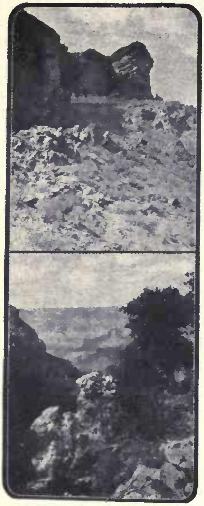


Fig. 36.

GRAND CANON OF ARIZONA.
Negative by T. S. Baldwin.

A rule may be laid down and followed in regard to lighting. **The principal source of light should come either from the upper right or the left of the scene.** A scene photographed with the sun directly at the back of the camera will usually be flat or tame in photographic effect, because no shadows are visible; neither should the sun be directly in front of the lens, as the scene would consist of nearly all shadows. An exception to this rule can be applied to marine views; the greatest amount of shadow obtainable in these gives the boldest results.

Painters say that the trouble with photography is that it reproduces with perfect fidelity the unimportant details of nature, but fails to portray her strength and character, her subtle moods, her broad effects. But occasionally the camera falls into the hands of an artist who handles it with the master's touch, and painters and sculptors and critics must applaud.

Too much detail is the weak point in nine out of every ten landscape photographs. The aim of the artistic photographer should be to preserve in his pictures that freedom from inappropriate objects and superfluity of detail which, by detracting from their simplicity, destroy their real strength and value.

A "pretty bit" is always preferable to a "general view." It centers the interest. A whole township on a single plate is inartistic unless the township consists of a towering peak which of itself is a picture. (See Figs. 36-37.)

Avoid giving the picture a mechanical look by breaking up, so far as possible, the straight lines, yet preserving enough of them so that it will not be a jumble. Do not bring the horizon line, especially if it be unbroken, across the center of the picture, but have it either above or below the center. On the other hand, to be successful, a picture must be well balanced in light and shade, or it will appear to be "lop-sided." Some

FIG. 37.
LOG TRAIN IN THE WOODS.
Negative by T. S. Baldwin.

workers, and good ones, too, claim that in composition certain geometrical figures must be followed—the triangle, the semicircle, etc.—but if the foregoing hints be borne in mind they will suffice for the beginner, will start him in the right direction and later on, when he has had a few lessons in the school of experience, he can if he likes, take up a more detailed study of the rules of composition.

Exposing.—The first difficulty which presents itself is the length of exposure. How long shall the shutter be allowed to remain open? is the question, and it is a most difficult one to answer. Assuming that the photographer possesses only one lens, that he has decided to keep to one size of stop for the present—say F-32—and that he intends only to use one speed of plates, three of the several factors which govern the length of the exposure are fixed and the matter is considerably simplified, but the chief factors which remain are the nature of the subject and the quality of the light with which it is illuminated.

An old adage says that exposure should be made for the shadows and let the high lights take care of themselves. The darkest portions are to be found among the trees, and as a general rule it may be taken that the nearer the object is to the camera the longer will be the exposure it will require, for there is less of that ever-present haze between it and the lens, and that haze, often invisible, reflects into the camera a considerable quantity of the kind of light which affects the plate. Let it be assumed that a summer's day has been chosen, and the exposure is to be made somewhere towards noon. The stop is F-32, and the plate a slow one. An exposure of three seconds should be about right, but there are so many things which have a modifying effect upon it that it is quite impossible to give more than the merest idea of its length. To expose correctly can only be learned by considerable experience, by repeated trials and careful comparisons of the results. Full directions will be given in the chapter in which development comes under consideration, by which the novice can tell whether he has erred on the side of over or under exposure, and he will soon learn to estimate pretty correctly the approximate extent of the error. A few trials made with intelligence will speedily give him a very good idea as to the duration of the exposure for a given subject under given conditions, and from the knowledge thus gained he will be able to calculate the correct exposures for other conditions.

This same view made the subject of a photograph at midday in the winter would require an exposure of longer duration, according to the quality of the light. Or, again, towards evening, even in the middle of summer, when the sun is in the west, and the whole landscape is bathed in the reddening rays of the setting sun, the three seconds' exposure may be multiplied without fear of the picture being overdone. It is impossible to teach the art of correct exposure; it will only come as the result of experience. The beginner should do his best to keep the conditions as invariable as possible; that is to say, he should, just at first, keep to one class of subject and one time of day, as well as to one lens and one plate. Then he can get his exposure right with very little trouble for that one set of factors.

It is desirable that the finished photograph should show a fair amount of detail, but in securing this result care must be exercised in order not to over-expose the distant hills so that they become merged in the sky and get lost. If in the developed negative the landscape stands out almost white, while the sky is a dense black, and the hills much too plainly marked, the exposure has been too short, and the result is extreme contrasts of black and white, with no delicate half-tones and an absolute lack of detail in all the deeper shadows. If, on the other hand, there is any amount of detail in the landscape, while the sky is a thin gray, with the hills invisible, and there is a general dullness and lack of contrast about the whole thing, it may be safely surmised that over-exposure is the fault. This matter will be more fully dealt with in the chapter on "developing." For the present I will confine myself to again hinting that it is better to over than to under expose, for this defect can often be compensated for in development, while for the other there is no cure, and we will imagine that the exposure of this particular subject has been mastered so that we can pass on to the consideration of others.

In an open view, where there are no heavy shadows in the foreground, the necessary exposure will be much shorter, and where a landscape is taken from the top of a hill or high building, the time should be very short, indeed, for all portions of the view are distant. In a view of this description, where there is already a great lack of contrast, full advantage should be taken of the fact that under-exposure, accompanied by judicious "forcing" in development, tends to increase of contrast. Photographs taken in woods and wherever there are dense masses of foliage, will require a much longer exposure than at first sight would seem necessary, owing to the fact that the green light which finds its way through the interstices of the trees is to a great extent robbed of its actinic power, and is no longer able to affect the sensitive plate to the same degree.

Architectural Subjects.—Architectural subjects are deservedly great favorites with many photographers, for it is in the making of pictures that come under this heading that photography finds one of its most pleasing features. Its practice is not attended with any particular difficulties, but it is one of those branches of the art which will reward, by conferring the ability to produce fresh beauties, the painstaking labor of the most highly accomplished photographer. Although the merest tyro may begin on architectural work at once if he please, yet it is almost impossible to attain the highest plane of excellence, for very rarely is a photograph of a given building produced so perfect that, under certain conditions, a better one could not be made.

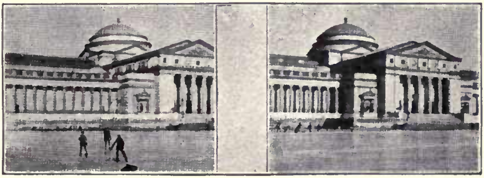


FIG. 38. FIG. 39.

These two views (Figs. 38-39) of the same building illustrate the importance of shadows. They were made from the same point of view. The one at the right was photographed at 10 a.

m., the camera pointing northeast. Observe the shadows, giving the proper projection to the architecture.

The picture at the left was taken at 1 p. m., with the sun almost directly behind the camera. It is thus almost devoid of shadow, resulting in a flat and imperfect photograph.

All architecture is full of straight lines; therefore it is necessary to use, when portraying it, more than in anything else, apparatus which will not give distortion. In the first place, a Rectilinear lens is a necessity for reasons already stated (see Chapter on "Lenses"), and then again the rising front and the swing back with which the camera is fitted, but which, up to the present, has been somewhat of a mystery, becomes an important adjunct.

USE OF THE SWING BACK.

Suppose it is desired to take a photograph of the exterior of a high building. In order to include the upper portion in the picture it will be necessary to tilt the camera upwards. Now the upper parts will be farther away from the lens than the lower portions, consequently they will be reproduced smaller in proportion, and all parallel lines running upwards will follow the venal law of perspective and appear to converge. But artists do not recognize that parallel lines running upwards in a high building must appear in the eye of an observer stationed below to converge towards the top, and buildings are so often portrayed with the vertical lines drawn strictly parallel that a photograph in which they are shown convergent gives to the building a toppling-down appearance which is not pleasing to the artistic eye. It is the function of the swing back to overcome this defect. The back of the camera should always be kept strictly vertical when photographing architectural subjects, and the upright lines in the original will be produced upright in the resulting picture. Another method by which the same result may be brought about to a modified extent is by the employment of the rising and falling post. This method has the disadvantage, however, that in extreme cases it may be necessary to raise the lens to such an extent that the light passing through it cannot reach the lower portion of the plate, which is therefore left blank. As regards the actual length of exposure where architectural subjects are concerned, this is governed in much the same manner as in the case of landscape, but as a general rule the times should be shorter. A new white building will only require about half the time that would be necessary for a landscape view under similar conditions as to lighting, and so on, while one that is built of red brick or that has become blackened with age will necessitate a correspondingly longer exposure.

CHAPTER XI.

PORTRAIT PHOTOGRAPHY.

Portraiture at Home.—There is no more interesting branch of picture making than portraiture, and the required accessories can be found in every home. To attain good results it may take a little patience and study, but for all this the amateur will be well repaid in the satisfaction brought by his first successes. The first element to be taken into consideration is the light. A north light is preferable, and it should, if possible, be unobstructed by trees or buildings; but where this cannot be avoided the disadvantage should be compensated for by giving additional time to exposure. The light should also be a top light—that is, it should be above the head of the sitter, a result easily accomplished by opening blinds and shades to their full limit and then pinning a cloth over the lower half of the window.

A PROFILE PORTRAIT.

Photographed in an ordinary sitting room with arrangement of light, camera and subject according to illustration Fig. 40. Negative by T. S. Baldwin.

Cross Light to Be Avoided.—All light should come from one source, otherwise the shadows will be so cut up as to lend a disagreeable and unnatural appearance to the face.

A room with a large window should be chosen as the place for operations, and a day when the sun is not shining through the window, but when its light is reflected in by a white cloud or a light-painted house opposite. Place the sitter about three or four feet from the window and slightly behind it, so that the majority of the light will fall upon his face from the front and from above. This will probably leave the other side of the face in deep shadow—a grave fault, which must be removed by the aid of a white screen, such as can be improvised by hanging a white sheet over a clothes-horse. This reflector should be placed beside the sitter, but slightly in front on the opposite side to the window, and its position may be varied and the quantity and direction of the light from the window modified by drawing the curtains from place to place, until that kind of illumination is obtained which is calculated to give the best effect to the sitter's particular style of features. In portraiture, as in most indoor photography, there is a tendency to very high contrasts in the resultant print. A face which is much more brightly lighted on one side than on the other, though not sufficiently so as to seem objectionable, will appear in the photograph perfectly white and absolutely black—like so much chalk and soot. Everything should be done to lessen the contrasts by carefully arranging the light before exposure, and no haste should be made to put the cap on the lens or to close the shutter, for a full exposure will materially help to get the desired effect. Of course, it should not be overdone. There should be considerably more light on one side of the face than on the other, or it will appear perfectly flat and chalky, with many of the features invisible altogether. It is only necessary to remember that in indoor portraiture the contrasts are liable to exaggeration, and precautions should be taken against an undue hardness in the resulting print.

How the sitter is to be placed depends largely upon the features. Care should be taken to have the eyes in an easy and natural position and looking very nearly straight ahead. If turned decidedly to either side they will give a disagreeable expression, a sort of caricature of slyness.

The background should be appropriate and simple and should form a contrast with the sitter. A portiere hung against the wall makes a very satisfactory dark background, and where a light one is desirable a sheet will answer the purpose; but in case it is used the assistance of a third party should be called in to keep the sheet in motion during exposure, so that it will be out of focus. A good light background may frequently be obtained by posing the subject in front of a lace window curtain, the shades, of course, being drawn down in such a case. As a rule, however, the dark backgrounds are more desirable, and prints from negatives made with them are more readily handled by the amateur than those with light backgrounds, which require vignetting.

After the first experiments the student will learn to study his sitter's face critically and will become able to judge by a rapid scanning of the features whether a profile, a half or a full front will give the most artistic results.

The largest stop that will cut the picture sharply should be employed, thus making a short

By courtesy C. & N.-W. Ry.

GREEN LAKE, WIS.

exposure possible, for the shorter the exposure the more natural will be the expression on the face of the sitter. No matter if the background is out of focus; that is merely a necessary evil in the picture and will divert less attention from the subject if a trifle subdued by indistinctness.

In the case of a portrait taken in the interior of an ordinary room, the larger lens aperture is a positive necessity, for the exposure necessary with a smaller one would be so inordinately long as to tire out the most patient sitter.

It is difficult to give an idea of what would be the correct exposure for a portrait in an ordinary room; there are so many varying conditions to be considered that any attempt to take them into account in imagination would only be confusing. There is nothing for it but for the tyro to make a guess at its length and then to correct it according to results. Then, having ascertained what length of time will yield satisfactory results under a certain set of conditions, its estimation for varying cases is as much a matter of calculation as anything else. However, an approximate idea of the length of exposure necessary may be gathered from the table, given under the chapter, "Photographing Interiors." Remember that when you double the diameter of the aperture of the lens you increase its size four-fold, so that it will pass four times as much light and the photograph taken with it will only require one-quarter the time of exposure. The length of the exposure is inversely as the square of the diameter of the lens aperture.

Illustrations. — The following illustrations (Fig. 40) will greatly assist the amateur to a clear understanding of the arrangement of the room and the effect of light and shade on the sitter.

This illustration shows a room 16x20 feet, containing two windows, both fronting south. The window at the right is completely covered by an opaque curtain, and the other window has

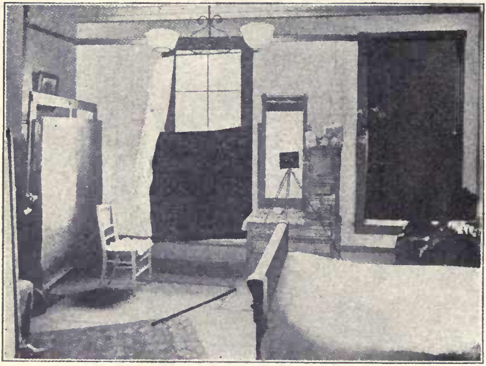


Fig. 40.

its lower half covered by a black cloth, leaving the upper half open, thus admitting the light to make the portrait. Background and chair were placed as shown in illustration. The child's portrait (Fig. 41) was produced as shown in Fig. 40. The black line on the floor shows the position of the reflector, which was three and one-half feet from the child. The chair in which she was sitting was two and one-half feet from the window, and the background was three feet behind the child.

The portrait shown in Fig. 42 was taken in a room with three windows. Two of these were closed, admitting no light. The window at the right of the child, and on the casing of which the child rests its hand, was closed by a dark

Fig. 41.

curtain up to a point even with the child's head. The light producing the portrait comes only from the upper part of this window. The reflector used to soften the shadow side of the face was a sheet of white cloth about five feet square tacked to the tops of two high-backed chairs about three and one-half feet from the child. It stood at an angle of about 45 degrees to a line drawn between the child and the camera. The walls of the room served as a background.

The portrait shown in Fig. 43 is that of a young lady taken in the same position as portrait of child shown in Fig. 41, with no change of either background, reflector, light or camera.

FIG. 42.

The portrait shown in Fig. 44 was made under the same conditions, except that the background was moved nearer to the wall, the camera was moved farther over to the middle of the room, and the reflector was placed nearer to the sitter. A white background should not be used, for the reason that it reflects so much white light.

The silhouette (Fig. 45) was made by placing the sitter at an ordinary window, with the camera lower than the head. A snapshot exposure was made, the window or sky serving as background.

What is known as a Rembrandt lighting is often very effective and is obtained by photographing from the shaded instead of from the lighted side of the face. The relative proportion of the shaded and lighted sides of the face can

Fig. 43. Fig. 44.

be changed by simply turning the sitter's head toward or away from the light. A slight change in position makes a wonderful change in the lighting, and the sitter's face should be carefully studied to obtain the best effects.

In "A Rembrandt Portrait" (See Fig. 46) we give a marked case of this lighting. In "The Chorister" (See Fig. 47) the artist has used the Rembrandt lighting but a trifle. Between these two extremes many effects can be obtained that are also desirable.

Outdoor Portraiture.—Portraits can be taken very well in the open air, and, indeed, provided certain precautions be observed, this method is

FIG. 45.

FIG. 46.

more likely to give quite as satisfactory results in the hands of an amateur who does not possess a regular studio as will indoor work. In open air portraiture, to cut off the light which comes in the directions in which it is not required in order to give value to that which falls in the right direction, the sitter should be placed in an angle of a wall so that the building shields him from the light on one side, and if there be any means of cutting off some of the top light, so much the better. As an idea of the exposure required in such a case, between five and six seconds may be quoted, where the F-32 lens aperture is retained with the slow plates on a fine day in summer. This should be only taken as a basis from which the exposure may be calculated; for in a general way it will be better to employ a larger lens aperture and faster plate and give a proportionately shorter exposure. A stop of four times the diameter, which would be called F-8, would necessitate an exposure, as already explained, only one-sixteenth as long, or

FIG. 47.

under half a second; and in this time the sitter will have little chance of moving, while the photographer has the opportunity of seizing that moment for exposure when the subject appears at his best, without being obliged to run the risk of spoiling everything by giving warning that he is ready to take the picture.

Portraits should not be made in the sunlight. However, where figures are merely accessories to a landscape, or a part of some interesting scene, there is no harm in snapping them in a bright light, but where the face is the central point of interest in the picture it must be in the shade. Strong sunlight destroys the expression of the eyes, while the heavy shadows cast by the nose and other features, or by the hat, if one be worn, will entirely distort the face, and while a likeness may remain, it will certainly be an unkind one. Outdoor portraits should, therefore, be taken in the shade of a veranda or tree and made by time exposure. The time to be given must be learned by experience, depending largely as it does on the amount of reflected light, the hour of the day and the time of year. After a few trials the amateur will be able to properly judge the light and time the exposure, but he should understand that it is easier to save an overexposed than an underexposed negative, and he should therefore be sure to give time enough.

Of one thing, however, he should be careful. Many a good portrait has been ruined by an inappropriate background, and there is no more unsightly or more commonly used background than the clapboarded side of a house. The regular lines crossing the picture are most trying to the eyes and are most inartistic. Backgrounds as a rule should form a contrast with the sitter and should not be a prominent feature of the picture. A trellis of vines, the dense shade of a grove back of the subject, or a grassy slope all make appropriate backgrounds when properly handled.

Portraiture in the Studio.—The requisite

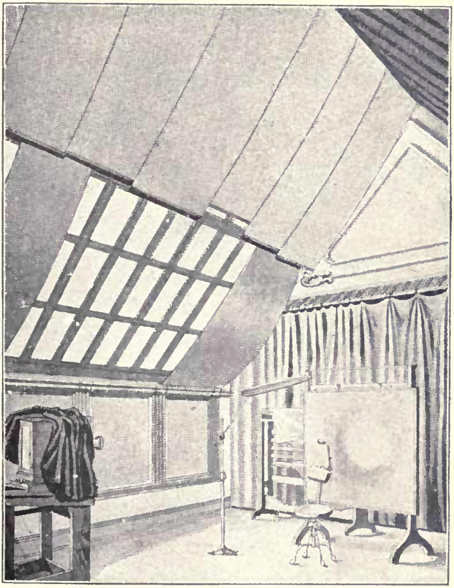


FIG. 49.

necessary to produce good portraits is a properly adjusted light. The half tone cuts under the sub-caption "Lighting" which follows will give an approximate idea of portrait lighting, the light for which should come from one source only, and that above the head, to the right or left, as the case may be. A suitable background should be used, which consists of some tinted or painted material of a semi-gray or neutral color, usually placed a couple of feet back of the subject, and a reflector or grading screen consisting of white muslin stretched smoothly on a frame at least four to six feet square, placed at an angle of 45 degrees

FIG. 50.

FIG. 51.

to the imaginary line between the lens and the subject, and the proper distance from the model.

Lighting.—Long before photography was known the old masters of painting discovered the true system of so lighting the human face as to display its most striking characteristics. The painter, however, could modify the lights and shades with brush and colors, while the photographer must light his subjects in the exact proportions he desires to reproduce.

The portrait shown in Fig. 50 illustrates what is called artists' lighting. It was taken in an ordinary studio, with curtains arranged as shown in Fig. 49. The relative positions of sitter, background, camera and reflector are shown in Diagram No. 1, Fig. 53.

The portrait shown in Fig. 51 was taken with the sitter and the light in the same relative positions as for the portrait shown in Fig. 50, but the camera, the reflector and the background were changed to the positions shown in Diagram No. 2, Fig. 53.

FIG. 52.

The portrait shown in Fig. 52, showing the dark line down the entire profile, was photograped in the same room as Figs. 50 and 51, but was changed to the other side of the light, as shown in Diagram No. 3, Fig. 53, no reflector being used.

Many other pleasing effects can be obtained by arranging camera, background and subject according to Diagrams 4 and 5 of Fig. 53.

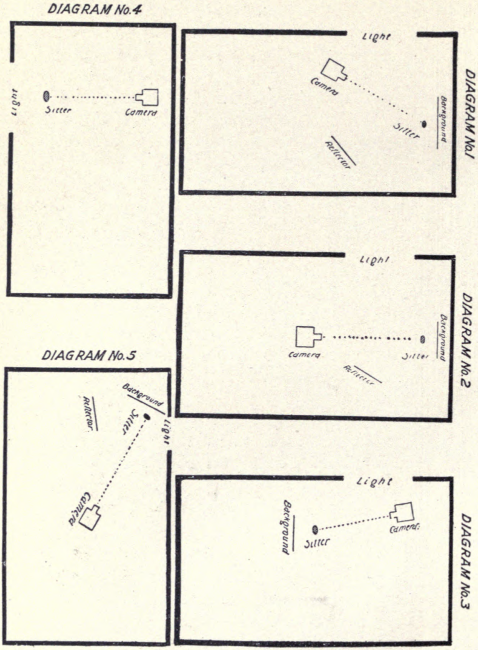
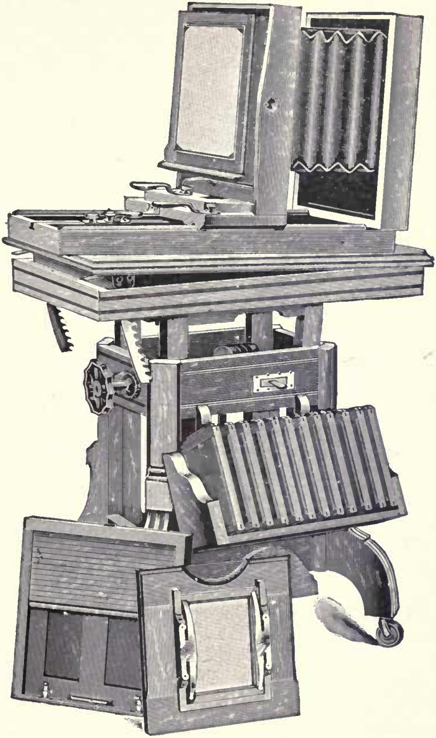


DIAGRAM No.4
Light
Sitter
Camera
DIAGRAM No.1
Light
Camera
Sitter
Background
Reflector
DIAGRAM No.2
Light
Camera
Sitter
Background
Reflector
DIAGRAM No.5
Background
Reflector
Sitter
Light
Camera
DIAGRAM No.3
Light
Background
Sitter
Camera

FIG. 53.



Studio Portrait Equipment.

CHAPTER XII.

PHOTOGRAPHING INTERIORS.

Lighting.—In photographing interiors it is necessary to give greatly increased exposures, varied, of course, according to the illumination, the color of the walls, furniture, etc. Even in well lighted rooms exposures should seldom be less than ten to twenty seconds, and others from twenty-five seconds to hours, as in the case of some churches with colored glass windows, where light is subdued by the glass. The best results in this class of photography are obtained by plates specially prepared, called "non-halation," or "double-coated," which admit of a wide latitude of exposure. When the exposure has been correct the most perfect and beautiful results can be obtained by proper development.

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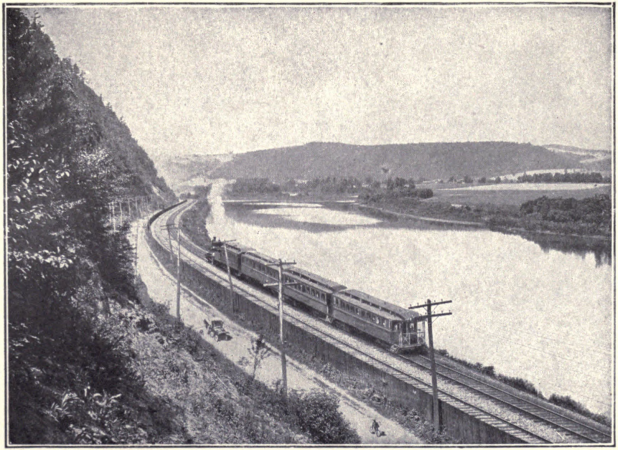
Photographing interiors and portraiture in ordinary rooms are closely allied, for in many respects there are marked points of similarity. For instance, there is a decided tendency to the exaggeration of the contrasts, which has to be overcome in the same manner in one case as in the other, by equalizing the illumination as much as possible, reducing the depth of the shadows and



SUSQUEHANNA RIVER AT OWEGO. LACKAWANNA RAILWAY LINES.

toning down the brilliancy of the high lights, and by giving exposures of amply sufficient length. As a general rule it may be taken that in the photography of interiors it is better to use a small stop in the lens and to give a correspondingly long exposure. This will tend to reduce the inordinate contrasts, and there is seldom any reason why the time should be unduly hurried, as is often required in the case of portraiture.

The first thing to be considered in regard to interior photography, as in most other branches of the art, is the point of view from which the picture shall be taken. In the case of a small room it is impossible to take in anything but just one corner of it—unless a wide-angle lens is employed—and the difficulty which immediately presents itself is to make that one corner appear in the photograph as representative of the whole as possible. A wide-angle lens is an instrument which has been designed to overcome this difficulty in connection with the small angle of view which the ordinary lens is able to embrace. It is a lens of very short focus in relation to the size of the plate which it will cover, and consequently it gives much smaller images and can throw a large quantity of them onto a plate of given size. However, the result is also very apt to be that the lines of perspective are very much distorted in a photograph taken in this manner, and a small room is made to appear like a long gallery filled with horribly disproportionate furniture. It is perhaps better to be contented with an incomplete but true representation of an interior than to produce a view which shows more but shows it incorrectly. In a general way it is best to take up a position for the camera in one corner of the room, for in a square room this gives

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Again, as regards exposure, it is impossible to give any definite instructions, for it may vary to any extent from half a minute to half an hour, and under difficult conditions may easily reach half a day or even more. The only thing in the nature of a suggestion which I can give is that the beginner try an exposure about ten times as long as that which he would guess to be correct, and he probably will not be far out. Unless non-halation plates are used he should be very careful that no windows form any portion of the picture, unless it is absolutely impossible to leave them out of it, for these, being far more brilliantly lighted than the other portions, will be sufficiently exposed when the rest of the picture requires a hundred times as long. The result of including them would be that the extra exposure, as it were, would, by the action known as halation, spread to the surrounding portions of the picture and fog them in that distressing manner sometimes seen in photographs of churches and other similar subjects. If the light from the window which must appear in the picture can be blocked out by such means as drawing a heavy blind or hanging a thick sheet outside—the interior course receiving its illumination from some other source—there is no reason why the result should not be satisfactory, and otherwise a great deal may be done bv the use of some form of non-halation or "backed" plates. Care should also be taken that no polished metal objects are allowed to reflect light directly into the camera, for if they do, except where the specially prepared plates are used, such things will appear surrounded with a halo which will not add to their beauty.

Approximate Time Needed for Interior Exposures.—The following table is an excellent guide for making interior exposures, and is based upon the time needed for exposures with the stop ordinarily used for snapshots in single lens cameras, and with the No. 8 stop in all rapid rectilinear lenses. When a smaller stop is used the time must be increased proportionately:

White walls and more than one window—Bright sun outside, 2 seconds; hazy sun, 5 seconds; cloudy bright, 10 seconds; cloudy dull, 20 seconds.

White walls and only one window—Bright sun outside, 3 seconds; hazy sun, 8 seconds; cloudy bright, 15 seconds; cloudy dull, 30 seconds.

Medium colored walls and hangings and more than one window—Bright sun outside, 4 seconds; hazy sun, 10 seconds; cloudy bright, 20 seconds; cloudy dull, 40 seconds.

Medium colored walls and hangings and only one window—Bright sun outside, 6 seconds; hazy sun, 15 seconds; cloudy bright, 30 seconds; cloudy dull, 60 seconds.

Dark colored walls and hangings and more than one window—Bright sun outside, 10 seconds; hazy sun, 20 seconds; cloudy bright, 40 seconds; cloudy dull, 1 minute 20 seconds.

Dark colored walls and hangings and only one window—Bright sun outside, 20 seconds; hazy sun, 40 seconds; cloudy bright, 80 seconds; cloudy dull, 2 minutes 40 seconds.

The foregoing is calculated for rooms whose windows get the direct light from the sky from three hours after sunrise until three hours before sunset. If earlier or later the time required will be longer.

CHAPTER XIII.

FLASHLIGHT PHOTOGRAPHY.

Pictures by Flashlight.—The rays of old Sol, once an all-important factor in picture making, are no longer an essential for indoor work. For capturing the beauties of the landscape we still depend upon him, but for interior work, especially at night, man's ingenuity has supplied a substitute for the sun's rays equally effective and more manageable. For many purposes, in fact, the flashlight is more desirable than sunlight. It can always be depended upon to shine when wanted and with just the proper brilliancy; it can always be depended upon to shine when ows fall in the desired direction, and, photographically speaking, it turns night into day. To the amateur "bottled sunlight" is an especial convenience, for his photographic work is frequently confined to the night time, to say nothing of the many times that he brings the flashlight into play in photographing his friends at evening gatherings. Indeed, it is as a means of photographing one's friends on such occasions that the flashlight is most commonly used, but the experienced amateur knows of many other ways in which to avail himself of its actinic powers.

Frequently it is desired to take a photograph of an interior which, by reason of a lack of illumination, or because some window which cannot be covered comes within range of the camera, is impracticable by daylight. In such cases a charge of flash powder solves the problem.

Again, it is desired to photograph a very large room which is lighted from only one side by daylight. To get a full time exposure in the darkest corner of the room would cause a de-

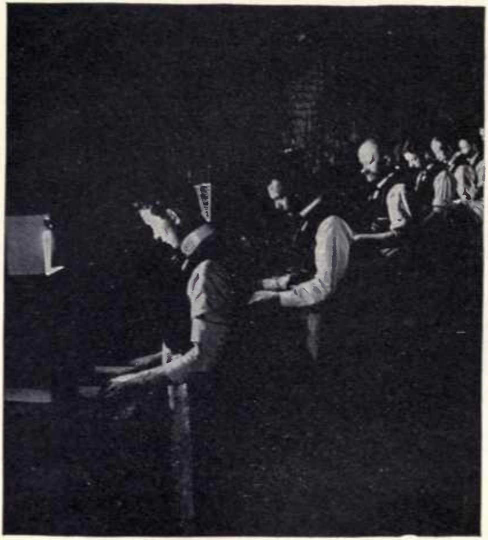


FIG. 54.

cided overexposure near the windows. A flash of powder, concealed from direct line with the lens by some article of furniture or by a screen, illuminates the dark corner and gives a properly lighted exposure of the entire room. These are the ordinary uses of the flashlight, and by following the simple rules laid down the amateur can make pictures with as great an assurance of success as when making snapshots out of doors. For the production of unusual effects, however, one must study all the conditions, weighing carefully cause and effect, and must not yield to disappointment if success be not attained at first. There are many ways in which the flash may be made to co-operate with other artificial light, or with daylight, to produce a unique or artistic effect, and to the serious worker it offers another means to the end most desired by all photographic workers—pictorial effect.

Flash powders are put up in three ways: In bottled form for use in the flash lamp, in cartridges having fuses and requiring no extras, and in flash sheets, which are used by simply pinning them up against a cardboard on the wall and igniting the lower corner.

The same general rules will apply whether the lamp, the cartridge or the flash sheet be used.

Preparation of the Flashlight.—The light should always be placed two feet behind and two to three feet to one side of the camera. If placed in front of or on a line with the front of camera, the flash would strike the lens and blur the picture. It should be placed at one side as well as behind, so as to throw a shadow and give a little relief in lighting. The flash should be at the same height or a little higher than the camera. A piece of cardboard a foot square placed under the powder will prevent any sparks from the flash doing damage. A sheet of white cardboard set up behind the flash will act as a reflector and increase the strength of the picture.

Taking the Picture.—Having the camera and the powder both in position, the camera should be set shutter open, as for a time exposure, but the stop ordinarily employed for snapshots should be employed. When the powder is ignited there will be a bright flash, which will instantly impress the picture on the sensitive film. Then close the shutter.

The Powder.—The amount of powder required to light a room varies with the distance of the object farthest away from the camera and the color of the walls and hangings.

TABLE.

For 10 feet distance and light walls and hangings, use 1 cartridge No. 2, 1 even teaspoonful; 1 flash sheet.

For 10 feet distance and dark walls and hangings, use 2 cartridges No. 2, 2 even teaspoonfuls; 2 flash sheets.

For 15 feet distance and light walls and hangings, use 2 cartridges No. 2, 2 even teaspoonfuls; 2 flash sheets.

For 15 feet distance and dark walls and hangings, use 3 cartridges No. 2, 3 even teaspoonfuls; 3 flash sheets.

For 25 feet distance and light walls and hangings, use 3 cartridges No. 2, 3 even teaspoonfuls; 3 flash sheets.

For 25 feet distance and dark walls and hangings, use 4 cartridges No. 2, 4 even teaspoonfuls; 4 flash sheets.

Note.—The No. 1 cartridges hold 50 per cent more powder and the No. 3 about half as much as the No. 2, and should be used accordingly.

Portraits.—Place the sitter in a chair partly facing the camera (which should be at the height of an ordinary table), and turn the face slightly towards the camera. The proper distance from the camera to the subject can be ascertained by looking at the image in the finder.

The powder should be on the side of the camera away from the face—that is, the sitter should not face the flash.

Groups.—Arrange the chairs in the form of a semi-circle, facing the camera, so that each chair will be exactly the same distance from the camera. Half the persons composing the group should be seated and the rest should stand behind the chairs. In case any of the subjects are seated on the floor the limbs should be drawn up close to the body, not extended towards the camera.

The Background.—In making single portraits or groups care should be taken to have a suitable background against which the figures will show in relief; a light background is better than a dark one, and often a single figure or two will show up well against a lace curtain. For larger groups a medium light will be suitable.

The finder on the camera will help the operator to compose the group so as to get the best effect. In order to make the image visible in the finder the room should be well lighted with ordinary lamplight, which may be left on while the picture is being made, provided none of the lights are so placed that they show in the finder, or if a focusing camera is used employ the ground glass screen in the usual manner.

When Using Flash Cartridges.—Remove the cover from the cartridge and place it upon a cardboard. All being in readiness, as before described, open the camera shutter, ignite the fuse while at arm's length, protecting the eyes in the meantime from the brilliant flash. Close the camera shutter.

If two cartridges are to be used the contents of one of them can be poured into the other, care being taken, however, that if any of the powder spills over it does not lie in such a position as to practically shorten the fuse.

Fuses used on these cartridges are very quick.

When Using Flash Sheets.—Pin a flash sheet by one corner to a piece of cardboard which has previously been fixed in a perpendicular position. If the cardboard is white it will act as a reflector and increase the strength of the picture. All being in readiness, as before described, open the camera shutter, stand at arm's length and touch a match to the lower corner of the flash sheet.

Close the camera shutter.

When two or more sheets are to be used they should be pinned to the cardboard, one above the other, the corners slightly overlapping.

As a matter of precaution, place a piece of cardboard beneath as well as one behind the flash sheet, so that in case a piece of burning powder should fall it will do no injury.

In General.—In portrait work it is always best to have the room well lighted when making the flash, if it can be done in such a way that none of the lights come within the range of the lens. If the room is darkened the sudden flash of the powder so strains the eyes of the sitters that it almost invariably gives them a staring look, whereas if the room is already well illuminated by gas or lamplight the strain is not great and the eyes will have a natural expression. Of course, where the room is brightly lighted the shutter should not be opened until the instant before the flash is made, and should be closed quickly after the flash is over.

When more than one flashlight is to be taken the windows should be opened and time allowed between each flash to free the room thoroughly from smoke, otherwise all of the pictures after the first one are liable to have a "foggy" effect. Good flash powders give a minimum of smoke, but the lens is even keener than the eye, and what will seem to be but little smoke in a room will oftentimes have a decided effect upon the picture.

When, for any reason, it is necessary that the shutter remain closed until the instant the flash is discharged and be closed again instantly afterward, it is well to use a flash lamp, as by so doing the shutter can be operated with one hand and the flash with the other, and their action thus made simultaneous.

In using the flash sheets it should be borne in mind that they are not instantaneous, and in portrait work the subjects should, therefore, be warned to remain still the same as if for a time exposure. For photographing young children or large groups these sheets are not recommended, owing to the fact that it is difficult to keep the subjects quiet during exposure. About one and one-half seconds are consumed in burning a single sheet, and the light is much less brilliant than is the instantaneous flash. This is a decided advantage where the subjects can be depended upon to keep quiet, as the eyes are not strained by the flash and do not have the staring effect so often seen in flashlight pictures.

Secondary Uses of the Flashlight.—The amateur ambitious of securing pictorial effects will often find an opportunity to use the flash in connection with some other light, either artificial or daylight. Fig. 54, at the beginning of this chapter, shows a picture taken in one of the Eastman Kodak Company's dark rooms by means of the flash in conjunction with the incandescent lights. In the dark room these lights are covered with orange paper, but for this occasion the paper was removed from one side, so that a strong light would be thrown upon each operator as he stood at his developing tray. Two charges of flash powder of about one thimbleful each were then arranged, one near the camera and the other behind a screen about half way down the room. The subjects being posed, two minutes' exposure was given by the electric lights, followed by the firing of two small charges of flash powder to bring out just a trifle of detail in the shadows. To the eyes of those familiar with the gloom of the dark room this picture is strikingly effective, especially when the lights and high lights are given an orange tint.

The portrait of the well-fed monk, entitled "Come We to This?" (See Fig. 55) is another illustration of what can be accomplished through a combination of artificial lights. After arranging the subject and accessories a bicycle lamp, put inside a box which stood between the skull and scroll, was so placed that it threw a powerful light on the subject's face, and was in a line toward the candle. After two minutes' exposure the box and lamp were quickly removed, the candle lighted, a weak flashlight made and the shutter closed.

These two illustrations are given merely to show the possibilities of producing pictorial results by a combination of the flash with other artificial lights. They will suggest to the amateur many ways in which this light can be utilized in producing artistic effects—the light from

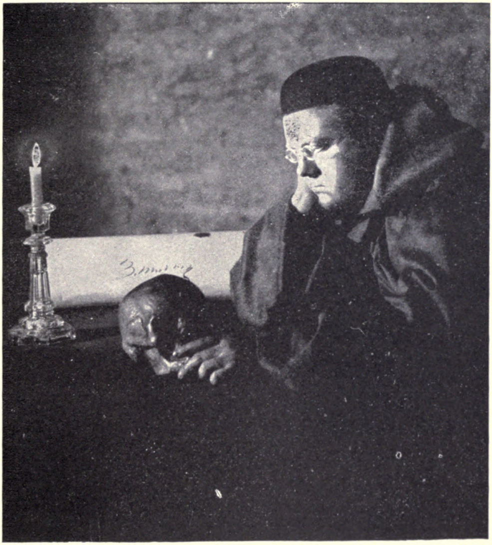


FIG. 55.

a reading lamp, or from the grate fire, the light from the moon—can all be made to work in such harmony with the flash as to produce photographs which are not only unusual and novel but have also a lifelikeness and fidelity to nature that make them pictures. The flashlight is one more agent that assists in making the photographer the master of his camera. Having control, not only of his lens, shutter and chemicals, but of the source and volume of his light, his work becomes creative, and even the devotees of palette and brush must acknowledge, if his results are pictorial, that he is an artist, not a "mere copyist."

Warning! Where Using a Flashlight Lamp always turn the burner away from the flash pan when the latter is being filled.

Never fill the pan when the burner is lighted and toward the pan.

Never light the burner when it is over the powder.

Never pour the powder from the bottle directly into the pan.

Always use spoon or measuring cup.

Never hold bulb in hand when turning burner over powder. An accidental squeeze of bulb would discharge the flash.

Never use flashlight powder in magazine lamps.

CHAPTER XIV.

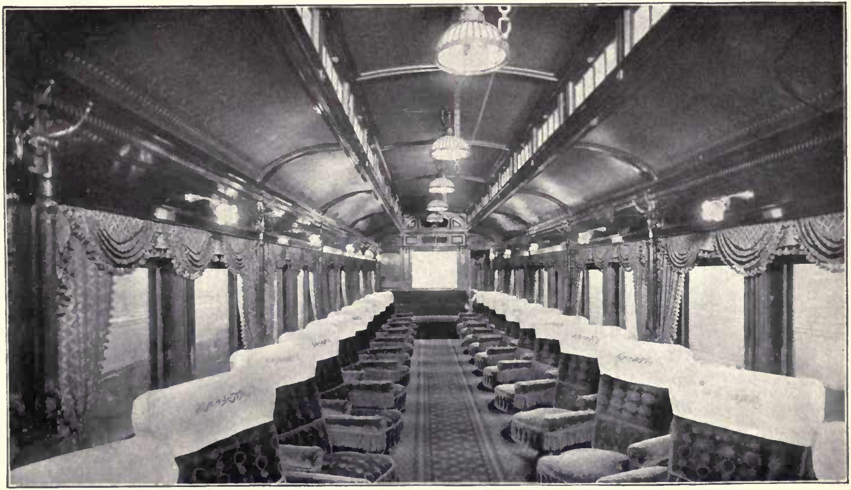
MISCELLANEOUS BRANCHES OF PHOTOGRAPHY.

Snapshots and Instantaneous Photography.—There is a great deal of misconception in the public mind with regard to what is called instantaneous photography. Many people seem to consider that it is quite a distinct invention, and that it requires a peculiar set of apparatus. It is not so. If you possess a lens which is sufficiently perfect to enable you to use a large aperture without seriously impairing its defining powers, and you use a rapid plate, you will simply require a mechanical contrivance to uncover the lens and cover it up again very quickly, in order to blossom out as a full-blown instantaneous photographer, only you must confine yourself to brilliantly lighted subjects. It is here that the difference lies. An instantaneous photograph can only be taken in a good light.

There is a strong temptation towards indiscriminate snapshotting when using a hand camera, for a new plate is so easily brought into position and exposed that the user is often inclined to waste it on an unworthy subject. Care and thought should always be bestowed upon every photograph that is taken, whether it be an 8x10 landscape or a 4x5 snapshot, and the knowledge which has been gained in landscape and similar work should be applied to the apparently much simpler hand camera photography. A street scene can only be successfully taken in the brightest hours near noon, because it contains all those elements—heavy shadows in the foreground, etc.—which in landscape work necessitate a longer exposure, and as in this case the time cannot be drawn out because of the moving objects in the picture, the other factor—light—must be increased in compensation. Out in the country, however, where the light is not partially absorbed by a heavy pall of smoke, those pleasing little studies of children and "grown-ups" and of pastoral life generally, of which the hand camera is such an excellent portrayer, may be successfully attempted in spring or autumn, while sea and sky effects—the brightest things in nature—can be photographed in midwinter, and even skating scenes, when the sun is shining, and there is plenty of snow about to reflect its light, come just within the scope of the hand camera bearer.

The two great things to bear in mind when contemplating instantaneous exposures are: Hold the camera perfectly still, for the least tremor is disastrous, and be quite sure there is sufficient light upon the subject. Then with rapid plates and a quick lens and an eye well enough trained to choose a good position, a good subject, and to seize the right moment for exposure, a satisfactory photograph can hardly fail to result.

Photographing Moving Objects.—There is probably nothing in picture taking in which the amateur asks more unreasonable things than in the making of snapshots of rapidly moving objects. If, for instance, he is an enthusiastic bicyclist, he takes his camera to the first race meet, secures a position alongside the tape, and as the riders finish, sprinting at a 1:40 clip, he takes a



INTERIOR PARLOR CAR ON PIONEER LIMITED, CHICAGO, MILWAUKEE & ST. PAUL RY.

broadside of them from a distance of ten feet and is disappointed in the resulting blur, for he has nothing else. Now, let us see the reason for this.

If he has a double lens instrument with pneumatic shutter it has worked in approximately 1-50 of a second, an apparently very short space of time, but we find on figuring it out that a bicyclist riding at the rate of a mile in one minute forty seconds covers 52.8 feet in a second, or over twelve inches in 1-50 of a second, the time the shutter is open—a sufficient distance to ruin the image. The distance the image will move on the plate during exposure is to the distance the object moves, as the focal length of lens is to distance from lens to object. In this case we will suppose the focus of lens to be six inches, and we know the distance from lens to object to be ten feet (120 inches) and the distance the object moves approximately twelve inches. We will let X stand for distance image moves on the plate and it gives us the following equation: X : 12 : : 6 : 120 — 6-10. Of course, the object moving 6-10 of an inch on the plate ruins the picture. We find then that in order to take pictures of moving objects at right angles there are two factors of prime importance—the speed of shutter and the distance from the object. In the ordinary amateur outfit the shutter speed cannot be materially increased and he must therefore take the picture from further away. Experiment has proven that in order to successfully take pictures of rapidly moving horses, etc., from a position near by and at right angles the shutter must work in from 1-500 to 1-1000 of a second (Muybridge claimed to have used a shutter working in 1-2000 of a second) and this extreme speed necessitates a special camera and lens as well as a special shutter, and then the resulting photographs are mere silhouettes, because with the present speed of plates and films there is not time to get any detail. But there are tricks in all trades and satisfactory pictures of rapidly moving objects can be readily made by photographing them from partly in front as well as from a reasonable distance. The accompanying picture (Fig. 56), a railroad train moving at full speed, shows plainly what can be done in this

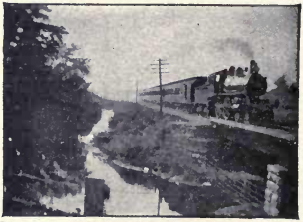


Fig. 56.

direction. It was made with a small kodak and is a good illustration of what can be accomplished by taking the picture from a point at a considerable distance from the object and also somewhat ahead of it. By acting on this hint the amateur can soon learn to take pictures of rapidly moving objects, and in such a manner as to avoid materially the disagreeable effect of blurring.

Copying.—It occasionally happens that the amateur may wish to make a photographic copy of a painting or engraving of another photograph which has acquired value owing to the death, perhaps, of the original of the portrait. Where any quantity of such work has to be done special apparatus should be employed, whereby the camera may be always retained with its optical axis exactly at right angles to the plane of the picture to be copied, but for the occasional requirements of the amateur a more makeshift method will be found to answer the purpose. The picture to be copied should be attached by any ready means to a vertical board placed as near as possible to a window through which a strong diffused light shines upon it. A very good plan is to attach it to the folding shutter of the window, if it has one, for that can be placed at different angles until a position is found where the light falls upon it in the most suitable direction. The camera, which must be of the long bellows variety, so as to admit of being racked out to a considerable extent, is placed exactly opposite it, both as regards height and lateral position, and it will be found that some considerable maneuvering is necessary in order to bring the image into the desired position on the ground glass screen and of the right size and in good focus. When this is satisfactorily accomplished the smallest stop should be inserted in the lens and a rather long exposure given.

Care should be taken that the lighting is not too much from the side of the grain of the paper, or the brush marks, as the case may be, will be painfully apparent on the finished copy; but, on the other hand, the light must not fall too perpendicularly upon the work, or some of it will be reflected directly into the lens from the shiny surface, which last state is worse than the first.

In the case of engravings or other pictures having black lines on a white ground, the exposure should be comparatively short, in order to avoid the flatness which results from weakness of contrast in the negative, and in copying paintings and all colored objects very great advantage will accrue from the use of orthochromatic plates in conjunction with a yellow screen, the uses of which have been fully explained in another chapter.

Reducing and Enlarging.—The same rule as given for copying can be applied to these processes. Assuming that it is desired to obtain a small negative from a larger print, the print is placed in position as outlined above and the camera is moved from it until the image shown on the ground glass is of the desired size. The camera is then focused and the exposure made.

The same rule applies to the making of a negative larger than the print from which it is copied. If the amateur has an 8x10 camera and desires to make an 8x10 negative from a 4x5 print, the print is placed in position according to directions given for copying. The camera is moved toward same and roughly focused until the image shown on the ground glass covers the glass completely. The camera is then sharply focused and exposure made.

How to Make an Enlarged Negative.—If the operator with the 8x10 camera desires to make, say, a 14x17 negative the process of making the enlargement is entirely different.

A means by which the user of a small camera can turn out large pictures is by making an enlarged negative and printing the picture direct from it by contact, according to any of the printing methods in general use. The making of an enlarged negative is a very similar operation to the production of an enlarged bromide print (See Chapter XX), the chief difference being that a large sheet of glass is handled instead of a piece of paper.

The number of operations required is doubled, for two negatives and two positives have to be made before the photograph is finished. However, it is not feasible to make a direct photographic enlargement on platinotype or any of the printing-out papers, and therefore it occasionally happens that an enlarged negative is a necessity.

The first step is to make by contact a really good positive print on glass—a transparency which, like a good negative, has that due proportion of detail to density; not too much or too little of either one or the other. This is called good printing quality. It is not necessary to enter into details as to how this is accomplished. Follow method given elsewhere for making lantern slides by contact (Chapter XXI). It is better to employ a glass plate specially prepared for positive transparency work, such as a lantern plate, and to use one of the developers recommended for positives rather than for negatives. The ferrous oxalate developer, of which the formula is given in connection with bromide paper, will be found to yield excellent transparencies if the instructions as to clearing, etc., be carefully carried out. It should be used in a stronger form than that recommended for the bromide paper, say one part of the iron solution to four, or even less, of the oxalate, the former being, of course, poured into the latter and not in the opposite order. Or the hydroquinone developer, of which a formula is obtained from the makers of the plates, may be used with results that cannot be surpassed.

The sensitive glass plate upon which the enlarged negative is to be taken may also with advantage be of the transparency variety, though in this case it may be developed with pyro or any other reducing agent which may happen to be the particular favorite of the photographer, provided always that it is suitable to the peculiarities of the plate used. The plate is attached to an easel just as it would be if it were bromide paper, except that drawing pins being inadmissible, some other method of fastening must be adopted. A very good plan is to drive three wire nails into the woodwork of the easel, two of them on a line with one another and sloping slightly upwards, while the third is considerably higher on, say, the righthand side, with its head inclined towards the left. The lower edge of the plate rests on the two lower nails and is pushed up against the remaining one so that it is prevented from falling forward. With regard to the exposure, some idea of its length will have been gained from previous experience with bromide paper, but a preliminary experiment or two should be made on a smaller plate of the same make, for these large ones are expensive.

Development is conducted in a precisely similar manner as in the case of an original negative, having regard to the particular printing process for which it is intended. Thus, for platinum paper it should not be at all yellow and need not be of quite so plucky a character as if it is required for printing upon printing-out paper or other similarly constituted medium.

Stereoscopic Photography.—It would no doubt occasion surprise were I to state that it is habitual for a person to "see double"; yet it is true. If a book is held edgeways before the eyes one side will be seen with one eye and the reverse side with the other. The same thing occurs to some extent with every object viewed. One eye sees a little more of one side and a little less of the other of every solid object that the eye can

FIG. 57.

embrace. There is not much difference, I admit, but there is a little, and it is that difference which enables you to tell that an object is solid without walking around it. If you stand perfectly still and look at an ordinary landscape you can be quite certain that some portions of it are nearer to you than others, and you can even make a pretty accurate guess as to the relative distances of different objects. But if you look at a photograph or painting of that landscape you will soon be able to find some details in it which you cannot for the life of you tell which are nearer and which farther away from the observer, while only those things which you know from previous experience must be solid can you with certainty invest with that quality.

But if you take two photographs of that landscape from standpoints separated from one another by about the distance there is between your two eyes and place them side by side and look at the righthand one with the right eye and lefthand one with the other these two pictures will be blended together when the impression reaches your brain, and you will get an idea of solidity and differential distance just as if you were looking at the original natural landscape. But there are very few persons who have acquired the art of looking at two different pictures with their two eyes separately, and the majority are obliged to have recourse to a specially-constructed instrument known as a "stereoscope," so called because it enables you to "see solid."

It is not such a very long time since no fashionable drawing-room was deemed complete without its stereoscope and set of photographs for the same, and even now, in many homes, the instrument is to be found enthroned—for at one time this most beautiful branch of photography enjoyed immense popularity. However, its star waned, unfortunately, though the signs of the times are that it is once more in the ascendant. Meanwhile there are many devotees who recognize the marvelously beautiful results which are possible with the stereoscope, and who, by their patient work and excellent photography, will be the means of placing the neglected art once more on its former pedestal.

Stereoscopic photographs are not very difficult to make. A special camera is required, having two lenses exactly alike, separated from one another by about three inches, and each casting an image upon one photographic plate of a suitable shape to receive them side by side. (See Fig. 58.) The interior of the camera is divided into two compartments, so that one picture shall not encroach upon the space reserved for the other. Stereoscopic lenses have to be accurately paired in order to produce pictures of exactly similar

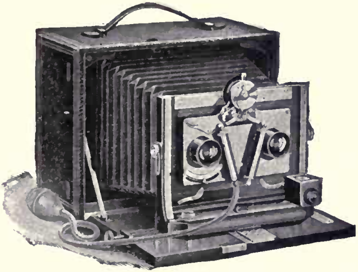


FIG. 58.

character as regards the size of the objects depicted, for lenses of the same make are rarely identical as regards focal length unless specially selected. The two lenses are attached together by a specially-designed duplex shutter. All these things can be obtained from the photographic dealers, so that the amateur who aspires to stereoscopic work—and he can hardly have a nobler ambition—will not find any difficulties in procuring the materials he will require.

It is easy to see that some subjects are far more suitable to stereoscopic treatment than others, and success in this branch of photography is largely a matter of the judicious choice of subjects. For instance, an open landscape view, in which all portions are of considerable distance from the camera, will not have its effect at all heightened by stereoscopic treatment, for there are no objects in the foreground round which the camera can look, as it were, and all the constituent parts are so distant and so much of one plane that there is nothing to which solidity can be given. In stereoscopic photography distance does not lend enchantment to the view, unless there is something in the foreground to accentuate that distance and to give it effect. Choose a subject in which there are several planes, one behind another, clearly defined by some conspicuous object in each, and then the full and marvelous effect of this "solid-seeing" photography will be brought out.

But there is one thing in connection with it which must have particular attention, and that is the great importance of ensuring that that picture which in nature would be seen with the right eye is placed in the righthand half of the stereoscope, or else the whole landscape will appear to be turned inside out. It is easy to understand that if one eye receives the impression that ought to go to the other the brain, whose duty it is to combine the two, gets considerably muddled up between them, and the result is a most peculiar mixture.

The two pictures fall side by side upon the photographic plate, the lefthand one on the left side and the right on the other, but each picture is, of course, separately inverted as regards left and right as well as top and bottom. Then,

MICHIGAN CENTRAL TRAIN AT FALLS VIEW STATION.
Courtesy of Michigan Central Ry.

when a print is made from the compound negative, the lateral inversion is corrected; that is to say, the righthand side of each picture appears upon the right, but both are still upside down. That is easily corrected, you will say, by turning the whole thing the other way up. Yes, that is so. But in doing so you will reverse the relative positions of the pictures, and put that one which has been taken with the lefthand lens upon the righthand side, which is just what I warned you against. The photographs will require transposing; the print must be cut in half along the central line, and the positions of the halves reversed. The operation, of course, is simply equivalent to taking the two pictures—which were produced upside down in the camera—and separately turning them right way up. If it be particularly required to print upon one piece of paper the negative itself may be cut in two and its two halves transposed.

Trick Photography.—In addition to its more serious picture-making uses, the camera is capable of affording the amateur photographer many opportunities of amusing and mystifying his friends. For instance, so-called "spirit" photographs: The sitter should be posed and the camera arranged all ready for the exposure in the usual way. The spirit or ghost must then take up his position in some expressive attitude behind the sitter, and, using a small stop, a very short exposure should be given. The spirit then moves away, and without any movement of either camera or sitter a second exposure of longer duration should be made. On development of the negative it will be found that the spirit comes out as a shadowy, transparent form, while the remainder of the picture is precisely the same as an ordinary photograph. A more hazy appearance may be imparted to the spirit by placing a piece of fine muslin gauze in front of the lens during the first exposure. A photograph by this plan can only be made by connivance with a sitter. If, however, the photographer wishes to obtain a similar result, without the sitter knowing what is being done, the first exposure on the "spirit" may be made some hours or even days before the actual portrait of the sitter is taken, though, of course, the same plate should be used for both exposures.

Some interesting photographic pictures may be obtained by the use of one or more mirrors, and, indeed, by standing opposite a mirror, the amateur may perpetuate his own portrait. By placing a sitter between a pair of parallel mirrors, arranged at a certain angle, so as not to reflect either the camera or operator, an interesting multiple portrait may be obtained, the one individual blossoming out into a whole row of exactly similar people. Also by arranging mirrors at proper angles the full face and right and left profile views of a person can be obtained on the same plate at one exposure. The distorted images presented by concave and convex mirrors may also be humorously turned to photographic account.

Probably some of my readers have seen photographs of a man playing cards with himself, or of a man about to cut his own head off. These pictures are termed "doubles," and are produced by the aid of an arrangement with two shutters which fits on to the front of the camera and which allows only half the plate to be exposed at once. The card player seats himself at one side of the card table and poses ready for the exposure. The righthand shutter on the exposing apparatus is then opened and one-half of the plate exposed. The man then moves to the other side of the table, and when he has placed himself in proper position the lefthand shutter is opened and the other half of the plate exposed. A simpler way of effecting the same result is to use a little device, procurable from any dealer in photographic supplies, known as a duplicator, or to cut a small disc of black cardboard just to fit inside the front end of the brass lens mount. A segment of this disc of sufficient size to expose rather more than half the plate is then cut off this disc. The lens mount is not screwed tight home in its flange on the camera front, but is left just loose so that it can easily be revolved half a turn without disturbing the camera. The subject should first be focused, and then the cue disc placed in position with the straight edge vertical. The sitter is then posed and an exposure made. The lens mount is then turned round through half a revolution, the sitter changes his place to the required position, and a second exposure is made. In each case, of course, the sitter should be directly in front of the uncovered portion of the lens.

Caricature portraits may be made in several different ways. For instance, take two photographs of a friend, one of the head alone and the other of the whole figure; but the latter should be on a much smaller scale than the former. Take a print from each negative, and then neatly cut out the large head from the first print and paste it on to the shoulders of the small figure in the second print. From the composite picture thus obtained make another negative, and then any number of prints can be obtained from this, showing your friend with a very big head on a very small body. Another plan is to make a comical drawing on a sheet of cardboard of a body and a pair of legs. Then the sitter who is to be caricatured should hold this drawing in front of him, and, placing his head just over the shoulders in the drawing, should be photographed in this position.

An amusing departure from the orthodox style of portraiture may be made by presenting a friend with a picture of himself inside a bottle. This should be prepared as follows: First photograph the individual on a sufficiently small scale to fit in with the size of the bottle. In this picture surrounding objects should not be allowed to appear. Then the bottle is photographed large enough to contain the man, and then by the combined use of the two negatives the finished print is made.

X-Rays and Their Uses.—At the beginning of the year 1896 the whole world, both scientists and laymen, were startled by the announcement that a means had been discovered of photographing the living human skeleton. And when a few days later the statement was substantiated by the actual photographs of the bones of the living hand popular excitement rose to a height which has rarely been reached on account of a scientific discovery.

Professor Roentgen, of Wurtzburg, was experimenting with some high vacuum electrical apparatus called, after the inventor, "Crookes' Tubes," and he happened to have some sensitive photographic plates lying upon the table, and he found that, by some means he did not understand, these plates, though securely guarded against the action of light in the usual manner by black paper wrappings, became fogged, just as if light had access to them. He, therefore, tried a few experiments with them, and these led to those curious and valuable results which have now made his name famous all the world over. He discovered that there was an invisible radiation from these Crookes' tubes which is not light, or at any rate is not light of the kind with which we are familiar, for it obeys none of the natural laws which govern all kinds of light, visible and invisible, with which we have ever had to do. The fact that this "New Photography," as it has been termed, has awakened so much interest is largely due to the happy thought which suggested that the effect of the new rays should be tried upon the human hand, when it was found that they would penetrate the flesh, but they could not pass the bones. Consequently, upon a photographic plate placed behind, the curious result was obtained of a shadow photograph of part of the living skeleton.

But there are many other substances besides flesh and blood towards which these unknown rays—they are called "X-Rays," because their nature is not known—behave in a peculiar manner; in fact, their effect upon the majority of things is quite different to what might have been expected from our previous experience in relation to ordinary light. For instance, glass is very nearly opaque to this mysterious radiation, while wood and cardboard are almost perfectly transparent. An ordinary photographic lens with which to bring these rays to a focus is, of course, out of the question, but that does not matter much, for, if glass were ever so transparent to them, it would not have the desired effect, for the rays cannot be refracted. So it will be seen these "New Photographs" are not taken by means of light, as far as we can make out, and they are certainly not taken with a camera. They are "shadowgraphs," pure and simple, and the agency by which they are made is probably some form of radiant electricity.

In making these "electrographs," as we might call them, a large Rhumkorff induction coil is employed in connection with an electric battery or other source of low tension electricity to furnish the high potential current required to actuate the Crookes' tube. The active rays spring from the negative electrode of the tube when excited by the electricity, and in the best forms of tube for this special purpose they are received upon a little mirror of platinum, placed just opposite the cathode—as the negative plate is termed—and so inclined that they are reflected downwards towards the sensitive plate placed beneath.

Let us suppose that what up to the present has been the most popular of all subjects has been chosen to be electrographed—the living hand. A large sensitive plate of the ordinary kind is wrapped up in a black paper envelope, which will protect it from the access of light, so that the operation may be conducted in a well-lighted room with impunity. The hand whose bones it is desired to shadowgraph is then laid on the plate, and the vacuum tube arranged at a height of about six inches over it. Then, the owner of the hand having been cautioned to keep it as still as possible, the electric current is turned on and the invisible radiations from the tube allowed to act upon the plate for a period of five minutes down to half a minute, or even less, according to the size and power of the coil. Then the plate is taken to a dark room and developed in the ordinary manner, and, all being well, it will show the flesh of the hand of a dark gray on a black background, upon which the bones stand out plainly revealed and almost white, while any metallic objects, such as rings, being absolutely opaque to the rays, will show up with brilliant whiteness.

MOVING PICTURE MACHINES AND MOTION PHOTOGRAPHY.

In the year 1887 the idea occurred to that great inventive genius Thomas A. Edison, to devise an

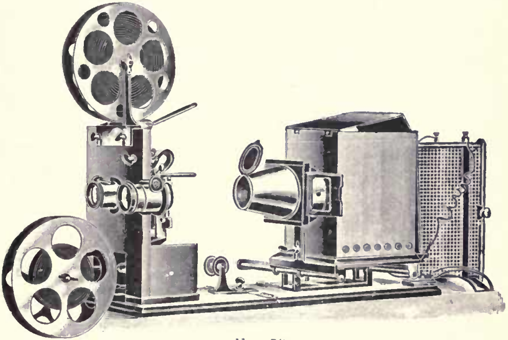


FIG. 59.

Giving front view of the Edison Projecting Kinetoscope. Rheostat on the right. Light centered on Stereopticon lens, which is shown adjusted to its position on the left-hand edge of the carrying case.

instrument which should do for the eye what the Phonograph does for the ear. This idea was partially accomplished in the production of the first motion picture machine, the original Kinetoscope. The early Kinetoscope was a ponderous and high-priced apparatus. It may be briefly described as a box with a peephole in the top. With this machine only one person at a time could enjoy the moving picture, owing to mechanical limitations.

The moving picture projecting machine of to-day, as the name implies, is an apparatus for throwing apparently living pictures and actual scenes upon a canvas or screen.

Owing to the simplifying of the apparatus and to the fact that the best machines are now so constructed that in them can be used not only the flexible film for projecting upon a screen the life-like image of objects in motion, but also the lantern slides for making stationary pictures, the form of entertainment made possible by the use of these machines has, in the past few years, grown enormously popular.

This marvelous instrument represents the very highest development in the art of photography—that of bringing before the eye an exact life-size reproduction of life motion, with all its accompanying effects of light, shade and expression. By means of a transparent picture film, an intense light and proper arrangement of lenses, the pictures are projected upon a screen one after another, in such rapid succession that the eye cannot perceive any intermission between them, thus producing a perfect illusion of continuous motion.

The Principle of the Moving Picture Machine is the same as the Stereopticon or Magic Lantern, only that the pictures appear on a transparent film and pass before the lenses in rapid succession.

The picture film is a long strip of celluloid 1⅜ inches in width and in length from 25 feet upward, according to the subject. The usual length of a film is from 50 to 100 feet. One minute is required to run a 50-foot film through the exhibition machine. The size of each photograph is ¾ inch by 1 inch wide. Each 50-foot film consists of about 800 instantaneous photographs, each slightly different from the other, taken while the film is passing the lens at a rate of about 15 to 25 photographs per second. To produce the animated movements the film must be moved past the projecting lens of the motion picture machine at the same rate of speed. From the beginning to the end of the film all the movements will be recorded that have been exhibited before the machine when the picture was taken. For each subject a separate film is necessary. The edges of the film are perforated, to pass over the sprocket device carrying the film while the subject is photographed. Similar sprocket wheels in the projecting machine carry the film in front of an intense light, which projects the picture upon the screen, thus both magnifying and illuminating the photograph.

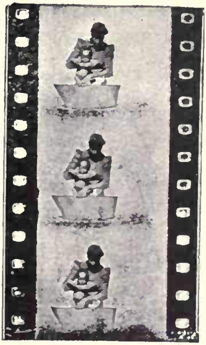


FIG. 61.

THE BATH.
Sample of Moving Picture Film, exact size.

So life-like, so true to nature and so perfect in every detail, with such life-like motions are the pictures as projected by these machines, that the observer can scarcely realize that what is before him is but a picture and not reality.

In the commercial world the use of the moving picture machine is growing. Manufacturers of heavy machinery and of mechanisms not easily portable, can send a picture demonstration to the uttermost parts of the world, at small expense. Thus the exact working of a piece of machinery can be shown to a prospective customer in South Africa, with as much clearness of detail as if the purchaser were examining the machine itself.

The moving picture machine has, as stated before, grown rapidly in popular favor of recent years. It amuses and it teaches. It combines profitable instruction with delightful entertainment. The list of films now at the disposal of buyers covers a wide variety of topics, some of them of great historical value. Many of the subjects will attain value as pictorial history which cannot be estimated in money. Such films as the Launching of the "Meteor," the Funeral of Queen Victoria, President McKinley's Last Speech, the Funeral Ceremonies at Buffalo, Washington and Canton, will offer material for accurate description that was impossible previous to the invention of the motion picture machine and moving pictures.

There are many languages upon this earth of ours, but pictures are the universal language, and future students of the historical will have reason for gratitude because of the invention of the moving picture machine, for by its aid history is being recorded every day. Miles of films are being filed away each month in the archives of historical societies and national museums, to be brought forth for the instruction of future generations.

At the present time the making of moving picture films, both negatives and positives, is altogether beyond the possibilities of the ordinary photographer. The long strips of film for making the negatives must be exposed by means of cameras of special construction; apparatus necessarily high priced and of no general use to the possessor because of its being designed for the specific purpose for which it is used.

The positives which are used in the exhibition machines, are printed from the negatives in a manner similar to that in which a lantern slide is produced, except that instead of a printing frame being used to hold the negative in contact with the sensitive film, an automatic printing machine is used. The great length of the strips of film render developing them in the ordinary manner absolutely impossible. Hence, to accomplish development, recourse is had to the use of large drums, which revolve in troughs containing the necessary developing and fixing solutions.

Around these drums the exposed film is wound. The drums being revolved, the film is brought in contact with the solutions contained in the troughs and development and fixation is thus accomplished. A further process in the completion of the films is the perforation of the edges. This is accomplished by a perforating machine which punches small holes at regular intervals along both edges, in which the teeth of the sprocket wheels of the projecting machine engage while the film is being exhibited. Thus it will be seen that the completion of a moving picture film ready to be used in the projecting machine necessitates not only a very high degree of knowledge of this particular work, but requires, likewise, apparatus and an establishment altogether beyond the possibilities of expenditure of the ordinary photographer. Hence, the making of these films is confined to a very few well equipped concerns, with whom the business is a regularly established commercial venture.

CHAPTER XV.

DEVELOPMENT AND COMPLETION OF THE NEGATIVE.

Equipment and Arrangement of the Dark Room.—As pointed out in a previous chapter, the process of developing the negative has to be carried on by the aid of the light from a ruby lamp, and since all other light must be excluded the room which is devoted to this work is usually termed the "dark room." If the reader is fortunate enough to possess a spare room at home, which can be set apart solely for photographic operations, his path of progress will be rendered considerably more comfortable than if he has to develop his negatives when and where he can. It is quite a mistake to imagine that any cupboard will do for the dark room, even if it is big enough for the photographer to get inside. Unless the work can be done comfortably, it is hardly likely to be satisfactory, and therefore it is much the best policy to select a room where both fresh air and elbow space exist in plenty. If the amateur has a room which he can devote entirely to photography, he will find the following items of furniture and fittings useful:

A table on which to do the developing, though better still than this would be a specially-made developing sink; a cupboard or chest of drawers, in which to keep his stock of plates, papers and various pieces of apparatus; and a set of shelves fixed on the wall, close to the developing table or sink, on which should be placed bottles of the various chemicals and solutions required for development. If gas is available, the burner bracket should be fixed just over the developing table; and if the convenience of a continuous water supply is also to be had the tap should be in an equally handy position. If a continuous water supply is not available a small tank fixed to the wall above the sink may be made to answer the purpose. Failing this, a bucket or large jug of fresh water should be kept at hand.

If a separate photographic room is not at the operator's command, the next best in order of convenience is the bathroom, and an excellent substitute it makes. In either case daylight may be excluded by a light structure of wood of such a size as to just fit into the frame of the window, and covered with some opaque material. I say opaque, for even in the daytime it is better to develop by artificial light, as daylight is continually varying in intensity, and thus makes it difficult to judge the density of the negatives. If, however, the reader prefers to work by daylight he can secure a fairly safe light by substituting for the opaque material two thicknesses of colored fabric, one thickness being a ruby color and the other a deep canary or orange. If this plan be adopted the screen thus made should be as little exposed to sunlight as possible, otherwise the color will rapidly deteriorate, and the screen will be thereby rendered unsafe. Such a screen should be tested from time to time.

Having thus prevented the admission of white light through the window, attention should be paid to the door, and any stray light finding its way through the keyhole or crevices should be promptly checked by brown paper. While, how-

A SNAP SHOT. FRENCH LICK SPRINGS.
Taken by an amateur during a trip over the Monon Route.

ever, the room should be made perfectly light-tight, it should not be air tight, for unless the bad air is permitted to escape and be replaced by pure air the atmosphere will soon become oppressive and even injurious.

In the event of neither of the above-mentioned rooms being available, the amateur must make the best of the accommodation afforded by one of the ordinary rooms of the house. In such case, of course, he must exercise especial care and cleanliness in handling his various solutions, so as not to damage the carpet or furniture.

The Choice of a Developer.—A "developer" may be defined as a chemical solution which, when applied to a plate which has been suitably exposed in the camera, will bring out or make visible the image produced by the action of the light on the silver bromide in the sensitive emulsion with which the plate is covered. That image is invisible until the plate has been subjected to the action of the developer, so that when the amateur removes his exposed plates from the plate holder they will appear precisely the same as when first placed in the holder ready for exposure. In making the image visible, what the developer really does is to reduce the opaque metallic silver—those parts of the silver bromide which have been affected by the light—and to leave unaltered those portions upon which the light has not acted. When the plate has been developed, and the latent image has been brought out, it has to be "fixed" before it can safely be allowed to make an appearance in daylight again. Immediately the plate has been developed it is subjected to a short washing in clean water and is then immersed in a "fixing" bath. After having been "fixed" the plate is unaffected in any further way by exposure to light, and all that remains to be done is to thoroughly wash it and let it dry.

But this explanation is carrying me ahead of my subject, for my present purpose is to indicate the nature and uses of the various developing agents commonly employed. This information may, perhaps, best be imparted in the following form:

Amidol.—This developer is chiefly used for two classes of work; snap-shot negatives and developing papers. It is very energetic in its action and is a good developer for bringing out detail. When used for bromide papers no clearing bath is required.

Eikonogen.—Very suitable for snap-shots and for portrait negatives. It is, however, but slightly soluble in water, and is, therefore, usually made up in quantity. It is rather difficult to obtain full density with this developer unless very pure crystals are employed and the exposure of the plate has been reasonably correct. If combined with a density-giving developer, such as quinol, good results may be secured.

Ferrous Oxalate.—This is a developer which at one time was very popular for negatives, but of late has been largely superseded by other substances. To secure the best results the exposure of the negative must be as nearly correct as possible.

Glycin.—This is a slow developer, giving gray-black images free from fog. It is much used for negatives for photo-mechanical processes.

Hydroquinone or Quinol.—This developer is a great favorite among amateurs on account of the cleanliness and ease with which it may be used. It gives blackish negatives and may be used repeatedly until exhausted. It is liable to produce harsh contrasts with an insufficiency of detail, and is slower in operation than some of the other developing agents. It is very suitable for bromide papers.

Metol.—Metol is one of the most energetic of modern developers and with short exposures produces negatives of extreme softness. A combination of metol and hydroquinone makes a very satisfactory developer.

Pyrogallic or Pyro.—Of all developers this is the one which is most widely known and has the longest reputation. By suitably modifying the constituents of the solution employed, pyro enables excellent negatives to be obtained, even in cases where the exposure has been far from correct, and in the hands of an intelligent user this power becomes of considerable value and importance. Further than this, it is fairly rapid in its action, any amount of density can be obtained, and the resultant negatives are of good printing quality. As an all-round developer for negatives pyro is still without a superior.

Rodinal.—Another name under which rodinal is sometimes sold is paramidophenol. It is chiefly used for developing hand camera negatives; but, while it brings out plenty of detail, there is occasionally trouble in obtaining satisfactory density. It is also a useful developer for bromide papers.

Agents.—The chemical substances mentioned in the above list are termed "agents," and are not used by themselves to produce development, but are mixed in certain proportions with a substance termed the "alkali," and with a bromide termed the "restrainer." The various portions of agent, alkali and restrainer are dissolved in a suitable amount of water to form the developing solution. Where these are all mixed together the developer thus formed is termed a "one-solution" developer. As, however, modifications in the relative proportions of the constituents will enable the operator to produce corresponding modifications in the character of the resulting negative, it is often a convenience to have two solutions mixed up, one containing the agent and the other the alkali. Then, by taking more of the one solution and less of the other, or vice versa, the development of the negative may be had more fully under control. Thus the rate of development may be hastened or retarded, and the contrasts in the negative accordingly increased or diminished. At the present moment the reader may not fully understand the significance of these facts, but the matter will be made clearer to him when I come to deal with the actual process of development. From the list of developing agents which I have just given the reader will see that he has a pretty wide field from which to choose. With a developer, as with the particular brand of plate, once the selection has been made it should be adhered to and its capabilities and peculiarities thoroughly mastered. Now, different makers of plates recommend different formulae for development, even though the same constituents may be employed in each, and whatever the brand of plates selected, while the general facts will still hold good, the particular formulae recommended by the makers of those plates should be adhered to when mixing the developer.

How to Mix the Developer.—The various chemicals of which the developers are composed are usually supplied in powders or crystals, and they should be stored in glass bottles, with close-fitting corks. India rubber corks should always be used in the case of potash or soda. Each bottle should be carefully and accurately labeled with the name of the substance contained therein, and the label should be as far as possible indestructible. That is, the inscription should be either sand-blasted onto the glass or should be written on a gummed label, which should be afterwards sized and varnished. No chemical or solution should be placed in a bottle which has previously contained another substance, unless the bottle has first been thoroughly washed out. On no account should any solution be poured into a labelless bottle, as the amateur will almost certainly forget just what the composition of the solution was, and when that is the case, it is useless to him. If space is limited, developers may be purchased in the form of powders. These developing powders are put up in small packages, occupying very little room, and when a developing solution is required it is simply necessary to dissolve one or more powders in water, according to instructions.

The dissolving of solid substances in water may be hastened by two methods: Firstly, by crushing the substance into a powder or very small pieces, and secondly, by using hot water instead of cold. The solution should, however, always be allowed to cool before it is used to develop with, otherwise the film of the plate will be injuriously affected.

How to Develop a Negative.—I will now assume that the reader has exposed a plate in the camera, and that he is ready to make his first essay at development. I will further assume he has prepared the solutions required according to the special instructions contained in the package of dry plates that he has used, or according to some one of the formulae given in Chapter XXIV., or that possibly he has obtained his solution ready prepared from a stock dealer. He must then proceed as follows: Light the ruby lamp and place the developing dish about twelve inches in front, or at such a distance as you can just see what you are doing. Next open the plate-holder, take out the exposed plate, and after lightly brushing it with a flat camel's hair brush to remove any particles of dust place it film side uppermost in the developing dish. Then, with a steady, sweeping motion, pour the developer over the surface of the plate. It is absolutely essential that the developer should cover the whole plate and that no air bubbles should be allowed to remain, otherwise the negative will be disfigured by markings due to unequal development. No signs of the picture will appear for about a minute or so, but the dish should be gently rocked during this period to keep the developer in motion. If the exposure has been about correct the plate will then gradually darken in places. Now watch closely. The development of an exposed dry plate is a process which cannot fail to deeply interest the most careless person. As the first faint outlines appear, under the influence of the developer, wonder grows into amazement at the change going on under one's very eyes. Outlines of familiar objects come out, as first the mast, then the hull, then the rigging and the cords of a great vessel comes to us from out the dimness of a fog.

In a portrait. the white shirt front and collar will first appear, to be quickly followed by the face. The reader should remember that in a negative everything is reversed—that is, a white collar comes out black, while a black hat will show white, or rather almost clear glass, in the finished negative. This being clearly borne in mind, the reader will be better able to follow the progress of the development. After the whitest portions of a picture, or the "high lights," as they are termed, have appeared, they will be followed by the half-tones, and ultimately by the shadows. If the picture appears gradually, in these successive stages, the development should be allowed to continue until all the details are fully brought out. If the plate is then held up to the ruby lamp and examined the high lights should be nearly opaque, while the deepest shadows should be transparent, but should clearly show the details. In a landscape, for example, the opaque part should be the sky, or the side of a whitewashed cottage, while the transparent part should be in heavy foliage on trees or bushes, but the leaves and branches visible in the negative; i. e., the deepest shadows should not appear as absolutely unaltered patches of the film. The edges of the plate which have been held by the rebate of the plate-holder will, of course, remain perfectly white, and it is a fairly safe rule to continue development until every part of the plate which has been exposed turns slightly gray, while the edges remain clear white.

The moment these edges show any signs of becoming gray, the plate should be removed from the developer and washed. With most plates there is another means of ascertaining if development has been carried far enough, and this is to examine the negative from the glass side, or back, by reflected light. If the development is sufficient the high lights and the less deep half tones will be visible from this side. Until the development has been completed the dish should be rocked from time to time as mentioned.

After the plate has been developed it should be washed under the tap, or in a dish of clean water, and should then be immersed in a fixing-bath, composed as follows:

Hyposulphite of soda..16 ozs. or 20 parts
Water up to..........80 ozs. or 100 parts

Hyposulphite of soda is commonly referred to as "hypo."

The above quantity of solution will serve for fixing a large number of plates, and if only a small quantity is required for a few plates it can be easily mixed, provided the same proportions are maintained, viz., four parts of water to one part of hypo.

The hypo bath does not take very long to prepare, and may be mixed, if preferred, just before development is commenced. The plate should be placed in the fixing bath and left there until it is completely fixed. This may be readily judged by examining the back of the negative by reflected light. If any of the unaltered silver bromide is still undissolved, it will appear as a creamy white patch, and until the whole of this has been dissolved away and nothing but the picture on the clear glass remains, the fixing process should be continued.

After the negative has been fixed it should be thoroughly washed, either in running water or in several changes, the period required to eliminate all the hypo being about one hour, provided a thorough and continual change of the water is arranged for.

When washed the negative may be allowed to dry. Heat should not be applied to effect this quickly, as the gelatine will be in great danger of becoming melted. The negative should be placed in an almost upright position in a dry, cool place, where no dust is likely to collect.

How to Recognize and Correct Under- and Overexposure.—The foregoing description of the progress and development was based on the assumption that the exposure of the plate in the camera had been fairly correct. It is, however, extremely likely that the beginner will for some time, at any rate, make numerous mistakes in judging the correct exposure, and I will, therefore, now proceed to explain how such mistakes may be compensated for by a modification of the development. The reader will remember that I said the high lights in the picture would first begin to appear about a minute after the commencement of the development, if the exposure had been approximately correct. We will now suppose, however, that at the expiration of that time no indication of the picture appeared, and that, in fact, two or three minutes had elapsed before the plate first began to darken. If, after this, the high lights and half-tones came up quickly, and yet, in spite of a prolongation of development, no detail appeared in the shadows, it is a pretty sure sign that the plate was underexposed. The opposite case to this, viz., overexposure, is indicated by the picture appearing considerably before the expiration of a minute, and, instead of coming out regularly and gradually, it makes its full appearance in a very short space of time. In cases of gross overexposure the whole picture seems to flash out at once, almost directly the developer is poured over the surface, and the film appears to go gray and foggy. Of the above faults underexposure is the more serious, as in many cases it is impossible to bring detail out in the underexposed parts, no matter how the development may be modified. With care all but very extreme cases of overexposure can be sufficiently controlled to enable a satisfactory negative to be obtained.

If the negative appears to suffer from underexposure, as indicated above, the following procedure should be adopted:

Pour the developer back into the cup or mixing glass, and replace it in the developing dish with clean water. The developer must then be weakened or diluted with about an equal bulk of water. Pour off the water from the dish and continue the development with the weakened developer. The developer should be allowed to act until the high-lights have become quite opaque, and probably by that time a good deal of the details in the shadows will have appeared. I may here give the reader a hint as to altering the strength or proportions of the developer in use in the developing dish. This should never be done by adding the water or fresh solution to the developer while it is in the dish, as it is impossible for a thorough mixture to take place in this way, and unequal or patchy development of the plate will result. The developer should first be poured off into the mixing glass, and the requisite addition made. It can be then returned to the dish with comparative safety.

The correction of overexposure will require more prompt attention than that of underexposure, for in the former case the mischief is soon accomplished. As soon as there is an indication that overexposure is the fault, the developer should be at once poured back into the graduate glass, and very greatly reduced in strength by adding water. Also put in a few drops of a strong solution of bromide of potassium. The development can then be continued until the contrasts appear likely to be about normal, or until the action of the solution appears to be less vigorous.

To Intensify a Negative.—The reader will sometimes find that a negative, after development and fixing, appears thin; that is, there is plenty of detail and graduation, but the image is not sufficiently opaque to yield satisfactory prints. This may be due to one of several causes. For instance, it may be caused by overexposure; by removal from the developer before sufficient density was obtained; or by the thinness of the emulsion with which the plate was coated. A negative of this kind may be considerably improved by the process known as "Intensification." The following is the method of procedure:

After the negative has been fixed it must be thoroughly washed and then placed in a strong alum bath for about ten minutes. After a further washing it is placed in the intensifying solution, made as follows:

Bi-Chloride of mercury	½ oz. or 5 parts
Hydrochloric acid	45 grains or 1 part
Water	10 ozs. or 100 parts

A note of warning with regard to bi-chloride of mercury: This is a strong poison and is sometimes known as corrosive sublimate or mercuric chloride. It should not be allowed to come into contact with any cuts, etc., on the hands or fingers.

The negative should be kept in the above solution till it becomes a grayish white all over and then thoroughly washed and placed in a second bath composed of:

Liq. ammonia (U. S. P.)	1 oz
Water up to	20 ozs

When the action of this bath is completed, as may be noted by the cessation of a visible change in the color of the negative, the latter is taken out and thoroughly washed and dried.

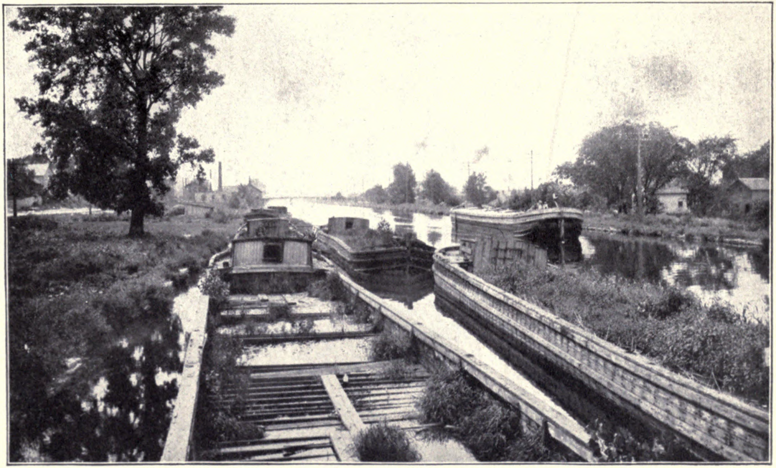
To Reduce a Negative.—In contradistinction to the foregoing, a process called "reduction" may be necessitated, if the negative should be so dense as to make it difficult to obtain a print. This is usually caused by the development having been too prolorged. The following is the method of obtaining a reduction of this excessive density:

The negative must be thoroughly washed after fixing, and should then be placed in a dish and covered with a clean solution of hypo. A solution of potassium ferricyanide is then made, as follows:

Potassium ferricyanide	1 oz
Water up to	10 ozs

Pour off the hypo from the dish into a measuring dish, add a few drops of the above solution and again pour over the plate. Reduction will at once commence and will proceed pretty rapidly, the rate depending upon the amount of ferricyanide added. As soon as the negative is nearly reduced enough take it out of the bath and thoroughly wash. The image will be reduced a little more during washing.

Drying Negatives.—Negatives should be dried as rapidly as possible; this is most conveniently



"ON THE RETIRED LIST"—LOCKPORT, ILLS.

Courtesy of Chicago & Alton Ry.

done by having a regular negative-drying rack. (See Fig. 62.) The ideal way is to place this rack holding negatives three or four feet away from an electric fan in motion; where this is not possible, the rack of negatives can be placed in the best draft of air possible in the house; never in the sun, particularly in summer. When the negative is dried too slowly in a close, warm room it will be of a different character and when dry will be thickened and very heavy in high lights; this is caused by the moisture on the plate

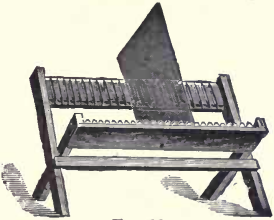


Fig. 62.

being heated by the air up to 85 to 90 degrees Fahr., thereby dissolving some of the minute sacs of gelatine in the film, permitting several atoms of silver to come together and form one mass; this going on all over the plate makes what is called a coarse-grained negative.

Varnishing Negatives.—All negatives should be varnished as a matter of protection. It is quite permissible to take prints from an unvarnished negative, and, indeed, there are many workers who will not take the trouble to protect their negatives by a coating of varnish. As, however, there are many negatives obtained which, from the nature of the subject, it is impossible to replace, I think the practice of varnishing is not an extravagant precaution to take against possible injuries from stray splashes of liquids, or the effects of a damp atmosphere. All photographic dealers supply a clear hard varnish for this purpose, and the method of its application is as follows:

First warm your negative by gently and evenly applying heat until it feels quite hot to the hand. Then hold the negative horizontally, film side upwards, on the finger tips, and pour a pool of varnish in the center. The negative should then be slightly tilted, first one way and then the other, until the varnish has traversed every portion of the surface of the film. Then tilt the negative up at a considerable angle and drain off the surplus varnish into the bottle. The negative may then be gently dried in front of a fire and allowed to cool.

Retouching Negatives.—Retouching means improving the negative by mechanical methods, either with a lead pencil or sable brush. Landscape negatives can be sometimes improved, especially where the negative is thin in sky, by smoking the glass side over a candle flame or by printing through a yellow tissue paper; this is not necessary in well-balanced negatives. Portrait negatives can very often be improved by retouching, as the unretouched negatives show facial defects in greater prominence than they really are. This is done by using a fine-pointed lead pencil on the surface of the film to blot out, modify or remove them and the deep shadows, particularly those at the corners of the mouth, crowsfeet, freckles, etc. Retouching is a profession of itself and to become proficient in the same requires an instructor.

Storing Plate Negatives.—When the amateur has made some progress in the practice of photography he will begin to accumulate a number of negatives of value and interest, and the question will arise as to how these may best be classified and kept. A simple and inexpensive method is to place each negative inside a plain envelope, and on the outside of this inscribe the subject and the circumstances under which the picture was taken. For example, one inscription might read thus: "Lake steamer entering Chicago harbor. June 25, 1902. ——'s '——' plate. Stop F-11. Exposure, one-thirtieth sec." Details such as these often prove of service for future reference. The negatives thus encased may be stored in ordinary cardboard boxes, and each box labeled outside with the nature of its contents, thus: "Summer Holiday, 1902. Chicago and neighborhood." Some readers may prefer to buy negative boxes ready made, and these can be obtained at a comparatively small cost. They are provided with grooves into which the negatives drop, and each box contains space for from twenty-five to one hundred plates. If these are numbered and a list of the subjects pasted inside the box lid any desired negative can quickly be found.

DEFECTS IN DRY-PLATE NEGATIVES AND THEIR REMEDIES.

Flat Negatives.—While flat negatives are frequently due to flat lighting of the subject, they are sometimes caused by too warm developer. Developer should not be allowed to get over 70 degrees Fahr. An unsuitable developing light will destroy the brightness of the shadows, causing the negative to appear flat.

Softening of Film.—Keep the developer at about 70 degrees Fahr. and no frilling in hot weather will result. Softening of the film can be avoided, however, even though the conditions of temperature are not perfect. After development rinse and place the negative in a saturated alum bath for five minutes. After fixing in a plain fixing bath place again in the alum solution for a few minutes; and the washing and drying, though warm, will not injure the film.

Weakness of Image is often the result of too cold development, but is generally due to underdevelopment, or developer too weak in pyro, or whatever agent is used.

Slowness of Development is caused by a cold developing room, smoky lens, dirty skylight, or decomposed developer. Hydroquinone is a slow developer, especially in cold weather.

Too Much Contrast is generally caused by too contrasty lighting of subject. Underexposure, the use of a restrainer in developer, or a developer too weak in sal soda may cause the same trouble.

Fog and Its Causes.—Fog on a negative may result from several causes. It may be caused by defective light from the dark room lamp; by a leaky plate-holder allowing daylight access to the plate; by gross overexposure; or from defective emulsion on the plate. To protect plates as much as possible from the first of the above causes it is a good plan to cover the developing dish over during the greater part of the time development is proceeding, only removing the cover for the purpose of examination, or of altering the developer. To avoid fog from the second cause, plate-holders containing plates should be kept out of sunlight, or direct daylight, as much as possible, and also should be covered round by the focusing cloth, while the slide is drawn during exposure. A kind of fog known as "green fog" sometimes occurs, and usually this may be traced to either using too much alkali in the composition of the developer or to the action of the impure atmosphere in which the plates may have been stored. A remedy for green fog is the application of the reducer, as described above, and a subsequent intensification of the negative.

Spots.—Numerous round and very small spots are generally due to rinsing the plate before developing. Carefully avoid this. Large, round spots, but less numerous, are caused usually by using water containing vegetable matter, producing bubbles in the developer. Melted ice, distilled or well water only should be used. Angular spots are due to dust on the plate at the time of exposure. Plates should be dusted with a camel's hair brush before development and the plate-holder and camera kept scrupulously clean. The dusting may electrify the plate if done too vigorously. Twice drawn gently over the plate is sufficient. Glass splinters are often the cause of spots when a number of plates are developed together and the tray shaken in order to more rapidly cover the plates with developer. Triangular transparent spots are caused by using a developer on which a scum has formed. It should not be used without filtering. The scum forms rapidly if the room is warm and the water used contains organic matter. Opaque spots and lines are caused by allowing pyro, hypo, or sal soda to get on the dusting brush. The dark room should be kept absolutely clean; and carefully avoid spilling hypo or other solutions, for after drying the chemicals will float about in the air and cause endless trouble.

Granularity of Negative.—This trouble usually appears in warm weather, and is due to two causes—insufficient mixing of the developer, especially if too strong and too warm. Too much alum in the fixing bath may also cause granular negatives. Do not use a muddy fixing bath. Filter it.

Opaque Finger Marks.—Finger marks are generally caused by placing the exposed plates all film down in a box, while awaiting development. After exposure and before development always place the plates film to film, or keep them entirely separate in a grooved box.

Pinholes.—Pins may not appear to have a very direct connection with photography, but I imagine that the beginner will not have produced very many negatives before he discovers the nature of "pinholes." These are tiny transparent spots which make their appearance on the film during the development and fixing of the negative. These transparent spots, of course, allow light to pass through freely, and, therefore, when a print is taken from the negative every pinhole is represented by a little dark spot on the print. The chief cause of pinholes is dust on the plate during exposure, and the surest way to prevent their appearance is to dust out the plateholders every time plates are to be put in, and also to lightly dust the surface of the plates themselves before putting them in the holders. This operation is best performed with a broad, flat camel's hair brush, which should be perfectly clean and dry. If pinholes do occur in a negative in spite of all precautions, the best way to nullify their ill effects is to touch or spot them out by carefully working over them with a lead pencil. Transparent spots of a larger kind than pinholes may be caused by the presence of air bubbles in the developer, and as these are more difficult to remedy than the pinholes great care should be taken when developing to see that no such air bubbles are allowed to exist.

Halation.—Halation or spreading of the high lights usually occurs in negatives of subjects in which high lights and very deep shadows occur, as, for instance, in an interior of a building, where a strongly-lighted window has to be included on the same plate as a dimly-lighted portion of the room. For the shadows a long exposure must be given, and this exposure, being far in excess of that required for the window, the light from the latter seems to spread and form a mist or halo round that portion of the plate. This misty appearance is caused by the reflection of some of the high light which has managed to pass through the film to the back of the plate. There are two ways out of the difficulty; one is to use specially coated plates—non-halation plates—and the other to "back" ordinary plates. To "back" a plate means to coat the glass side of the plate with some substance which will absorb any light which falls upon it, and thus prevent it being reflected back again. The following is a useful formula for preparing this "backing" mixture:

Burnt sienna	2 ozs
Caramel	1 oz
Gum mucilage	1 oz

Grind the above constituents together thoroughly and then add 2 ozs. of methylated spirit.

This mixture may be easily applied to the back of the plate with a soft brush or a piece of cotton wool. It can be readily wiped off again, prior to development. The operation of backing the plates must, of course, be performed by the aid of the ruby lamp in the dark room.

TO DEVELOP CARTRIDGE FILMS.

Film, to avoid curling, must always be developed face down, otherwise it is handled in much the same manner as plates, except, of course, that it must be cut up before printing.

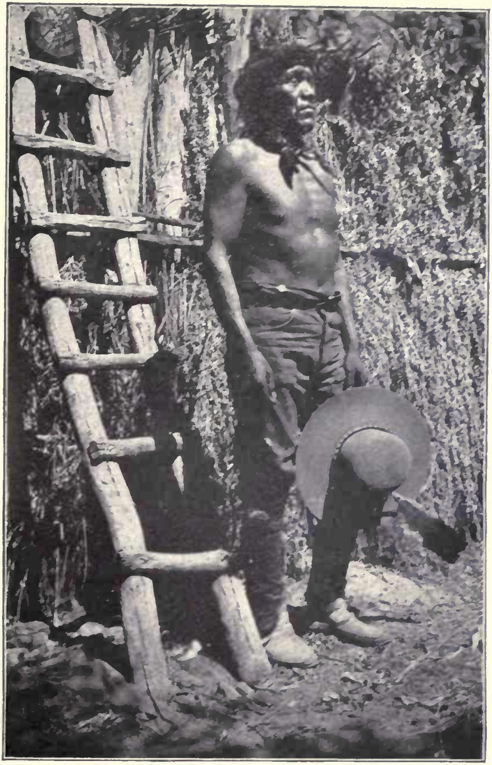
For all cartridge rolls smaller than 4x5 development should be started in the strip, as this method removes the possibility of cutting through the negatives. The same method may be used with the larger sizes, but owing to their length is, perhaps, not quite so convenient as to cut up the film before development is started. Having shut out all extraneous light from the dark room and lighted the dark room lamp,

a. Unroll the film and detach the entire strip from the black paper.

b. Pass the film through a tray of clean cold water as shown in Fig. 63, holding one end in each hand. Pass through the water several times, that there may be no bubbles remaining on the film. When it is thoroughly wet, with no air bubbles, place the strip of film in a tray of water, immersing it fully but not folding tightly so as to crack it.

c. Prepare the developer as described in chapter XXIV.

d. Now pass the film through the developer in the same manner as described for wetting it and shown in Fig. 63. Keep it constantly in motion.



HAVASUPAI INDIAN CHIEF, CATARACT CANYON, ARIZONA, ON THE SANTA FE.

Photo by W. H. Simpson, Chicago.

and in about one minute the high lights will begin to darken and you will readily be able to distinguish the unexposed sections between the negatives.

e. With a pair of shears cut the negatives apart and place them face down in the tray of clear water.

The negatives may now be immersed in the developer one section at a time, and developed

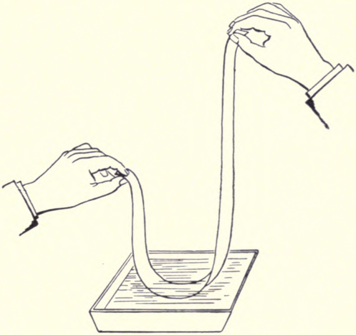


FIG. 63.

and fixed according to instructions given for dry plates and sheet film.

This method must always be followed with the cartridge roll holder rolls, but they may first be cut in two at point where perforations occur in the middle of strip.

Another Way.—1. Unroll the film and cut the exposures apart as shown in Fig. 64. In unrolling the film preparatory to development care must be taken that the end be not allowed to roll over the paper. The exposures should be cut apart with the paper on top. Fig. 65 shows a cartridge unrolled with the film on top. To correct this simply turn back the film as indicated by the dotted lines, thus bringing the film under the paper.

2. Fill a tray nearly full of water, and put into it the exposures, one by one, face down;

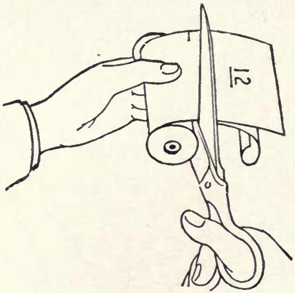


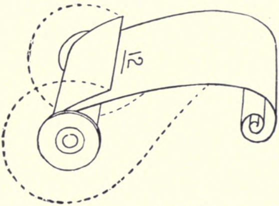
FIG. 64.

put them in edgewise, to avoid air bells, and immerse them fully. Cover the tray with a bit of brown paper to keep out the light from the lamp.

3. Prepare a developer according to instructions in chapter XXIV.

4. Take one of the exposures from the water and immerse it face down in a second tray. Rock it back and forth to prevent streaks and air bub-

bles; in about one minute the film will begin to darken in spots, representing the lights of the picture, and in about two minutes the operator will be able to distinguish objects in the picture.



Incorrect Method.

FIG. 65.

The developer should be allowed to act 5 to 10 minutes. The progress of the development may be watched by holding the negative, from time to time, up to the lamp. (See Fig. 66.)

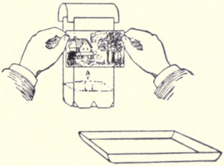


FIG. 66.

5. Transfer the developed film to a third tray and rinse two or three times with water, leaving it to soak while the next film is being developed. Only one negative should be developed at a time until the operator becomes expert; then he can

manage three or four in the tray at one time and the developer will answer for a dozen films before being exhausted. As each successive negative is developed it should be put, with the preceding negatives, in the washing tray and the water changed twice to prevent the developer remaining in the films from staining them.

6. Put two tablespoonfuls of hyposulphite of soda into a fourth tray, fill two-thirds full of water, and stir until dissolved. This is called the fixing bath.

7. Immerse the negatives one by one in the fixing bath until they are entirely clear of white spots and are transparent instead of milky by transmitted light. This will require about 10 minutes.

8. The red or yellow glass can be removed from the lamp as soon as all the exposures have been fixed.

9. Pour off the fixing solution into the slop bucket and fill the tray with clear, cold water; repeat this at intervals of five minutes, five or six times, keeping the negatives in motion or transferring them back and forth to tray No. 3, one by one, to ensure the water acting evenly upon them. The fixing solution must only be used in tray No. 4, and the negatives, after fixing, must not be put in either No. 1 or No. 2 trays. Neither must any of the fixing solution be allowed to touch the films through the agency of the fingers or otherwise, until they are ready to go into the fixing bath, otherwise they will be spotted or blackened so as to be useless.

10. When the negatives are thoroughly washed put one-half ounce of glycerine into one pint of water (four portions measured with the graduate glass), stir well and soak the negatives in

the solution for 5 minutes; then remove them and wipe off the surplus moisture with a soft, damp cloth, and pin them by the four corners face up to a flat surface to dry. The glycerine solution may be used repeatedly. The trays and measuring glass should now be rinsed out and set away to drain and dry. When the negatives are dry they are ready for printing.

Defective Negatives.—By following closely the foregoing directions the novice can make seventy-five per cent or upwards of good negatives. Sometimes, however, the directions are not followed and failures result. In such cases the instructions given for the correction of faults in dry plate negatives may safely be followed to correct like faults in film negatives.

THE CHEMISTRY OF DEVELOPMENT.

Constantly changing conditions of light and temperature may make it necessary at times to change the proportions of the different chemicals given in developing formulas. We therefore give the effect of each ingredient on the plate:

Pyro is the agent that gives strength.

Sulphite of soda preserves the pyro and prevents the negative from staining yellow.

Sal soda gives detail by softening and opening the pores of the film, causing the pyro to penetrate and act more vigorously.

If pyro alone were used the development would be very slow and decomposition of the pyro and stain of the negative, due to the absence of the sulphite, would prevent full development of the details.

The addition of sulphite of soda alone would simply enable the development to be continued to a greater extent without stain, but would give a contrasty negative, wanting in detail.

Pyro, sulphite of soda and sal soda, in the proper proportions, the negative correctly timed, and the temperature of room from 70 to 75 degrees Fahr. should give you a good negative in four minutes' development. If in that time your negative is too strong and wanting in detail it is a proof that, under your condition of light, you have used too much pyro—try 25 per cent less. If, however, the high lights are not too strong and the detail is wanting, the exposure was too short. This also might be overcome by a timely additional of sal soda at the early part of the development. Again, if at the end of four minutes your negative appears all over nearly alike (weak and too much detail), then it is overtimed; or, if the film appears soft, too much sal soda has been used.

If the development has continued six, eight or ten minutes, and the result is a flat, weak negative, either your developer is too weak in all its ingredients or the chemicals are impure, or, perhaps, the room is too cold.

Too much pyro gives contrast with proper time of development.

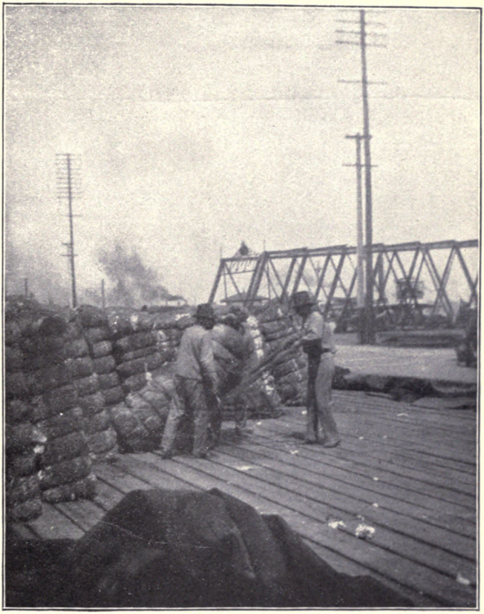
Too little pyro gives a weak negative with longer development.

Too much sal soda clogs up the negative with quick development.

Too little sal soda causes contrast and slow development.

GENERAL INFORMATION.

Color of Negative.—Gray negatives make weak prints and are the result of too much sulphite of soda in the developer.



COTTON ON THE WHARF AT NEW ORLEANS, LA., ON LINE OF ILLINOIS CENTRAL RAILROAD.

Blue-black and grayish-black negatives are quite pleasing to the eye, but do not give the best prints, as the delicate definition in the negative becomes a blank shadow in the print, thus giving a contrasty appearance not noticeable in the negative.

Greenish brown or yellowish black are the most desirable colors in the negative. From a negative of either of these colors you get in the print all you see in the negative, and the definition will print out clear and bold. With these colors, however, the negative should not be made so strong. Precautions must be taken to use water free from organic and other injurious matter (see article on water), and also to use neutral sulphite of soda or some in which the alkali has been neutralized (see sulphite soda). If the negative should develop too blue or gray use less sulphite. Too much sulphite gives gray; too little gives yellow.

Water.—If distilled water only was used in making solutions of developer, half the troubles in development would be avoided. Distilled water is oftentimes not easily procurable, and so the water at hand must be used. If river water is taken it should be boiled, cooled and filtered before mixing, as it generally contains much vegetable and other organic matter. Well water that is free from iron and sulphur and not too alkaline may be used without boiling. If it contains any of these it should be boiled and filtered. Melted ice is good, but should be filtered.

Sulphite of Soda.—Keep in a cool, dry place and in a well-corked bottle. If kept in a warm place the crystals melt and run together, and if exposed to the air the water of crystalization evaporates, leaving a white powder; it is then unfit for use, being changed into a sulphate through this contact with air. Owing to the many brands of sulphite of soda on the market and their various degrees of alkalinity, it is necessary to test it before using as directed by our formulas. Dissolve 4 ounces of sulphite of soda in 16 ounces of water and then add 20 drops of sulphuric acid. If this solution turns red litmus paper blue the sulphite of soda is too alkaline. To neutralize the alkali set aside 5 ounces of the solution and to the remainder add sulphuric acid (C. P.) until the blue litmus paper turns slightly red. It may be necessary to add 100 drops, more or less. Then add the 5 ounces set aside and the solution is ready for use.

CHAPTER XVI.

PRINTING, TONING, MOUNTING AND FINISHING OF MISCELLANEOUS PAPERS—VIGNETTING.

The novice in the mysteries of photography has now been carried in imagination through all the operations necessary in the making of the negative. He is the possessor of several first-class but imaginary negatives—pictures in which all those portions which should be white are black and those which should be black are represented by clear glass. He will recognize that this is merely a means to an end, and that the way to produce a positive picture from a negative is to place a sensitive surface in contact with it, and to expose to the action of light so that the rays passing through all those portions of the negative which are transparent will turn the sensitive surface black in those places, while the dark parts of the negative will protect it from the darkening influence, and so form a print which is positive—which has its lights and shades in the correct relation to one another. The process by which this result is obtained is known as Photographic Printing, and the resultant positives, made on sensitized or printing papers, are called prints.

Until quite recently Albumen Paper was used almost exclusively by the photographer, but while this paper yields most excellent and permanent results, it is extremely tedious and troublesome in manipulation, and of late years the field which it held so long has been almost entirely preempted by the ready prepared products.

These prepared papers are of many kinds, and are generally known as Emulsion or Aristotype papers. The word Aristotype, however, covers a very broad field, as nearly all the products are made after different formulae and each brand has little peculiarities of its own that require special treatment in manipulation. For this reason it is impossible to outline a method of operation that will exactly suit all kinds, and the instructions herewith given are but general.

These various papers are known generally as Collodion, Gelatine, Bromide, Ferro-Prussiate, etc. They are divided into two great classes, known as Printing-Out papers and Developing papers. From the large number of brands on the market it is possible to obtain almost any grade or texture desired, such as smooth or glossy surface, mat surface, etc.

The various manufacturers enclose with each package of their product specific instructions for manipulation, and the amateur will do well to follow same closely.

By Printing-Out papers is meant those kinds on which all details of the negative are printed fully out, the paper afterward being subjected to the toning and fixing processes presently described.

Developing papers are those with which the details of the negative, instead of being printed out, as with printing-out papers, are exposed in contact with a negative and after exposure are developed and fixed in a manner very similar to that in which a negative is produced. Platinotype and kindred papers partake of the nature of both Printing-Out and strictly Developing papers, as in their use they are printed out to a dim outline and afterward developed. Developing papers are many times quicker than any Printing-Out paper. Those who have but little time in daylight for photographic work, instead of spending hours in printing, washing, toning, etc., can in a very few moments make all their prints by exposure to any artificial light, and in an equally short time develop and finish them, thus leaving all the sunshiny hours for other pursuits.

Of the many papers offered probably the most desirable, for the beginner at any rate, is a Gelatino-Chloride (chloride of silver in an emulsion of gelatine) printing-out paper. In the negative we have learned that the image is latent until brought out by chemical action. In the printing-out paper the image "prints-out" at once. Before it is toned and fixed it is in the same condition as a proof received from the photographer. The chemical action clears the high lights and shadows, gives the proper tone and "fixes" the print, i. e., makes it permanent.

The processes of toning and fixing may be combined in one bath or may be done separately. For convenience the combined bath can be used, but care should be exercised not to overwork the bath. Toning with an overworked bath will not yield permanent results and no attempt to economize by overworking the toning bath should be made, as disappointment will be the inevitable result.

Printing.—In order to hold the paper in contact with the negative during the operation of printing, a special frame is employed, with a hinged back and springs to hold it down, this being known as a printing frame. The back is hinged so that while one half of the print in progress is firmly held by one spring in its position behind the negative, the other half can be turned back by the printer in order to see what progress has been made, with the full assurance that it will drop back exactly into position for further exposure, if that should be necessary.

Though printing-out paper is sensitive to the action of the light, it is not so to anything like the same degree that a photographic plate or film or developing paper is. For instance, gas light has practically no effect whatever upon it, and all the operations of placing it in the printing frames and so on can be conducted in weak daylight with impunity instead of in the dark room.

To make a print, the first thing to do is to remove the back from the printing frame by shifting aside the two pressure springs and lifting it out, when, the frame being laid face downwards on a table, the negative to be printed is placed in it, with the film side uppermost. Then a piece of sensitized paper is placed in position on the negative, with its shiny side downward, so that the two films are in contact with one another, the back is replaced, the springs brought to bear upon it and the whole placed in some position where plenty of light will fall upon it. On an ordinary bright summer day printing frames placed on the window sill on that side of the house on which the sun is not shining will, with negatives of average density, yield prints of good quality at a fair rate of printing. Of course, the amount of exposure which a given print will require depends not only upon the quality and brilliancy of the light, but also very considerably upon the density and color of the negative under which it is exposed. Moreover, the speed at which a print is made affects its ultimate quality to a marked extent, and a long exposure in a poor light, tending to brilliancy in the resultant print, will give a more plucky picture, with higher contrasts, from the same negative than one in which the exposure has been a short one to a brilliant light. Extra brilliancy is not always desirable, as, for instance, when the contrasts in the negative are already as high as is at all necessary, and in this case a short exposure to a very bright light—even to direct sunlight, in extreme cases—will give the best results. On the other hand, when the negative is unduly thin and weak, as when it has been overexposed, a brighter plate than would normally result may be obtained by slow printing in a very weak light, or by allowing the light to filter through a piece of tissue paper placed over the printing frame.

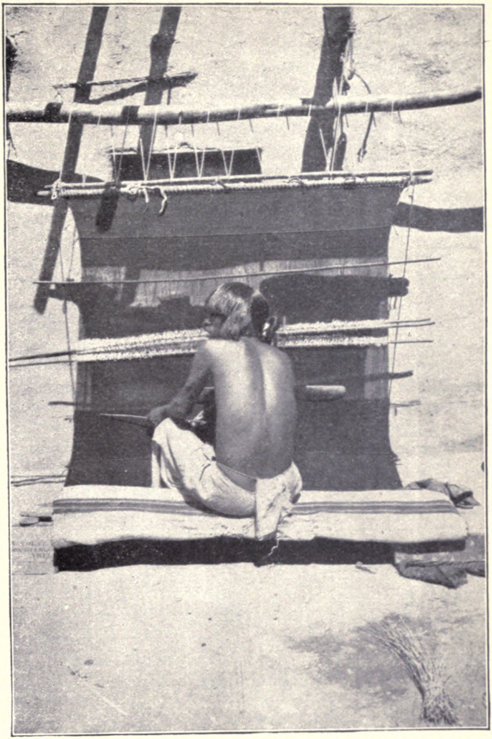
Prints upon printing-out papers should always be more deeply printed than it is desired that the finished picture shall be, for they always fade more or less in the subsequent toning and fixing operations. It is difficult to give definite directions for the exact extent to which this extra printing should be carried, especially as it varies for different papers and different toning solutions; but a little experience will soon reveal the amount of fading which has to be guarded against with any particular materials and precautions can be taken accordingly.

Toning.—When the prints are taken from the frame they are of a bright red color, not altogether a displeasing hue, if it could be retained, but it can not, for the effect of the necessary fixing bath is to transform it into a horrible bilious brown. In order to avoid this objectionable feature recourse is had to what is called the "toning bath," a very dilute solution of chloride of gold, in which the prints are placed, the effect of which is to throw down on all those portions of the print in which there is already a deposit of silver a thin film of metallic gold, which imparts to it the proper tone.

As the toning operation is a somewhat tedious one, giving very nearly as much trouble where only two prints are concerned as for two dozen, it is expedient to postpone it until there are a sufficient number of photographs to be toned to make it worth while. Albeit, the treatment should not be put off for too long, as the prints deteriorate with the lapse of time. A week or so, however, will have no appreciable deterrent effect if prints are kept in an absolutely dark receptacle.

The formulae and treatment recommended by the manufacturer—who, it is only natural to suppose, knows more about the peculiarities of his own products than any one else—should be strictly adhered to. In the sheet of instructions issued with every packet of paper there is given an extremely simple and excellent recipe for a toning bath, although it is generally pointed out that any of the recognized formulae for this class of paper may be used.

All photographic chemicals may be very much deteriorated by accidental admixture with foreign substances, but none are so sensitive to contamination as the toning bath. A separate dish should be reserved for toning, and never on any account used for anything else. Successful toning can only be accomplished by observing the greatest cleanliness in all the operations and all the materials and vessels used, for the smallest quantity of hypo, for instance, will have a very detrimental effect upon the results.



MOKI INDIAN WEAVER, PUEBLO OF ORAIBI, ARIZONA, ON THE SANTA FE.

Photo by W. H. Simpson, Chicago.

Chloride of gold is a component part of nearly all toning baths and it is advisable for the amateur to have always prepared a quantity of gold solution, ready for immediate use.

This chemical (chloride of gold) being a very precious salt, and, moreover, being deliquescent—that is, liable to take up moisture from the air and become liquid—is sold for photographic purposes in tiny, hermetically-sealed tubes holding 15 grains apiece. This small quantity of the tiny crystals being practically unweighable by ordinary mortals, it will be found convenient to mix it with water, which can then be conveniently measured. Procure a 16-ounce stoppered bottle, put 15 ounces of water in it, together with the tube of gold, from which the label must be previously washed with warm water, then insert the stopper and shake the bottle until the tube breaks. You will then have a solution of gold chloride in which every ounce contains one grain of the precious chemical, which can be easily measured out into the required quantities by means of a graduated glass.

It will be found that some formulae require the use of a certain number of ounces of gold solution. Others state that a certain number of grains of gold must be used. These apparently conflicting requirements need not prove confusing to the amateur if he will remember that, when made up according to directions given above, each ounce of the gold solution contains one grain of pure chloride of gold. Hence, when the formula he intends following calls for, say, 7½ grains of gold he must use 7½ ounces of the gold solution.

Having thus prepared his gold solution, the amateur is ready to make up his toning bath according to the special instructions accompanying the particular brand of paper he is using or according to instructions herein given.

DIRECTIONS FOR TONING WITH THE COMBINED BATH.

Place prints without previous washing in the following combined toning and fixing bath:

Stock Solution.

A—Hyposulphite of soda	8 oz.
Alum (crystals)	6 oz.
Sugar (granulated)	2 oz.
Water	80 oz.

Dissolve above in cold water and

When dissolved add borax	2 oz.
Dissolved in hot water	8 oz.

Let stand over night and decant clear liquid.

Stock Solution.

B—Pure chloride of gold	7½ grains
Acetate of lead (sugar of lead)	64 grains
Water	8 oz.

Solution B should be shaken up before using and not filtered.

To tone fifteen 4x5 prints take:

Stock Solution A	8 oz.
Stock Solution B	1 oz.

Pour the toning solution into a suitable tray and immerse the prints one after another. Several prints can be toned at once if they are kept in motion and not allowed to lie in contact. Turn the prints all face down and then face up and repeat this all the time they are toning. The prints will begin to change color almost immediately from reddish brown to reddish yellow, then to brown and finally to purple. The change will be gradual from one shade to another and the toning should be stopped when the print gets the shade desired.

When the proper shade has been obtained in toning bath the prints should be transferred for five minutes to the following salt solution to stop the toning:

Salt	1 oz.
Water	32 oz.

The extra fixing bath should be used to ensure thorough fixing.

After the salt bath give one change of cold water and fix for ten minutes in the

Extra Fixing Bath.

Hyposulphite of soda	1 oz.
Sulphite of soda (crystals)	60 grains
Borax	¼ oz.
Water	20 oz.

Wash one hour in running cold water or in sixteen changes of cold water, when prints may be mounted.

The combined bath must be started cold, not above 50 degrees Fahr., and must not be allowed to rise to temperature above 60 degrees Fahr. This condition can be obtained by placing a piece of ice in the bath when toning. If the bath is too warm, you will get yellow prints with a greenish cast in the half tones.

Use a thermometer and keep it in toning bath all the time.

The combined bath is an acid solution. The borax neutralizes only the excess of acid in the alum. Any attempt to neutralize the bath will precipitate the alum.

The combined bath should not be used a second time.

Clean trays once a week with nitric acid or sulphuric acid and water to prevent white spots or blotches on the prints.

TONING BY THE SEPARATE TONING AND FIXING METHOD.

The method of toning and fixing just described is by means of the combined bath. That is a solution in which the chemicals for toning the prints and those for fixing (rendering them permanent) are combined in the one solution.

The combined bath has as its chief claim to consideration the fact that when it is used the operations of toning, fixing and washing are rendered much less tedious than when the separate method is used. However, very few combined baths will produce permanent prints, hence the photographer has recourse to what is known as the separate method of toning and fixing, which, when properly used, will render absolutely permanent prints.

To use the separate methods mix as follows:

Toning Bath.

Chloride of gold	1 grain
Water	40 oz.
Alkali (saturated solution of borax or bicarbonate of soda)	10 drops

To obtain warm tones use less alkali. To obtain cold tones use more alkali.

Having mixed up the toning bath, put it aside while you give the prints their preliminary washing. Place them one by one, taking care that each is submerged before the next is put in, into a large basin full of clean, cold water and as soon as all are in transfer them one at a time to another similar bath of water and then again to the third and so on until all have been washed in several changes of water for at least ten minutes.

When the prints are ready for toning they should be removed from the washing water, for too much soaking is not good for them, and put in a heap to drain. Then one at a time they are placed in the toning bath and kept moving about in the solution until there are about a dozen under treatment. This is about as many as can be comfortably attended to, and by this time the first ones should be nearly toned. As soon as this stage is reached the print should be transferred to another dish of clean, cold water, to stop further action, and a fresh one can be put into the toning bath to take its place. Meanwhile all the prints in the toning solution must be kept in constant motion to avoid unequal action, from which patchy pictures would result; the best plan is to keep continually drawing the bottom print out of the liquid and placing it on the top, taking each one from the bath as it is seen to be finished and replacing it with a fresh one from the heap.

When all the prints have been through this operation the fixing bath should be prepared. The fixing bath is much weaker than that used for negative work, and should always be freshly mixed for each batch of prints. The following strength is recommended, though the proportions need not be very exactly measured:

Fixing Bath.

Hyposulphite of soda................	3 oz.
Water	20 oz.

Ten minutes will suffice to complete the operation and again care should be taken to prevent the prints sticking too closely to one another and so interfere with the action of the hypo. The final washing, whose duty, as in the case of the negatives, is to remove all trace of the hypo and which must, therefore, be most thoroughly performed, for upon its thoroughness the permanency of the prints almost entirely depends, takes at least fifty minutes, and is best accomplished in a print washer in running water, if possible, or, failing that, in continual changes, one print at a time.

PRINTING ON DEVELOPING PAPER.

For the amateur there is perhaps no more satisfactory printing process than that offered by the use of developing paper. There are many brands of this kind of paper on the market which are familiar to most users of the camera, viz.: Velox, Dekko, Argo, etc. Papers of this class are many times as rapid as printing-out paper. Prints made by this process give soft platinum effects with a minimum of trouble and expense.

Printing may be done by either artificial light or daylight and the print then developed by subdued daylight or lamp light. If daylight be used the amateur should simply pull down all of the window shades and, having filled the printing frame in the usual manner, step to the window, raise the shade a trifle, give the required exposure, pull down the shade and proceed with development. If exposure is made by gas light he should turn up the jet to its full capacity for the required time and when ready for developing simply turn the gas low, so as to subdue the light, and then work directly under it. To the amateur who has no regularly equipped dark room this feature of the paper is a great convenience, as the bath room or kitchen can be readily utilized for the work either by day or night, without the necessity of pinning blankets over doors and windows to stop each stray ray of light.

When filling the printing frame the paper not used should be promptly replaced in its envelope and put away in a dark drawer.

Exposure.—As papers of this class vary in sensitiveness the instructions given, so far as duration of exposure is concerned, are but general. The special instructions inclosed in every package of paper must be accepted in preference to any general rule. To print from a negative of average density expose two minutes, six inches from an ordinary six-foot gas burner. A very thin negative will print in about one minute and a very dense one would require from four to five minutes, but the average exposures will be from two to three minutes by this light. If exposed to direct sunlight an exposure of from one to five seconds will suffice. As a general rule printing by artificial light will give better results, and after the first two or three experiments it can be determined by the appearance of a negative just how much time will be required for printing.

Development.—Developing papers do not print out, but the image is latent and must be developed the same as with a negative or a bromide print.

For your developer make up a stock solution as follows:

Hydro-Metol Developer.

Water	12	oz.
Metol	7½	grains
Hydrochinone	30	grains
Sodium sulphite, crystals pure	218	grains
Sodium carbonate (crystals)	163	grains

Dissolve and add about 25 drops of a solution composed of bromide of potassium ½ oz., water 5 oz. This solution is to be used without diluting.

Olive green tones may be obtained by diluting developer with two or three ounces of water and adding 12 to 15 drops of the bromide of potassium.

Soak for a few seconds in cold water, then place face up in tray and pour on developer. If the print has been properly exposed development will be very rapid. The instant print reaches the required density it should be transferred directly (without washing) to the

Hypo Bath.

Hyposulphite soda	1 oz.
Acetic acid (or alum ¼ oz.)	4 drops
Water	5 oz.

Keep print moving during first few seconds of immersion.

Wash thoroughly for one hour in at least twelve changes of water and hang up to dry.

Four ounces of the diluted developer will answer for half a dozen 4x5 prints, then it should be thrown away and a new developer prepared from the stock solution.

Failures and Their Causes.—Weak prints are caused by underexposure or weak developer.

Overdark prints are the result of too long exposure or too strong developer.

Muddy whites are usually from lack of bromide in developer, but may be caused by paper being light-struck, by forcing development of undertimed prints or by failure to move prints in hypo bath.

Greenish-brown tones are the result of too much bromide in the developer or of the use of old or weak developer.

Yellow stains come usually from insufficient washing or fixing, but are sometimes the result of not completely immersing the print in developer or of not keeping them moving for a few seconds when first put into hypo.

Brown or purple stains sometimes result from incomplete fixing or from failure to keep prints moving in the hypo. The remedy is obvious.

White spots are the result of bubbles on the paper while in the developer.

Making Blue Prints and Sepia Prints.—Print making on Ferro-Prussiate (blue print) paper is simple in the extreme, no chemicals whatever being required. Make prints in the same manner as described for making gelatine prints, but continue until a shade darker than the finished print should be, then wash the print for ten minutes in clean water. The resulting picture is of a very agreeable, bright blue color on a white ground and is as permanent as the paper itself.

Blue prints should not be burnished.

The paper known under various names as Sepia matt is handled almost in exactly similar manner as the blue print paper and produces most beautiful matt surface prints of a warm sepia brown tone.

Printing-In Clouds.—The time is past and gone when a landscape photograph having a plain white sky is considered complete. It has been recognized that a photograph, like any other picture, must show clouds of some sort, if it has any sky at all, and, as clouds—requiring a very much shorter exposure than the majority of terrestrial objects—rarely appear upon a landscape negative, it is necessary to introduce them into the print by a second exposure to light under a special cloud negative. The amateur will do well to make for himself a set of negatives of different kinds of clouds so that he will have a number to select from, and will be able to find one to suit any picture he may take. Attention should be paid to the direction of lighting of the clouds, so that a landscape lighted from one side may not be wedded to a cloud on which the sun is shining from the opposite direction.

The recently introduced Ray Filters and Ray Filtergraphs render the making of cloud negatives comparatively easy, as they are constructed primarily for this work.

If the black space representing the sky on the landscape negative be not sufficiently dense to prevent the light from darkening the paper behind during printing, it must be painted out or masked to make it so, and this is most easily done in the following manner: Make a rough print upon any kind of printing-out paper and, with a pair of scissors, cut carefully along the line of demarkation between the landscape and the sky portion. Put both pieces in the sunlight to darken, and attach the sky half to the glass side of the negative in the right position to make the sky perfectly opaque, taking care that it does not overlap other portions of the picture. Then make the print in the usual manner, and afterwards print in the sky from a suitable cloud negative, using the other half of the divided photograph as a shield for the landscape portion already printed, in the same manner.

Trimming.—The prints should be neatly trimmed before toning, taking off the blank edges caused by the printing frame.

The majority of views are improved by trimming off a liberal margin; especially is this true of views where some central object really comprises the picture.

A good guide for trimming is the glass form, as by its use you can see where to trim to best advantage.

Place the print, with face up, on a clean sheet of glass, and on the print place the glass form. Press down firmly on the form with one hand, and with the other cut along each edge of the form with a sharp knife. An ordinary pocket knife will answer. The knife should be kept well sharpened.

A better method is to use any of the regular print trimmers as sold by dealers in photo materials.

Trim your prints freely. It is safe to say that three pictures out of every four can be improved by a judicious use of the shears. One picture has too much sky, another too much foreground and another one a whole side with nothing in it worth keeping. When a portion of a picture has nothing in it that is interesting or necessary to the balance of the picture, cut it out. Take two cards and experiment with your photographs, laying the cards on them in such a way as to cut out from view what seem to be undesirable parts; then apply the shears. An experiment of this kind will soon satisfy you that the shears can be used to advantage.

Vignetting.—Portraits are sometimes printed in such a manner that the picture gradually fades away towards the edges where there is perfectly white paper. This "artful fakement" is called vignetting, and is accomplished, as will be imagined, by shielding the edges during exposure or printing by means of a suitable mask. Vignetters, as they are called, can be purchased from any dealer in photographic accessories, but as nearly every different picture or portrait requires a mask of different shape or size, it is less expensive for the amateur to make his own vignetting shapes as he requires them. Take a piece of card of the size of the negative to be vignetted and cut a hole in it of oval or other shape, as the case may be, and rather smaller than that area of the picture which is to be unaffected by the shielding. Then with a pair of scissors snip out V-shaped pieces so that the hole is serrated all around inside like the edge of a saw. Place this card in the printing frame before you put the negative in, and bulge it out so that the teeth stand out in front of the glass to the extent of about half an inch. Then print in the ordinary manner, but in well diffused light, and the result should be a nicely graduated vignette without a trace of the serrated edges being apparent.

Mounting.—After the prints are washed they are ready for mounting on cardboard, or, as usually called, card-mounts; this operation is very simple.

Remove the prints from the water one by one, drain off all surplus water, and place in a pile, with faces down, on a clean sheet of glass.

Apply a thin coat of paste to the back of upper print, using a bristle brush for that purpose; place the print carefully on the card-mount, working from the center to the ends so as to be free from air bubbles. Place a piece of cheese cloth over the print to prevent it from becoming rubbed or torn, and rub the paper with the palm of the hand until the print lies perfectly smooth.

If the prints are not required to be mounted at once on leaving the water, they should be dried, and when mounted subsequently they should be thrown into clean water until they lie flat, and then mount as usual. Do not try to mount them while dry.

One of the best articles for making prints lie smooth is a small squeegee roller, which is sold by all dealers in photographic materials.

After being properly mounted and thoroughly dried the prints should be burnished by running them through a Burnisher.

Card Mounts.—In choosing card mounts for prints great attention should be paid to the particular character of the picture to be mounted. The beauty of a photograph is also very much enhanced by the harmony of its surroundings as to color, etc., when hung. This is not the place, however, to enter discursively into a subject which is largely a matter of taste.

As regards the mount itself, in its relation to the picture, it is difficult to lay down any general rules as to its choice, but it will be safe to say that it should be chosen with a view to heightening the effectiveness of the picture it is to contain and of lending importance and dignity to its salient features. For instance, if the picture contains high lights which require accentuating, a heavy mass of dark color in the mount—if it be not included in the picture itself—will be found to lend vigor and brilliancy.

Where the photographs are arranged in albums the same variety of choice of environment is not practicable; but even here there is scope for the exercise of the photographer's good taste, for much may be accomplished in a negative kind of way, by the careful choice of neighbors, so that incongruity of fellowship may be avoided; for the telling qualities of a picture are considerably enhanced by placing it among others whose particular qualities tend by contrast to bring out its full beauty.

Very convenient albums known as Squeegees have lately been introduced, in which unmounted photographs may be inserted into the thickness of the pages, as it were, in much the same manner as cabinets are slipped in the old-fashioned portrait albums. Photographic mounts, either plain or ornamented, with seasonable legendary inscriptions, suitable to Christmas time, etc., built upon the same principle, can also be obtained.

Glossy Prints.—Few amateurs care to go to the expense or trouble of burnishing their own prints, but they can readily obtain a beautiful glace finish in a simple manner by drying prints on a ferrotype plate in the following manner:

1. Clean the ferrotype plate with hot water each time it is used. Polish with a soft cloth until plate is absolutely free from dirt or specks of any description. Swab with a tuft of soft cloth or cotton batting, wet with a solution composed of benzine 1 oz., paraffine 10 gr. Rub dry with a clean cloth and polish with a chamois skin or very soft cloth. Use a soft brush to remove particles of dust from plate.

2. Lay the wet print on the ferrotype plate. It must be in perfect contact to produce a uniform glossy surface. This contact is better secured by avoiding air bells in laying the print down than by endeavoring to expel them by heavy pressure—light rolling with a print roller (with cloth between) is all that is required—heavy pressure being liable to make prints stick in spots.

3. When surface is dry brush over the back of print (while still on the plate) with a thin solution of white glue.

4. When "bone" dry strip the print from the plate and lay the print on a mount, the face of which has been well moistened with a wet sponge.

5. Rub down with a dry blotter, then dry face up, free from dust.

Note.—Prints finished by the above process can be kept very nicely unmounted if so desired, the glue on the backs preventing curling.

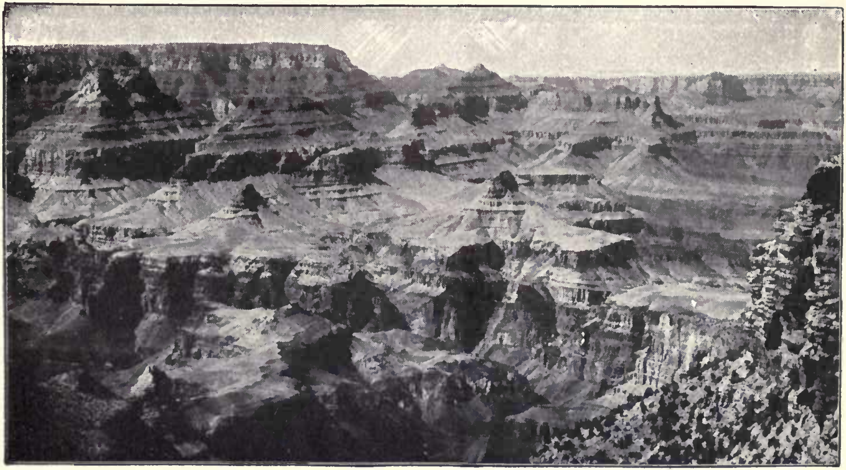
CHAPTER XVII.

PLATINUM PRINTING.

So far all the printing methods that have been described depend upon the fact that certain of the salts of silver are sensitive to light; that is to say, they are either directly darkened by the action of light, or they have conferred upon them the susceptibility of the blackening influence of a subsequent chemical operation called development. But one of the most beautiful of all the printing processes is that in which the chemical salt of the metal platinum is substituted for that of silver, and so pleasing are the prints made by this process that it has come to be recognized even by the lay mind as something distinct from the usual application of scientific processes, and "platinotypes" come in for a large share of admiration everywhere.

Of all the modern printing processes at the command of the photographer, whether amateur or professional, none deserves to be more popular than the platinum. The simplicity of manipulation combined with the beauty of the results obtained with it is enough to recommend it to every photographer. And above all, the prints produced by this method are as permanent as the paper which supports the image.

Its range of yielding the strongest blacks with pure lights and a long scale of intermediate halftones or grays is only equaled by the carbon process. The platinum print has an undescribable charm, suggesting atmosphere, though the



GRAND CANYON OF ARIZONA.

By courtesy of the Atchison, Topeka & Santa Fe Ry.

negative printed on another medium may be entirely devoid of this valuable pictorial quality.

Notwithstanding these decided beauties and charms, the great majority of photographers, and especially beginners, imagine that platinum printing belongs to the advanced stage of photography.

Excluding the process of producing blue prints, none is so easy and simple and none requires so few chemicals and so little time and trouble to produce a finished print.

There is no toning to be looked after, a little very dilute acid answers for the fixing, and there is only short washing.

In printing, the image is only partially visible and it takes a little experience in overcoming the difficulty in judging how far to go. This factor has undoubtedly been the great bugbear of this otherwise almost ideal photographic printing process, and has been the cause which frightens the beginner who has generally accustomed himself to some of the printing-out silver papers. But in consideration of the fact that the difficulty is often more imaginary than real, and that the manipulations of developing, cleaning and washing hardly take more than a few minutes, is it not worth while to at least try this mode of printing?

As stated, platinotype printing presents no special difficulties when once its little peculiarities are understood; but there is one thing about it which demands most careful attention, for upon that depends, in a very great measure, the success or failure of the process. The sensitive paper, both before and during printing, is most susceptible to the influence of damp, which, if it has been allowed to affect the paper, will inevitably cause it to yield muddy and degraded-looking prints, which are unsatisfactory and unprofitable.

Platinotype paper can be obtained from most dealers, together with all the accessories required in the working of the process. It is manufactured in sheets 20x26 inches, but can be bought in any desired size, packed in dozens in a tin tube. The writer wishes to warn the beginner not to buy the paper in any way but in tins, for otherwise he will not receive it in proper condition. The advice of some dealers in this matter is ruinous. The paper is packed in tin tubes, as it is extremely sensitive to damp, which spoils it. Each tin contains a bit of cotton-wool, enclosing a small piece of asbestos, saturated with calcium chloride, which absorbs all traces of moisture apt to get into the tube and which would otherwise attack the paper.

In a fairly cool place it keeps for months. Excessive heat will deteriorate it rapidly, so that in a very hot climate it is best to keep it in a refrigerator.

Inasmuch as the paper is more sensitive to light than the gelatine and collodion silver papers in the market, it must be handled in subdued light; that is, not too near a window nor out of doors.

After opening a tube and taking out a sheet for printing purposes, pack away the balance exactly as originally packed, and the sheets can be kept in good condition until wanted.

As a further precaution against the evil-working influence of dampness it is necessary to place between the pads of the printing frame and the sensitive paper during exposure a sheet of thin vulcanized India rubber, and it is most important that the pads themselves should be perfectly dry. Indeed, that word "dry" is the keynote of the whole thing; every part of the apparatus used and every bit of paper right up to the process of development must be thoroughly dry if the best results are to be secured.

The only difficulty about the process is as regards the exposure, for not being, strictly speaking, a printing-out paper, a certain amount of experience and skill is necessary in order to judge when the operation is complete. It is not so much a case of estimating beforehand the length of exposure necessary as, for instance, where bromide paper and other processes of printing by development are concerned, for, after the light has done its work, there is a distinct image of the picture upon the paper, from which an experienced printer can tell in a moment whether the operation has been carried sufficiently far or not. It is much more nearly allied to the use of printing-out paper, for an ordinary printing frame with its hinged back is employed, and the length of time required is determined, not by previous calculation, but by examining the progress of the print from time to time during exposure.

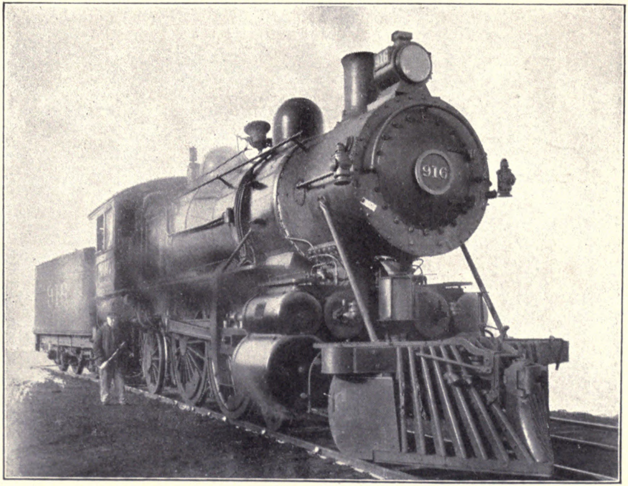
The paper, when first taken from its tin case, is of a pale canary-yellow color, which, by exposure to light, becomes modified into a light grayish brown.

In printing it is exposed in the usual way to daylight (sunlight preferably, according to the writer's opinion), and is examined from time to time to note the progress of the printing. This must be done with the back to the window. The image is only partially visible. A little practice will teach the student how far to print; actinometers, as recommended by some, being entirely unnecessary.

Care should be taken with the prints in all the stages prior to the development that they do not become unduly exposed to light, for its action upon the paper does not manifest itself until afterwards. It is more sensitive than any of the printing-out papers, and must be guarded accordingly. When first taken from the frames, unless the prints are destined for immediate development, they should be quickly placed in the tube to protect them from the action of the damp air. Then, when the time comes to develop them, they are floated one by one, face downwards, on the surface of the solution, and the operation takes thirty seconds or possibly more. There is another method of development which has great artistic possibilities in clever hands, and that is by applying the solution, re-strained with glycerine in order to make it slower in its action, by means of a camel's hair brush. Very beautiful effects can be gained by this method, especially if advantage is taken of the re-straining power of pure glycerine to hold back those portions of the picture which are not required of such depth as the remainder.

The color of a platinum print is essentially black, but this tone can be modified to a small extent by making the developer very slightly alkaline for a warm black, or acid when cold tones are desired.

The developing is done by immersing the print in a solution of oxalate of potash, which brings out the image in its full strength nearly instantaneously.



STANDARD PASSENGER LOCOMOTIVE, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

Oxalate of potash solution, normal strength; i. e., 1 lb., dissolved in 50 oz. water.......	1 part
Water	2 parts

The makers usually recommend a special substance which they call by various names for the development of their papers. But as the treatment of the prints where this developer is used differs in no essential way from the other case, it will be unnecessary to further mention same.

As soon as development is complete the print is transferred to a fixing bath composed of:

Hydrochloric acid (pure)......	1 part
Water	60 parts

Immerse the print face downwards in this bath contained in a porcelain dish, and leave it there for five minutes or so, or until all the prints of the batch have been developed and placed in this clearing, or fixing bath. Then, when the last one has had its five minutes' soak, they are all transferred to a second, precisely similar, bath, where they must remain for, say, ten minutes, when they are again transferred to a third bath, compounded in exactly the same manner, and there left for a quarter of an hour. This triple clearing is followed by a good washing in three changes of water—to the second of which a little washing soda may be added to neutralize any acid remaining in the prints—and after fifteen minutes or so they are ready for drying.

Full particulars and detailed instructions are enclosed in every tube of paper.

The paper comes in various varieties, which are marked as follows:

*AA (smooth, thin).
BB (smooth, stout).
CC (rough, very stout).

These are the cold bath papers which are in general use here in the United States, and which give pictures of a black image.

Besides this class, the Platinotype Company manufactures the "Sepia" papers, which are developed hot, and give a rich brown print. They also come in the various varieties of smooth and rough.

The most popular of all these grades is that known as CC; it is a tough heavy paper, with a decided tooth or grain like a rough drawing medium. It also has better keeping qualities than any of the others.

It cannot be impressed too forcibly upon the beginner that moisture is the greatest enemy of the process, and that it is necessary for him to keep printing frames, pads and negatives perfectly dry, if he is aiming at superior results. For certain effects it is sometimes desirable to allow the paper to absorb some moisture, but this will hardly be in the line of a beginner. It is therefore to be recommended before starting a day's printing to dry the printing frames and pads in the kitchen or in some dry place, and even to dry the negatives if the air is laden with humidity. Gelatine is very hygroscopic: that is, it readily absorbs moisture. It might also be pointed out that with paper which is old and perhaps slightly damp printing need not be carried as far as with fresh and dry paper.

Most photographers have an idea that the platinotype process requires a so-called "plucky" and "brilliant" negative. This is not the case. Any negative which gives a good result with other papers will yield good prints with platinum.

In using the cold bath paper it is at times advantageous to develop it hot. This can be done in case one is printing from a rather harsh negative, which, if developed in the ordinary way, would yield a print devoid of all graduation or half-tone. If developed hot the same print will come out with considerably more softness; that is, yielding more half-tones.

In other words, the temperature of the developing bath has a decided influence on the tonality of the print, as also on the color of the image.

The colder the bath, the colder the image may be set down as a rule. The warmer the bath, the warmer the image. Thus, one is enabled at will to produce either a cold blue-black picture or one of a warm black, the resulting color depending entirely upon the temperature of the oxalate solution.

Dampish paper yields prints of a brownish-black color, with a tendency to mealiness.

At times it is desirable to increase the vigor of a print, and in order to accomplish that result the print must be developed in the following developer, recommended by Horsley Hinton:

Oxalate of potash	1 lb.
Phosphate of potash	4 oz.
Sulphate of potash	½ oz.
Water	6 pints

This solution develops the prints rather slowly, and is especially suitable for prints from very flat negatives.

It may be remarked that although the Platinotype Company recommends its own developer for use with their paper, I have found the pure neutral oxalate of potash fully its equal. Their salts undoubtedly contain some phosphate of potash besides the oxalate.

Platinum prints may be toned in various ways. The most common is the "Uranium," which changes the color to a rich brown or red-brown. The ordinary uranium intensifier may be used for this purpose, the print simply being immersed in it for a time.

An excellent method for uranium toning is given by A. Horsley Hinton:

Solution 1.

Uranium nitrate	48 grains
Glacial acetic acid	48 minims
Water	1 oz.

Solution 2.

Potassium ferricyanide	48 grains
Water	1 oz.

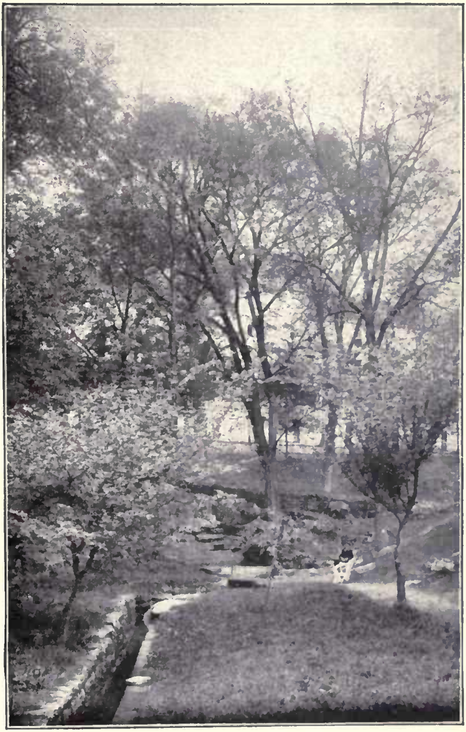
Solution 3.

Ammonium sulphocyanide	½ oz.
Water	1 oz.

For use take ¼ oz. of each Nos. 1, 2 and 3 and 25 oz. water.

A finished unmounted platinotype print, thoroughly cleared from all iron salts, is placed in a flat dish and flooded with the above solution and the dish rocked continuously.

The color of the print will gradually change; the toning should be carried on a little further than when the desired tint has been reached, as the picture will dry out a little colder in color than it appears in the toning bath. It is now brought into a dish of water containing a few drops of glacial acetic acid. The water must not be alkaline, as it would dissolve the uranium compounds deposited on the print and thus change its color again. This property of alkaline water may be made use of in case the desired



FRENCH LICK SPRINGS.

By courtesy of Frank J. Reed, Gen. Pass. Agt. Monon Route.

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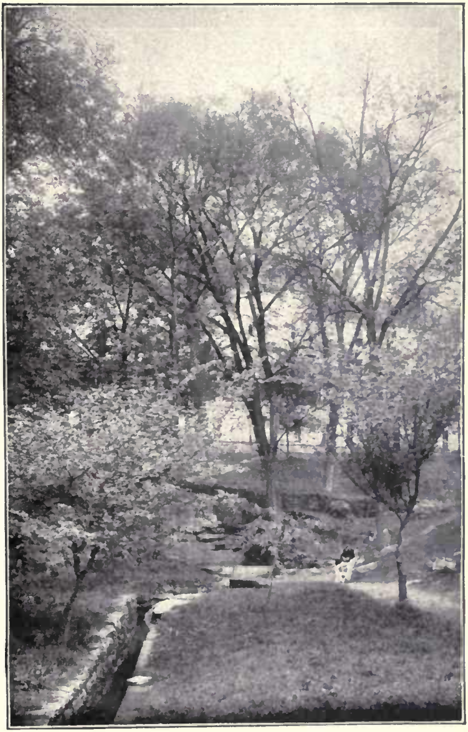


FRENCH LICK SPRINGS.
By courtesy of Frank J. Reed, Gen. Pass. Agt. Monon Route.

color of the toned print is unsatisfactory, and one wishes to get it back into its original condition.

It has as yet not been conclusively proven that platinum prints treated with uranium are permanent.

Besides the usual method of developing platinum prints, there is one which is especially fascinating for the more advanced worker who wishes to control every part of his print; that is, by local development.

This can be accomplished by using the glycerine method referred to in the platinotype instructions.

It consists essentially of painting the image by means of the oxalate solution, using a brush for the purpose, the paper having first been exposed to light under the negative in the ordinary way.

The method is so full of latitude that prints have been produced by its means that look like fine wash drawings.

In short, it will be seen by the various matters referred to in this short resume of the platinotype process that it is beyond doubt the printing method par excellence for the amateur.

An entirely new platinum paper recently put upon the market is Eastman's WD (water-developing) platinum paper.

Extreme simplicity of manipulation, pure platinum tones, absolute permanence and rapid printing are qualities which commend this paper to every amateur. It requires nothing but water and acid for the entire process of developing and clearing, yet is not only like platinum, but is platinum.

Print until shadows are a deep canary color and high lights are slightly visible. When printed immerse print in hot water (110 degrees

Fahr.), face up, sliding it in edgewise to avoid air bells. Development will require but a few seconds, after which the print is to be plunged into the

Clearing Bath.

Cold Water	15 ozs.
Muriatic Acid (C. P.)	¼ oz.

Soak print face down for five minutes each in two changes of clearing bath. Wash for fifteen minutes in running water or in five changes of clear water, five minutes in each change.

Paper should be developed as soon as possible after printing—never later than the same day.

This paper is packed in tubes and should be kept dry and cool. What has been said regarding keeping and printing with ordinary platinum applies also to the water development paper.

CHAPTER XVIII.

CARBON PRINTING.

It is very doubtful whether any process so completely fills the requirements of the artistic photographer as does the carbon process. Its long scale, reproducing perfectly every gradation of the original negative, its permanence, its great variety of color, its wonderful transparency in the deepest shadows, and its adaptability to any surface, all combine to render it the most perfect of photographic printing methods. Sometimes, indeed, its very perfection is a barrier to its use. If we have to print from a flat, thin negative in carbon we shall certainly obtain a flat, thin result, but for a negative with a very full scale of gradation, especially large and enlarged negatives, it is the process par excellence. Year by year it gains steadily in favor, and our exhibitions have greatly improved in general appearance by the variety of color it has given to their walls. In this short article it is my intention to give a brief outline of the process, embodying the salient points, which, if followed by the tyro, should insure his success, but at the same time I would recommend him, after he has mastered the initial difficulties, to read some text book and make himself thoroughly acquainted with all the details and higher branches of the subject. Carbon printing, as we know it today, is based on the fact that a mixture of gelatine, with a chromic salt, is gradually hardened and rendered insoluble on exposure to light. If, therefore, paper is coated with such a mixture of sensitized gelatine, containing any permanent pigment—carbon was originally used, hence the name of the process—and if this paper is placed underneath a negative and exposed to actinic light, we shall have a positive image formed consisting of soluble and insoluble gelatine; insoluble in exact proportion as the light has reached the surface of the pigmented compound. Development consists in washing away with hot water those portions of gelatine which the light has not affected sufficiently to render insoluble. Now, without going more minutely into details at this stage and perhaps frightening the beginner with imaginery difficulties, I would assure him that the process only needs care, cleanliness and exactness at every stage in order to insure success.

To those taking up carbon printing for the first time a start should be made with the "single transfer process." This is the simplest form and has some advantages over the "double transfer" because less manipulation is required, and, moreover, it is easier to produce prints on rough drawing papers by its means. The only objection to it is that everything becomes reversed; what was on the righthand side of the original is now on the lefthand side of the print, but this is of little moment for purely artistic work. Of course, where enlarged negatives are required, specially for carbon printing, they are usually made reversed and such will give a true result after printing by the single transfer process. Eastman films may be printed through the film itself; i. e., with the celluloid side in contact with the "tissue"—as the pigmented printing paper is technically called—and the resulting print will render the picture in its correct aspect.

Requirements for the Single Transfer Process.

Carbon Tissue.
Black Varnish or Lantern Slide Binders.
Single Transfer Paper, a little larger than the negative.
A Flat Squeegee—not roller.
Squeegeeing Board.
Bichromate of Potash.
Camel's Hair Mop Brush.
Thermometer.
Alum.
Actinometer.
Blotting Paper.
Three Dishes (two for cold water and one for Alum Solution).
One Developing Tank or large basin to hold hot water.

Sensitizing the Carbon Tissue.—Carbon tissue is the name given to the paper coated with pigmented gelatine and may be purchased from the photographic stock dealers in almost any desired color. When insensitive it will keep in a dry place almost indefinitely. Should the beginner be able to purchase it ready sensitized, he is advised to do so, because tissue sensitized in the making is usually manufactured from softer gelatine and consequently development is easier and quicker. Sensitizing is, however, a very simple operation, and if done at night the tissue is ready for use when dry the following morning and will keep in good condition for about a fortnight, although, when preserved in a calcium tin, such as is used for platinotype paper, its longevity is very greatly prolonged.

The sensitizing solution is made as follows:

Potassium bichromate	1 oz.
Water	20 oz.
Ammonia	5 drops

The temperature of this solution should not be over 65 degrees Fahr. In summer it may be necessary to cool it with ice. A dish, somewhat larger than the tissue, should be filled to the depth of about one inch with solution. The tissue is now immersed in it, care being taken to avoid air bubbles as much as possible; but, should they occur, either on the back or front of the tissue, they must be quickly removed by lightly brushing the surface with the camel's hair mop. The usual time for immersion is about three minutes, but this varies greatly according to the temperature of the solution. A good plan is to remove the tissue immediately it becomes limp, placing it surface side downwards on a squeegeeing board—a plain board covered with sheet zinc—and then removing the surplus moisture with a stroke of the squeegee. Should a squeegeeing board not be available, a sheet of plate glass forms an efficient substitute. The tissue is now raised from the board and hung up to dry by means of clips. The tissue does not become sensitive till nearly dry.

Drying the Tissue.—The greatest care must be taken that this operation is carried out under suitable conditions, for after all success depends very largely upon it. It is advisable to dry the tissue as quickly as possible and in an atmosphere free from all impurities. A properly constructed drying cupboard is very useful for the purpose, although an ordinary room in which the fire has been burning during the day and which has been darkened to prevent the entrance of white light will do just as well, and tissue left there at night will be ready for use the following morning. Care should be taken not to expose the tissue to even the weakest actinic light, because it is more sensitive than silver paper, and, moreover, any light action set up continues when the tissue is placed in a dark place. The tissue being quite dry, it is stored in a pressure box ready for use.

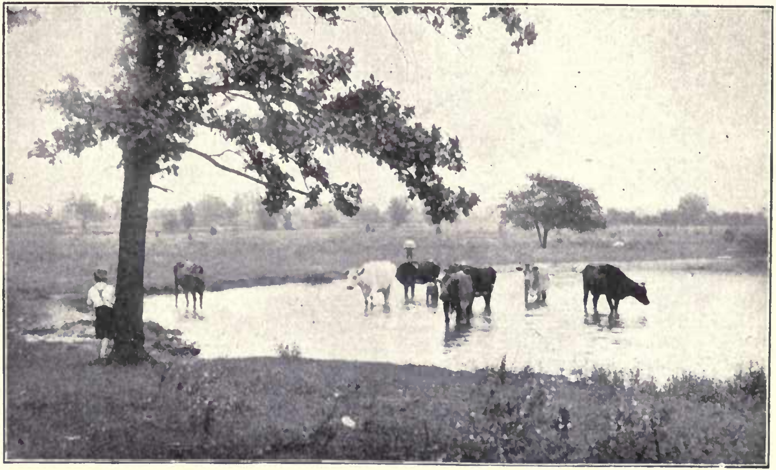
Preparing the Negative.—Negatives for carbon printing should be vigorous and full of gradation. Do not attempt your first print from a flat, thin negative. Each negative must be provided with what is termed a "safe edge." This is made by painting round the edge of the negative with black varnish, or by sticking a strip of black or yellow paper round the negative on the glass side. Commercial lantern slide binders are very convenient for this purpose because they can be affixed in a few moments. Without this safe edge there is great danger of the insoluble gelatine picture leaving its support during development.

Printing.—The Actinometer.—The negative being prepared, we have only to place it in a printing frame, with a piece of the sensitized tissue in contact, and expose to daylight as in any ordinary printing process. Now, as we are printing on a dark-colored surface, it is evident that we must have some means for calculating the necessary exposure. Instruments for this purpose are known as actinometers, and any of the commercial forms will be found quite simple in use after one or two trials. An alternative to their use is to take a negative of equal density to that we are printing in carbon, and, placing it in a frame with a small strip of Solio paper, expose the frames simultaneously to daylight. When the strip of Solio paper is printed to the "pretty" stage—i. e., lighter than it would be for toning—we may consider our carbon print is finished and ready for development.

If we pause for a moment to think of what has taken place during printing we shall see that the image of insoluble gelatine lies on the surface of the pigmented film instead of in contact with the paper supporting it. It follows therefore that if we place the "tissue" in hot water the gelatine between the image and the paper will be dissolved and the insoluble film forming the picture will float away and be lost. Of course, this difficulty might be overcome by printing through the paper, but this procedure would give rise to other troubles. The grain of the paper, the long time taken in printing—even when the paper is oiled—and the loss in definition, are serious obstacles to the success of this method. The difficulty has been met in a simple manner. If the printed tissue is placed in water for a few moments and then brought into contact with a flat surface excluding air it will adhere during development. We therefore prepare wood, paper or other material on which we desire to transfer our image by coating it with a layer of insoluble gelatine. Single transfer papers, smooth or rough, white or tinted, may be obtained ready for use, but probably the ideas of the photographer lead him to sometimes require something different to the commercial article and he will prefer to prepare his own. For this purpose take

Nelson's No. 1 gelatine..........	1 oz.
Water	2 oz.

and after letting it soak for some hours, dissolve



A SNAP SHOT TAKEN BY AN AMATEUR ON THE LINES OF THE CHICAGO & ALTON RY.

by gentle heat. Add to this solution very gradually 20 grains of chrome alum, dissolved in 2 oz. water, stirring vigorously all the time.

With a stiff brush or sponge the chromated gelatine is applied to the surface of the wood or paper and allowed to dry. Ordinary papers require two coats, but Whatman and other rough drawing papers should have three. Should Nelson's gelatine not be procurable, any other make may be used in its place, but if they are harder the alum must be greatly reduced. Should Heinrich's hard gelatine be used, about four grains of alum would be sufficient. A larger quantity might cause coagulation during mixing.

Development.—The print being ready for development, we prepare two dishes of cold water, one dish of 5 per cent alum solution, a tank or basin of hot water about 100 degrees Fahr., a squeegee and squeegeeing board. Taking a piece of the single transfer paper, rather larger than the print, we immerse it in one of the dishes of cold water for a few minutes. (Whatman and other rough drawing papers should soak for hours, or else be placed in the hot water developing tank for half an hour before use.) The printed tissue is taken from the frame and placed in the dish of cold water, which contains the transfer paper, bubbles being carefully avoided. It usually commences to curl up and then gradually unfolds itself again. When nearly unfolded it should be brought into position, film downwards, into contact with the prepared surface of the transfer paper. Lifting both tissue and transfer paper by the one edge, drag them out of the water over the end of the dish and lay them "tissue" side uppermost on the squeegeeing board. Now apply the squeegee vigorously to the back of the tissue in order to expel all the water between the two surfaces. The transfer paper with the adhering tissue is now gently lifted and placed between blotting boards and kept under slight pressure for about twenty minutes. At the end of this time the transfer paper with the adhering tissue is placed in the tank of hot water at 100 degrees Fahr. In a few minutes we shall see small quantities of soluble gelatine exuding round the edges of the tissue. We now take one corner of the tissue and lift it right away from the transfer paper. Unless it comes quite easily and without force, it should be allowed to soak longer. The tissue being removed, a dirty mass is seen on the single transfer paper. All we have to do is to leave this mass with the hot water till development is complete. It is well to have a sheet of zinc or glass on which to support the picture during this operation or the paper support may get damaged. Errors of exposure may be partially compensated at this point. Overexposed prints may be reduced by raising the temperature of the hot water to 120 degrees or 130 degrees Fahr.; while underexposed ones should be left to automatically develop, face downwards, at a temperature of 90 degrees Fahr. When the print is developed it only requires a rinse in cold water, immersion in the 5 per cent alum solution for 10 minutes to harden the film and remove the bichromate salt, a final wash to remove the alum and the print is then hung up to dry by means of clips. When dry the prints may be mounted with any good mountant or starch paste.

Double Transfer Process.—As pointed out earlier in this article, the foregoing method reverses the picture unless a negative has been specially made for single transfer in the first instance. For direct prints where reversal would be objectionable we must use the double transfer process, which is quite as easy to work as the single transfer, but involves one more operation.

The additional materials required are:

Temporary Support.

Final Support.

Waxing Solution.

With this process the procedure is exactly the same as regards the printing and development, the only difference being that a temporary support takes the place of the single transfer paper. A flexible temporary support is manufactured specially for this purpose. If it cannot be procured, a sheet of finely ground opal will serve the purpose equally well, provided the print is to be finally transferred to paper or other flexible surface. Whichever is used the surface must be first prepared with waxing solution. This is composed of:

Yellow resin	36 grains
Pure beeswax	12 grains
Ether	2 oz.

After melting the wax add the resin and thoroughly mix, remove from the fire and add the Ether.

A small pool of the waxing solution must be poured in the center of the opal or flexible temporary support, and this is then rubbed all over the surface with a piece of clean flannel. Allow to stand for a few minutes and then lightly polish with another piece of flannel. Directly the smell of the Ether has gone, the support is ready for use and may be kept in this condition.

The print being developed, alumed, washed and dried, on the temporary support, is ready for the final operation. We cut a piece of the final support, a paper somewhat similar to single transfer paper, but coated with a thicker couch of more soluble gelatine, and place it in a 2 per cent alum solution about an hour before required for use. The print on its temporary support is now immersed in tepid water, 70 degrees Fahr.; the final support if withdrawn from the alum solution, lowered into the tepid water, avoiding bubbles, so that the gelatinous side comes in contact with the print. The temporary and final supports are now withdrawn from the water together, placed on the squeegeeing board, the final support being uppermost, and brought into perfect contact by the vigorous action of the squeegee. When perfectly dry the print will leave the temporary support without difficulty, indeed if dried in a warm current of air it will probably fall off without our aid.

Where opal is used it may be necessary to insert a knife at the edge of the print. The temporary supports are not damaged by these operations and may be used for a large number of times if waxed after each time of using.

In conclusion, I would urge every serious photographer to master this fascinating process, for, till he has done so, he must be unaware of many of the possibilities of his art.

CHAPTER XIX.

CONTACT PRINTING WITH PERMANENT BROMIDE PAPER.

The amateur who has learned to properly develop his negative will find little difficulty in the handling of bromide paper. There is nothing complicated in the process; development is simple and easy.

Bromide paper, unlike the comparatively slow printing-out papers, cannot be handled in daylight, but must be as strictly guarded from white light as a film or glass plate. In nature it is similar, in fact, to films or plates as the image appears only with development and no toning is required.

Sensitiveness.—Bromide paper is about one-twentieth as sensitive as a good dry plate or film.

With such paper, of course, printing is accomplished with a very short exposure indeed, followed by development, but no toning. The work can all be done in an evening by artificial light, which is often a great advantage to the amateur who likes to devote all the daylight hours at his disposal to the making of negatives which cannot be done at any other time. A bromide print is a study in black and white, and it is very greatly preferred on this account by many people to the warmer-hued pictures on chloride paper. That, of course, is purely a matter of taste, and the choice of a printing process must depend upon the particular predilections of the printer, when no other factors have to be taken into consideration. But bromide paper does not do justice to the majority of small negatives. It is very well in those of the larger growth, where a certain amount of depth of treatment, as the artists call it, does not involve a loss of more essential qualities, but for very small pictures, the lack of brilliancy, which is inseparable from this method of printing, and the loss, or rather suppression, of detail which it involves makes it not to be recommended for many subjects.

Some pictures there are which are greatly improved by being printed in this manner, for they neither contain nor require much wealth of detail. It is one of the things which the photographer will realize as he gets more familiar with his art, that the choice of a printing medium must depend largely upon the nature of the picture which it is to bear, for it will very greatly affect its quality and artistic value.

It will not be necessary to go very extensively into the details of this process, for the photographer is already well acquainted with the treatment of dry plates and the paper merely requires humoring in a very similar manner. Attention must be paid to the different requirements of a positive as compared with a negative, and great care must be taken to prevent the paper from becoming at all fogged, either by stray light or any other cause, but as bromide paper is coated with a much less sensitive emulsion than that used for plates—except where a specially rapid variety is required for enlarging, as explained in another chapter—there is but little difficulty in fulfilling this condition.

NAVAJO INDIANS WATCHING FIELD SPORTS, ARIZONA, ON THE SANTA FE.

Photo by W. H. Simpson, Chicago.

Light.—In contact printing with bromide paper the exposure is preferably made by artificial light to insure uniformity, and to avoid overexposure. Place the paper in a printing frame in the same manner as when using printing-out papers.

Exposure.—The exposure varies with the intensity of the negative, and the quality and intensity of the light, but may be approximately stated to be, using as thin a glass or transparent film negative as will make a good print, one-quarter second by diffused daylight, or ten seconds at a distance of one foot from a No. 2 kerosene burner. Very thin negatives should be printed by weak yellow light, like that obtained from a kerosene lamp turned down a little below the normal intensity. In this way a strong, vigorous print may be obtained from a negative that would otherwise be too thin and flat. Strong, intense negatives are best printed by daylight.

Development.—It is in the development that the chief difference lies between the treatment of bromide paper and plates, for a different kind of result is expected. In negative work it does not matter if the brightest portions are a little veiled—indeed, they generally are—it merely increases the time required in the subsequent printing to a slight extent, which is a matter of no moment. But in a print the high lights must be absolutely white, a condition which could scarcely be fulfilled by any of the reducing agents in common use for negative work.

Owing to this requirement the choice of developers is somewhat limited. It will suffice here to describe the one which is generally recognized as the best for the purpose. It is in two solutions, as follows:

No. 1.

Neutral oxalate of potash.	1 lb. avoirdupois
Bromide of ammonium...	20 grains
Water (warm)	64 oz.

No. 2.

Sulphate of iron.........	1 lb. avoirdupois
Sulphuric acid	1 drachm
Water (warm)	48 oz.

Both solutions should be filtered, and will be ready for use when cold. For use add one ounce of No. 2 to six ounces of No. 1, but not vice versa, or a heavy yellow precipitate will be thrown down, and the solution will be unfit for use. The developer when mixed should be of a brilliant red color, like so much red ink, and clear, or it is not in good condition. Both ingredients, when separate, are colorless.

The paper is exposed behind a negative in a printing frame to the action of the light of an ordinary gas flame for a few seconds, the length of time required, depending upon the distance and the brilliancy of the source of light, the density of the negative, and the rapidity of the particular brand of paper used. As a rough estimate, ten seconds' exposure may be given for slow bromide paper, a negative of average density—which is necessarily a vague definition—and a gas burned at a distance of about eighteen inches. Rapid bromide paper is usually about five or six times as quick as the slow. If you doubt the distance of the source of light, you must quadruple the length of exposure, multiply the distance by three, and the exposure time must be ninefold. You will in each case be giving an exposure of equivalent value, but with the longest time and the poorest light you will produce the brightest and most "plucky" points. Bromide printing is in any case inclined to yield results in which there is a tendency to higher contrasts than a chloride print would show, so that with fairly bright negatives a short exposure close up to the light is the thing to be generally aimed for.

Place the exposed print straight into the developing solution without any previous rinsing, and keep it there until the image with all its details appears fully out, but do not continue the operation long enough for the high lights to become at all degraded. When the development is judged to be complete, transfer the print, again without any washing, to a clearing bath made up by adding half an ounce of acetic acid to eighty ounces of water. It should remain in this bath—whose function is to dissolve out the lingering developer, which, if allowed to come in contact with plain water, would deposit an insoluble yellow precipitate in the thickness of the film—for three or four minutes, and then, after a thorough washing to remove all traces of the acid, it is ready for fixing. The hypo should be freshly mixed for each batch of prints and should be of the strength of one pound to two quarts of water, in which bath fifteen minutes' soaking will be sufficient to insure perfect fixation. The washing and drying operations are the same as in the case of gelatino-chloride prints, and mounting may also be accomplished in a similar manner.

Bromide paper is made in several varieties, such as rough slow, rough rapid, smooth slow, smooth rapid, etc. The choice between the rough and the smooth-surfaced papers should be decided by the nature of the subject to be printed thereon. For negatives with plenty of fine detail a smooth paper is to be preferred.

CHAPTER XX.

BROMIDE ENLARGEMENTS.

General Remarks on Bromide Enlarging.—The first thing to consider is whether what you contemplate enlarging is altogether worthy of the treatment. It should possess some other distinct merit besides mere technical excellence; something which shall give it a claim upon others besides its producer; some value of association; the pictorial record of a holiday, for instance, or it may be the portrait of a friend, and therefore valuable for that friend's sake, or, best of all, it may be artistic in itself, a thing of beauty, which it is pleasant to look upon and which will be valued for its own sake.

Secondly, there is the consideration, is the negative sufficiently perfect technically, to admit of satisfactory enlargement? All the tiny flaws, all the little scratches, pinholes and dust marks, even those that are invisible as far as the naked eye is concerned on the original negative, will be produced upon the enlargement with terrible fidelity, and a photograph which is capable of producing a passably satisfactory print may fail utterly in yielding anything but an execrable patchwork when subjected to the searching process of enlargement.

Enlarging by Daylight.—It could hardly be an exaggeration to say that three-quarters of all the photographs taken by the amateurs of the world are, owing to the very great popularity of the hand camera, of the size known as

4x5 or smaller. The universal use of the hand camera is largely responsible for this state of things. It is of very great advantage to the traveling amateur to carry about with him plates of the smallest convenient size, for not only is there by so doing a considerable saving of expense and bulk in the matter of plates alone, but the size of camera and all the rest of the paraphernalia should be considered. But 4x5 prints are small and generally fail to satisfy the ambitious cravings of the photographer, so the question presents itself whether it would be better to go in for larger apparatus and face the difficulties of weight, bulk and expense, or by enlarging them incur the expense and inconvenience.

The enlarging method has many very great advantages. Not only does it admit of carrying smaller equipments, which usually means that the photographer will be enabled to travel farther afield, but the small negatives which he produces are available for enlargement to any reasonable size and dimensions, so that he is not confined to one size of picture.

It is not generally known that large and beautiful pictures can be made from amateur negatives, and it is still less understood that these can be made by the amateur himself and without additional apparatus other than one or two large dishes for developing; in other words, the camera can be pressed into service as an Enlarging Camera, and play a part for which in the first place it was not intended.

The process is very simple and inexpensive. All that is required is a small room with a window, preferably facing the north, through which the light can come without being obstructed by any building or trees. All light should be excluded by means of a wooden shutter to fit the window frame (brown papers answer equally well secured by drawing pins). In this shutter an opening should be cut somewhat larger than the negative to be enlarged from. On either side of the opening grooves should be arranged in which to slide the negative. If the enlarger is so fortunate as to have a room with a window high enough to escape surrounding objects and

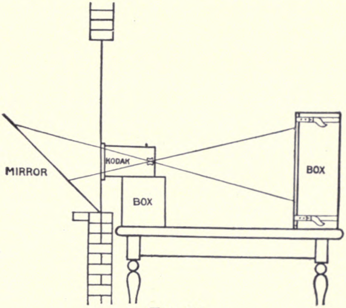


FIG. 67.

have a sky back-ground, it will not be necessary to use a reflecting mirror; should, however, the window not look directly upon the sky, a mirror 30 inches long by 24 inches wide, at an angle of 45 degrees, should be arranged outside the window so as to throw the light above onto the ground glas, mentoned below. (See Fig. 67.)

If a film negative is to be enlarged from, it must be placed between a piece of ground glass and a piece of plain glass, the ground surface being on the outside and the film side of the negative being next to the plain piece of glass. The negative should then be placed in position with the ground glass next to the light. The negative should be inserted upside down, thereby giving an upright image on the screen.

Folding cameras, having an opening the full size of the negatives they make, are especially adapted to use as enlarging cameras. Simply place the back of the camera to the opening containing the negative (first, of course, removing the ground glass, etc., from the camera) and focus by moving the lens back and forth in the usual way.

On a table or shelf, adjusted below the opening in the window, place your camera, having it so as to leave the back quite open. The camera should be placed in such a position that the back of it covers the negative and with lens pointing toward the easel.

The only other article now required is a support for carrying the sensitive paper during the exposure. If an easel capable of being placed perpendicularly is at hand, that will best answer the purpose, but an ordinary drawing board strapped to a box of suitable size and placed upon the table will answer very well.

Having covered this drawing board with a sheet of white paper, open the shutter of the camera as directed for time exposures, when you will see the image of the negative projected upon the paper. The easel will have to be moved until the enlargement is of the desired size, and the focusing done on the plain sheet of paper by using the focusing arrangement. Focus with the full aperture of the lens, but before exposure place the second or third stop in position.

The only light that should now enter the room should be that passing through the negative and through the lens. Should any light escape between the camera and the opening in shutter, a focusing cloth can be thrown over to keep it out.

Everything is now ready to make the exposure, and having secured a sharp image of the proper size, place the cap upon the lens, or close the shutter if your lens is one having shutter affixed, or throw a focusing cloth over it to exclude all light, and then on the plain paper used to focus upon, place the sensitive paper by pinning the corners to the board, care being taken that the paper is lying flat.

No hard and fast line can be laid down as to the correct time of exposure, as the light is constantly changing, so it is advisable for a beginner to make a test exposure upon a narrow strip of the paper he proposes to use, placed diagonally across the focused image. Having covered up three-fourths of this strip, give an exposure of one-half minute, then uncover another fourth, which will leave half the strip exposed, and give another half minute's exposure. Repeat the operation with the remaining two-fourths and then close shutter on the lens. It will be evident that this test strip has now received four different exposures. The first fourth exposure has now had two minutes, the second one and a half, the third one, and the last portion 30 seconds. Upon developing this strip it is easy to

NOTE.—As a help in getting the paper in the right place, a lens cap, which, instead of being opaque, is fitted with a little window of yellow glass, will be found very advantageous, for it will allow sufficient non-actinic light to pass to show the outlines of the picture.

judge which, or between which of these exposures is correct.

It will be a very dense negative that will require an exposure exceeding two minutes, and a very thin one that will need less than 30 seconds.

Having ascertained the time necessary, pin a piece of the Bromide paper of the desired size to the face of the easel, being careful to have it lie perfectly flat. Open the lens and give the proper exposure. Close the lens. The enlargement is now ready for development.

The time of exposure required in making an enlargement on Bromide paper is necessarily uncertain, especially when daylight is used, and is dependent on many circumstances.

1. The intensity of the light.
2. The strength or density of the negative.
3. The size of the enlarged picture.
4. The size of the camera.
5. The size of diaphragm or stop used in the lens.
6. The Bromide paper used.

The amateur must not be appalled by this seemingly formidable array of conditions, and need not for a minute despair of ever judging correctly in every instance.

While it is true that in order to obtain the very finest results, a knowledge of all these is necessary—and such a knowledge as can only come to one by careful observation and practical experience—perfectly satisfactory pictures can be made by the beginner. A very few trials will narrow the exercise of judgment down to the intensity of the light.

Vignetting.—The operator standing at the left of and half-facing the easel should screen the lens with a piece of straw-board about 16x20 inches, having a hole of proper shape for the vignette cut in the center. Having uncapped the lens the vignetter should be moved back and forth from the lens towards the easel so as to allow the head and shoulders of the image to appear on the screen. The movement out should be sufficient to show the image almost to the edge of the kit, and in far enough to cut close to the head and shoulders. This movement to and fro should continue through the entire exposure, which should not be less than twenty or thirty seconds, the lens being stopped down, if necessary, to get sufficient time to operate the vignetter.

To get a soft, evenly blended vignette requires some little practice, but the knack once acquired it becomes quite easy.

Extra Printing.—Faces and light drapery often require, to get detail, extra time in exposure. This is accomplished by using a card having a smaller aperture after using the vignetting card, and passing it over the portions requiring extra time. By keeping the spot of light moving almost any amount of additional detail may be obtained locally. Occasionally in a half or full length subject, a hand may require less exposure than the rest of the picture; in this case a small piece of cardboard, cut to the proper shape and stuck on the end of a knitting needle, can be used to screen that part of the image.

The paper lends itself to innumerable dodges which may be practiced in a similar manner, the operator being able to see just what he is doing from his position near the easel.

Soft Effects in Enlargements. — Wonderful softness and breadth can be obtained in enlarging on Royal Bromide paper by making the enlargement through a silk bolting cloth screen. The screen breaks up the intensity of the blacks, adds to the breadth of the half tones and when prints so made are given a sepia tone they have the appearance of rare old etchings. The screen can be most conveniently used by stretching on a strainer or frame.

The screen may be used in direct contact with the paper, in which case the enlargement has the effect of being made on fine meshed canvas, or greater diffusion of light may be given by placing the screen at a distance of about ¼-inch from the paper; the farther the screen is removed the greater the diffusion of light. The use of the screen increases the length of exposure about one-third.

With "smooth" paper the fine mesh or medium bolting cloth should be used. With "rough" paper use coarse mesh.

Silk bolting cloth for this purpose can be obtained of any dealer in photographic supplies.

Development.—Having made the exposure, the next step is to develop the picture, the process being much the same as in the development of a negative. Fill a tray nearly full of water and put the exposed sheets of paper into it one by one, face down. Put them in edgewise, to avoid air bells, and immerse them fully. Cover the tray with a bit of brown paper to keep out the light from the lamp. Mix the developer according to the following formulae for

Oxalate Developer.

Formula No. 1.

Oxalate of potash .... 8 oz.
Hot water ....24 oz.
Acetic acid (or citric acid ¾ oz.) . 1½ drams

No. 2.

Proto-sulphate of iron .... 8 oz.
Hot water ....16 oz.
Acetic acid (or citric acid ⅛ oz.)...¼ dram

No. 3.

Bromide potassium ....½ oz.
Water ....16 oz.

These solutions keep separately, but must be mixed only for immediate use. They are to be used cold.

To Develop.—Take in a suitable tray: No. 1, 3 oz.; No. 2, ½ oz.; No. 3, ¼ dram. When necessary to use a larger quantity of solution, mix in this proportion.

Take one of the exposures from the water and lay it, face up, in the second tray and pour upon it the developer. Rock it back and forth to prevent streaks and air bubbles. In about two minutes it will begin to darken in spots, representing the shadows, and in about three minutes the operator will be able to distinguish objects in the picture. The developer should be allowed to act until the picture is of the required depth.

The image should appear slowly and should develop up strong, clear and brilliant. When the shadows are sufficiently black pour off the developer and flood the print with

Clearing Solution.

Acetic acid ....½ dram
Water ....16 oz.

Do not wash the print after pouring off the developer and before applying the clearing solution.

Use a sufficient quantity to flow over the print, say 2 ounces for an 8x10. Allow it to act for one minute and then pour it off and apply a fresh portion; repeat the operation a third time, then rinse in four changes of pure water and immerse for ten minutes in the

Fixing Bath.

Hypo-sulphite soda	3 oz.
Water	16 oz.

While in fixing bath move prints about five or six times to insure even action of hypo.

After fixing, wash thoroughly two hours, in at least twelve changes of water and hang up to dry. Use fresh developer for each batch of prints. With a glass bottomed or rubber lined tray, seven ounces of developer are sufficient for a 25x30 print.

Object of Clearing Solution.—The object of the clearing solution is to prevent the precipitation of the iron from the developer into the fiber of the paper. This can only be done by keeping the paper acid while washing out the developer.

Citric acid may be used instead of acetic in the clearing solution, in which case use 1/8 ounce to the quart of water. Citric acid is less liable to cause blisters.

Blisters sometimes appear in bromide paper, and may be avoided by using a little common salt in the first washing water after fixing. The hypo must not be stronger than three ounces to the pint of water.

ROYAL BROMIDE PAPER.

The method of developing given above and the Ferrous-Oxalate solution is suitable for any bromide paper except that brand known as Eastman's Royal. The following formula is especially recommended for use with the Royal Bromide paper and may, if desired, be used with any of the others.

Directions for using

Amidol Developer (Concentrated Solution).—The concentrated stock solution is prepared by dissolving in succession in

Water	12 oz.
Sodium sulphite, crystal	3 oz.
Amidol	½ oz.

Enough of this stock solution should be prepared at one time for one day's use.

To Develop.—Take in a suitable tray:

Concentrated stock solution	1½	oz.
10 per cent solut'n b'mide potas'm	8	drops
Water	6	oz.

Use cold. After exposure, soak the paper in water until limp and brush lightly over the surface while wet with a tuft of cotton; then flood print with the developer.

The image should appear slowly and should develop up strong, clear and brilliant. When the shadows are sufficiently black, pour off the developer and rinse the print thoroughly with pure water. If the print has been over-exposed a small additional quantity of a solution of bromide of potassium should be used as a restrainer.

NOTE: The above developer can be used over by the addition from time to time of some fresh developer. If, however, the restrainer solution has been added to it the developer should not be used again except for prints that are known to have been over exposed.

Fixing Bath.

Immerse prints for ten minutes in the

Hypo-sulphite soda	3 oz.
Water	16 oz,

After fixing, wash thoroughly two hours and hang up to dry.

Sepia Tones, with Royal Bromide, Enameled, Matte-Enamel or Platino Bromide Paper.—By using the following formula rich brown and sepia tones can be readily obtained with prints on Royal, Enameled, Matte-Enamel or Platino Bromide paper after they have been developed and fixed. The tones produced are believed to be permanent and not subject to the bronzing in the shadows which occur in bromide tones in Uranium. Where warm sepia tones are desired the Royal paper gives best results if slightly over-exposed and under-developed.

Hypo-sulphite of soda	20 oz.
Ground alum	4 oz.
Hot water	2 gal.

Dissolve the hypo in the water first, then add the alum slowly; when all is dissolved the solution should be milk white. Allow it to settle, then decant the clear solution and use cold.

To Tone.—After prints are developed and fixed wash in three or four changes of water and then immerse in the cold toning bath, being careful to remove all air bells. The print or prints should be handled over occasionally during the first four or five hours and may then be left in the bath over night or until the desired tone is acquired.

After toning wash thoroughly two hours and hang up to dry.

Details.—Be sure and fix thoroughly before toning.

Prints should be toned face up.

Solution may be used repeatedly by adding fresh bath occasionally.

A number of prints can be toned in the same bath at the same time.

Spots or unevenness in the tone will disappear if print is left in the bath and occasionally moved.

The toning takes from fifteen to twenty hours.

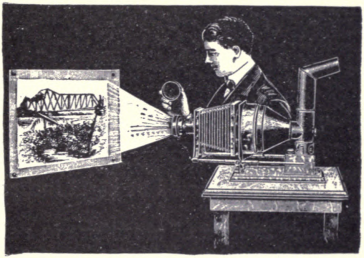


FIG. 68.

Bromide Enlargements by Artificial Light.—But all amateurs cannot afford to devote daylight hours to the making of enlargements, and some are so placed that it is not convenient to knock holes in the window shutters, and various other objections may occasionally arise to render this method of enlarging a scarcely desirable one, and to cause a good means of enlarging by artificial light to be regarded as a consummation devoutly to be wished.

Either an ordinary magic, or, as it is now called, "optical," lantern, or, better still, one specially built with this object in view, will be necessary. (See Fig. 68.)

Such lanterns can be had, fitted either with a good kerosene lamp or with the much more perfect limelight. Incandescent gas light, too, is much recommended for the purpose, and some are loud in their praises of acetylene gas, which as now produced, and used by means of the modern acetylene generator and burner bids fair to oust all competitors from the field except limelight and electricity. When a lantern is used for enlarging work the condensing lenses of the instrument—(the large lenses directly in front of the light)—must be at least one inch larger in diameter than the plate measures at its greatest length. Thus, for enlarging from 4x5 negatives, the apparatus should have condensing lenses six inches in diameter. For enlarging from 5x7 negatives the condenser should be eight inches in diameter, etc.

The proper method of procedure in using the enlarging lantern is as follows: Take a smooth board about 30x36 inches—a drawing board is best for the purpose—cover it with white paper and hang it against the wall with picture cord so that it will hang perfectly straight. Place the lantern on a portable table at a distance of about three feet, with the lens directly opposite to the center of the board. The lamp should then be lighted. Any other light in the room should then be turned out.

Place in the lantern just behind the condenser, between the light and the lens, a sheet of fine ground glass. This will diffuse and soften the light before it reaches the negative and will, without any reduction in the size of the lens aperture, yield a much more satisfactory and pleasing picture.

Then place the negative, film side out, in the negative carrier frame and insert in the stage of the lantern so that the negative will be close to the condensing lens. Focus the negative on the white paper. The size of the enlargement must then be determined by moving the table on which the lantern stands. When the size is determined it must be again carefully focused and the screws that bind the rods tightened.

The lens should be stopped down if the image is not sufficiently sharp.

The place where the bromide paper is to be placed should now be marked on the board. Then place the cap on the lens, and by the light from a ruby lamp fix the bromide paper on the board with thumb tacks in the space marked. Now make the exposure by removing the cap from the lens.

The exposure is regulated by the density of the negative, the size of the lens diaphragm used and the size of the enlargement.

The following is given as a guide for exposure; An enlargement 11x14 from a clear 4x5 negative with a medium size stop will require about three minutes. A dense negative or a larger enlargement will require more exposure.

After the exposure has been made the paper is then developed in the manner already described.

WHAT PAPER TO USE.

Royal Bromide Paper.—Is particularly recommended for use where 14x17 or larger prints are to be made. When enlarged through bolting cloth and sepia toned, prints on this paper have the breadth and softness of rare old etchings, having dark, sketchy backgrounds, deep shadows and snappy high lights. When using bolting cloth screen the time of exposure should be increased about one-third.

Standard Bromide Paper.—Is a natural surface bromide paper, which is especially adapted to all kinds of enlargements, particularly copies on which crayon or pastel work is to be done.

The emulsion is coated on three different weights of paper—A, thin smooth; B, heavy smooth; C, heavy rough.

Platino-Bromide Paper.—Platino-Bromide is a new argentic bromide paper, giving soft, rich effects, velvety blacks, absolutely pure whites and having a dead surface like platinum. Unlike platinum paper, however, it will keep before and after exposure, and can be printed by lamplight. Pictures made on it are permanent as the paper itself.

Enameled Bromide Paper.—Prints on Enameled Bromide paper, when untoned, combine the soft effects of a platinum or bromide tone with a highly enameled surface. This paper has a slightly pink tint which especially commends itself to those who object to the coldness of an ordinary bromide tone.

Prints on Enameled Bromide paper, when toned with the hypo toning bath and dried on ferrotype plates, are in no wise inferior to the best aristo prints in richness of tone and depth of detail and gloss, hence enlargements made in this way from good negatives are fully equal to contact prints and require no finishing.

Matte-Enamel Bromide Paper.—This paper combines the brilliancy of an enameled paper with rich carbon blacks. Like the enameled, it is lent warmth by its slightly pink tint and is capable of taking a beautiful sepia tone.

Two Grades—Hard and Soft.—The Bromide papers, except Royal, are made in two grades, "Hard" and "Soft." The "Hard" paper is especially adapted to use with sunlight, and should therefore be used for enlarging by daylight, while the "Soft" paper should be used for contact printing and for enlarging by artificial light, as it is especially adapted to work with artificial light.

HINTS.

Mealy Mottled Prints.—Over-exposure and short development.

Greenish tones are obtained by over-exposure and too much bromide.

Face of permanent bromide paper can always be distinguished by its curling in. Convex side is always the back.

Fixing.—The operator can tell when a bromide print is fixed by looking through it or upon it in a good light; unfixed portions will be a greenish yellow.

Yellow Prints.—Prolonged development will cause yellow prints. The exposure must be correct, so as to allow of quick development.

Forcing development does not give good results for the above reason.

Running water is not so sure a means for washing prints as changing them from one tray to another, allowing them to soak at least ten minutes in each fresh water; twelve changes are sufficient—no less.

Retouching negatives.—Coarse grinding for retouching should be avoided and the retouching "burned in" to the varnish over a spirit lamp to avoid having the scratches show in the enlargement.

Clean Dishes, Clean Hands. — The faintest trace of hypo-sulphite of soda or of pyrogallic acid is fatal to good results with Bromide paper, and the operator cannot be too careful to avoid any contamination. The tray used for developing with oxalate should never be used for anything else.

To avoid yellow prints four things are absolutely necessary.

1. The developer must be acid.
2. The clearing solution must be used as di rected.
3. Fresh hypo solution is required for fixing each batch of prints.
4. The washing must be thorough after fixing.

Cleaning the Prints.—The surface of Enameled Bromide paper is extremely delicate and liable to abrasion, which shows in hair-like lines like pencil marks after development. Fortunately they can be easily removed after the dry print before mounting by rubbing with a tuft of wet cotton.

Flexible Prints.—Permanent bromide prints soaked in a mixture of glycerine five ounces, of water twenty-five ounces, and dried, will not curl and may be used for book illustrations unmounted. The heavier papers, B and C, are especially adapted for this purpose.

Straightening Unmounted Prints.—After drying, prints may be straightened by the scraping action of a sharp-edged ruler applied to the back, the corner behind the ruler being lifted as the ruler is passed along.

Glossy Prints Without a Burnisher.—Beautiful glossy prints may be made on Enameled Bromide paper by using ferrotype plates by following instructions given for this process in the treatment of Gelatine paper.

Another Method.—A fine gloss may be given Enameled Bromide Prints by coating the mounted print with a solution of gum arabic 1 ounce, water 4 ounces; filter through chamois skin each time before using. Apply smoothly with a camel's hair brush. If too thick to spread smoothly, thin with water to proper consistency.

Mounting on Card.—Bromide prints may be mounted wet or dry; the prints should not be dried between blotters, like chloride paper, but should be hung over a line, or laid back down upon glass or clean paper. To mount, brush over the back with thin starch paste, lay the print on the mount and rub into contact with soft cloth.

Prints on Enameled paper may be rolled or burnished or dried on ferrotype plates.

For burnishing the print must be quite dry and a dry lubricator used, castile soap answering for that purpose.

"C" paper and the Royal Bromide papers are intended to retain their rough surface and should not be rolled.

DON'T.

Don't use old hypo for fixing.

Don't use the developing dish for fixing.

Don't put the prints between blotters to dry.

Don't fail to rock the tray well while developing.

Don't rock in one direction only, unless you want streaky prints.

Don't fail to lift the print up and turn it over in the clearing solution.

Don't let a jet of water play on the paper while washing; it will cause blisters.

Don't use old developer on large prints for the sake of economy; use it fresh every time.

Don't use twice as much acid as directed in the developer or clearing solution; enough is enough.

Don't say you can't work bromide paper because you fail to get a good result the first time. Perseverance in all things.

Don't expect that the light reflected from a red brick wall will be sufficient for enlarging. Unless your enlarging window has an unbroken horizon use a reflector.

Don't suppose that a permanent bromide print is liable to fade because the paper turns yellow. All paper will become yellow after exposure to light and air. For example, see any old engraving or etching. This yellowing or mellowing of the paper has nothing whatever to do with fading.

CHAPTER XXI.

LANTERN SLIDE and TRANSPARENCY MAKING.

No book on photography would approach anything like completion without due attention being paid to transparency work, for that is not only one of the most beautiful of the processes at the amateur's disposal, but it is one of the most useful for various decorative purposes.

By far the largest number of photographic transparencies take the form of lantern slides; for this represents a method by which the amateur can exhibit his photographs to the very best advantage, and in such a manner that they will be pleasing and interesting to all his friends—which cannot always be said of a set of miscellaneous prints. It might seem to the superficial observer that transparencies designed for lantern work and those intended merely for visual purposes would differ only in point of size and not necessarily in that. But that is not so. There is considerable difference in the quality of transparency required for the two purposes, and one which would be most effective for window decoration, say, would be almost useless for lantern work, while a perfect lantern slide when held up and examined in the ordinary way, appears to be lacking in "pluck" and vigor and all those brilliant qualities which give to photographic transparencies their chief charm.

The reason for this is, of course, the very different conditions under which the two are viewed.

In the case of the window transparency, the picture is seen direct by brilliant light pouring right through it and going straight to the eyes, consequently, considerable density and depth of detail are requisite to give it effect, while with the lantern slide the light, after passing through the slide, is spread out over a large white sheet and reflected by that into the eyes, so that a very slight deposit upon the transparency is sufficient to make a marked difference in the amount of the illumination.

Window Transparency.
FIG. 69.

The most desirable qualities in a lantern slide are extreme transparency, so that as much light as possible may be allowed to reach the sheet, consistent with a sufficiency of contrast between the lights and shades; and good definition, for the slight diffusion of focus, which is often a distinct artistic gain in the ordinary photograph upon paper or other opaque support, is quite inadmissable in a lantern slide, where such a very great magnification would make the lack of focus seem abominable. Those faults in a negative which, though almost invisible and unnoticeable in a direct paper print by contact, show up in a terrible manner when the picture is subjected to the tremendous magnification of an optical lantern. Therefore, a grain of dust, a gnat, a wandering hair will appear respectively like a huge boulder, an elephant, and a sea-serpent, it follows that only negatives which are microscopically sharp and technically perfect or nearly so, are eligible for the purpose of lantern slide making.

Lantern Slide Making by Contact.—Optically speaking, there are two methods of making lantern slides—leaving the chemical part of the subject out of the question altogether at present. They are called respectively, the contact method and the reduction method—terms which will hardly require an explanation, for they are self-explanatory. Lantern slides by contact can, of course, only be made of the same size as the negative from which they are printed, that is to say, the objects which are shown in the negative will be reproduced in the lantern slide of the same size, and if the negative be larger than the lantern plate only a certain portion of the picture can be included in the transparency. Lantern slides are now always made of one standard size, namely, 3¼x4 inches, and if that portion of your negative which you wish to include in the slide be larger than three inches across, the only plan will be to adopt the reduction method.

However, the majority of photographs taken by amateurs are of the 4x5-in. size, and most of these will be of such a character that, by sacrificing half an inch from either side—often not a considerable loss—they are available for lantern slide purposes without further trouble. To make a lantern slide by contact, place the negative face uppermost in a printing frame—we will suppose that it is a 4x5 one, for the sake of argument—and place over it, film to film, one of the special lantern plates sold by any of the good makers. Hold the frame up to the light of a red lamp while selecting the best portion of the picture for reproduction, and when the lantern plate has been placed in position satisfactorily, fasten in the back and expose to gaslight or lamp light.

The character of the results upon lantern plates can be very considerably modified by varying the conditions under which exposure is made; a long exposure to a poor light tending to high contrasts or harshness, while an equivalent exposure under the opposite conditions tends to softness or lack of brilliancy.

Lantern Slide Making by Reduction—Daylight.—But the lantern picture-maker will probably soon find that he is considerably hampered by this necessity to reproduce his negatives in fac-simile as regards size, for he will constantly find that he is obliged to cut out portions that are really valuable as pictorial constituents, and that many of his best views are ruined by the limitation of the process. For even 4x5 negatives are not always amenable to being ruthlessly cut off to the square of their smaller diameter, though they have been specially taken with a view to be ultimately made into lantern slides, while those larger yield themselves up to the treatment less and less, in proportion to their size. So that if much lantern slide work has to be done, some method of reducing the picture to the standard size soon becomes more or less of a necessity.

Again, the subject is divisible into two principal methods of procedure, which come under the heads of Daylight and Artificial light. We will take them in the order named. If the reader will refer to a diagram which I gave in connection with the subject of enlargement upon bromide paper he will see for that work the light of the sky is reflected by means of a mirror or a suitable substitute through a hole in the shutter of a darkened room, thence through the negative from which the picture is to be made, and afterwards through an ordinary photographic lens by which the image is projected upon the sensitive surface placed to receive it. The size of the resulting picture depends upon the distance of that sensitive surface from the optical system. Now suppose that the sensitive film be moved so close up to the lens that the image of the negative, instead of being enlarged, is actually reduced in size, and that the bromide paper is replaced by a lantern plate. Then you have all the elements for a daylight apparatus for making lantern slides by reduction. But it will be much more convenient in this case to turn the camera around so that the lantern plate can be contained in the plate holder instead of the negative to be copied, for that can easily be held in a frame attached to the shutter in which the hole is cut.

The negative to be reduced, then, is supported in front of a hole cut in the shutter of a darkroom, and outside of that shutter there is a mirror or other reflector, by which diffused daylight shines through all parts of the negative equally. Opposite is a photograph camera con-

taining a sensitive plate, and a positive picture of lantern slide size to be made from that negative. Thus it is simply an ordinary photographic
18 operation. The camera must be of the long focus variety, capable of racking out to twice the usual length and it would be as well to draw upon the ground glass a circle or a square to indicate the position which the lantern plate will occupy
45 when the plate holder is inserted. Focus the image as carefully as possible with the full aperture of the lens, and use a small stop for the exposure. It would be misleading to attempt to
70 convey an idea of the length of time required. There are too many factors to be taken into consideration that cannot be reckoned with beforehand. A few trials will soon show the exposure
95 required, and when found, make a note of it.

The making of lantern slides by reduction has many distinct advantages over the contact method, which has not yet been touched upon. In the first place it yields far more perfect results as far as good definition is concerned, and that, it must be remembered, is a very important matter in connection with lantern slides. Then it admits of adding suitable skies to photographic transparencies. The amateur has been advised to make for himself a stock of useful cloud negatives for use in connection with his various landscape photographs as occasion may arise. Let him make from these, by contact or reduction, as he likes (for if they are 4x5 negatives it does not much matter) a series of sky pictures, upon lantern plates just as if those plates already contained landscape views to which it was desired to add clouds. Every lantern slide, and, indeed, all other transparencies, are finished by being mounted with a plain glass in front of them to protect the films from injury. Therefore the easiest way to add clouds to one of these is to print the sky upon that cover glass by a separate photographic operation, and this method has this advantage, that you can "try on" a number of different cloud effects upon the landscape picture until you find one that suits. Another advantage of the reduction method of making slides is that it permits the more readily of that judicious "faking" that may often be the means of so greatly improving the artistic value of a lantern picture.

Lantern Slides by Reduction—Artificial Light. —A word or two respecting the reduction method of making lantern slides by artificial light: If reference will be made to that portion of this work which is devoted to bromide enlarging with a lantern, it will be found that the negative to be operated upon is placed in the slide stage of that instrument. Now, if the front lens of that lantern be removed, and the photographic camera, prepared for lantern slide making, exactly as in the last-considered case, be put in its place, a reduced image of that negative will be thrown upon the ground glass, and that image, falling upon a lantern plate, will afford the means of producing a slide by reduction with artificial light.

When used for reducing, remove the bellows of the lantern from the frame at the back. Then take away the whole front, including bellows, front and rods. Place a ground glass in the negative holder first, then the negative, and insert the negative holder in the stage in the usual manner and light the lamp. Then take the ordinary camera and point its lens opposite the negative, focus sharply to the desired size, then insert the plate holder, containing a kit, with the lantern slide plate or transparency plate, and make the exposure.

As regards all the other proceedings, they are similar to those which pertain to reducing by daylight.

Developing Lantern Slides.—In developing a lantern slide, the main thing to be borne in mind is that the greatest transparency possible must be obtained, while at the same time the other essentials are not to be neglected. All portions of the picture which represent white, that is, all the high lights, must consist of absolutely clear glass. They must not merely appear white by comparison with other portions of the slide, but there must be actually no deposit upon the film, and the test is to lay the slide down upon a sheet of white paper, and if the high lights do not then appear to be at all veiled, the slide may be pronounced a good one as far as this most important particular is concerned. But that alone is not sufficient to insure a technically perfect lantern slide. It will not do at all if the shadows be all represented by dense, impenetrable black; for then the clearness of the high lights would be only an aggravation of the terrible sootiness of everything else. No portion of a lantern slide should be so dense that the print of a newspaper cannot be read through it if both are held up to the light. Remember that the density of a lantern slide appears upon the screen to be exaggerated, and exposure and development must be regulated accordingly; but it does not by any means follow that the height of the contrasts is

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increased to any extent. A slide must be full of "pluck" and vigor; but those qualities must be attained rather by the extreme whiteness of the lights than by the heaviness of the darker portions.

As regards the choice of a developer, that should be decided by the recommendations of the makers of the particular plates being used, just as in the case of negative plates or any other commercially-supplied sensitized commodity. As a general rule, hydroquinone, as a developing agent, is one of the best that can be employed, but it requires to be used with care and discretion, for the very qualities which make it valuable to the clever worker (the power which it gives him of obtaining sufficient density from even the most unpromising weak negatives, and so on) are of the kind to make it unmanageable in the hands of those who have not taken the trouble to master its peculiarities. Here is a formula which will be found to suit nearly every plate:

A.

Hydroquinone	240 grains
Potassium meta-bisulphite	240 grains
Potassium bromide	60 grains
Distilled water	15 ozs.

B.

Potassium hydrate (sticks)	600 grains
Distilled water	15 ozs.

For use, take of A and B each one part and mix with six parts of water. If this developer does not appear to quite suit the plates, try using a little more water, and that will probably make it right. I have found it to work very well with all the lantern plates that I have used, and that is why I recommend it, but all the same, you cannot do better than stick to the one recommended by the plate maker, unless upon trial you find this to yield better results in your hands. For there is no doubt that different workers secure their best results with different developers, even when they are using the same brand of plates; but the developer, whatever it is, must be one that suits the particular peculiarities of the plates with which it is used.

Covering, Binding, and Finishing Slides.—I have already hinted that before a lantern slide is actually finished, it must be mounted by binding it to a protecting cover glass. These cover glasses can be bought ready cut to size and carefully selected so as to be as free as possible from any bubbles or other flaws in the glass. That the glass, both of the slide and the cover, should be very thin, will go without saying when it is remembered that there are two to be mounted together, and it is hardly necessary to again point out how terribly exaggerated are all little specks and flaws when the slides are subjected to the immense magnification of an optical lantern. However, the beginner need not trouble much about these cover glasses at first, because, for every slide that he turns out which will be worthy of mounting, he will in all probability spoil at least one lantern plate, and so, by cleaning off his failures he will be supplied with a sufficient number of cover glasses to mount his successes. The simplest way to remove the films from spoiled plates is to soak them for a while in dilute hydrochloric acid, when the gelatine will float away, leaving the glass support perfectly clean. It then merely requires rinsing in plenty of clean cold water, drying on old linen and subsequently polishing.

Between the photographic slide and its protective cover a paper mask is placed to form a kind of framework to the picture, and also, incidentally, to prevent the two touching each other so that the film might possibly become chafed after considerable use. It is one of the most important things as regards the ultimate effectiveness of the picture in the lantern, that this mask should be so chosen and that it suits the shape and character of the photograph. Color, of course, does not enter into the question at all as it does in considering the framing and mounting of an ordinary picture, for the mask must, of necessity, appear black upon the screen; but masks of all manner of shapes and sizes can be bought and should be carefully chosen for each picture, while for out-of-the-way cases, it is not a very difficult matter to cut a special mask out of black, opaque paper.

Having chosen a suitable mask and placed the cover glass in position, or if necessary, a cover glass bearing clouds of description to fit the view, the next thing is to bind the whole together. Again, the fore-sighted manufacturer comes to your aid with strips of gummed paper, called lantern slide binders. It is quite possible that you will experience some difficulty in making these sticky strips adhere to the glass, in which case strong starch paste, in which a little sugar has been dissolved, applied to them instead of water, will generally be found to overcome the difficulty. Lay the strip, gummy side uppermost, upon a sheet of newspaper, apply the paste evenly with a stiff brush, rubbing it in several times till the paper is quite limp, and then, beginning right up at the left-hand side, place the compound slide and cover glass in center of the strip and press it down. The next movement I can only describe by asking you to imagine that the glasses are circular instead of square, for it is analogous to rolling them—together, of course, along the length of the strip, so that they pick it up as they go. In reality, this movement is performed one side at a time, and when the third side is lowermost, the paper attached to the first can be folded over and pressed down with the hand, so that at that edge the two glasses are bound firmly together. Then it is moved on to one more place and the second side treated in a similar manner, and so on, until all four are finished. The operation seems somewhat difficult at first, but the knack of it comes with a little practice.

Photographic Transparencies for Home Decoration.—If you hold up a technically-perfect lantern slide and look at it by transmitted light you will see that it is not by any means to be regarded as a perfect transparency for viewing in that manner. It will appear thin and weak by contrast. But by this time, it is to be hoped you will be a sufficiently good photographer to overcome that defect when you want to make transparencies for direct visual purposes, such as for the decoration of windows and the like. It is really only a matter of judicious development. A transparency that is required for other purposes than lantern work should be carried farther in the developing process, in all other respects, its treatment is precisely the same.

Few people have any idea of the great possibilities as regards home decoration which are opened up to them by photography, especially through the channel of good transparencies. Such pictures come in for a great variety of decorative uses, the number of which, it might also be said, is only limited to the photographer's ingenuity. Lamp shades, fire screens, window blinds and many other things which are often so exceedingly unsightly in themselves, can be turned into things of beauty by the tasteful use of photographic pictures in this form. Transparencies intended for such uses should, as I have already said, be specially made upon transparency plates, and backed with a sheet of ground glass in order to heighten the effect, and lantern slides which are often too dense to be really serviceable in their original capacity, can be turned to account, in this manner. They may be hung around opal glass lamp globes, for instance, where, besides serving the useful purposes of shielding the eyes from the glare, they form a very pretty ornamentation. But numbers of such uses will at once suggest themselves to the fertile imagination of the photographic amateur. It will be quite unnecessary to do more than throw out this suggestion.

CHAPTER XXII.

THE GUM-BICHROMATE PROCESS.

When a photographer has had the courage to go through some technical article on the working of a new printing process he feels the conviction that on following closely the author's instructions he will be able to produce a good print by the process described; at any rate he knows beforehand what qualities this standard print ought to have. I do not see the way to produce this happy confidence in the present case, for although I think I am capable of giving a definition of what a good albumen or gelatino-chloride print ought to be, by comparison with a bad one, I am quite unable to define the good gum-bichromate print, and no instructions of mine will enable even an ardent worker to produce what a true artist will call a good gum-bichromate print. All that I can do is to enable him to produce a sheet of coated paper, the coating of which will dissolve and disappear in the places where light has not caused insolubility, while in other parts the coating will remain more or less adherent, according to the quantity of light admitted.

This is the definition of the process in a nutshell: What we want is a film—a colored coating which, after exposure to light under a negative, will give us a surface quite soluble in some parts, partly soluble in others, totally insoluble in the rest. If we succeed in manufacturing this sheet of coated paper we shall have in our hands the foundation of a good gum-bichromate print—it rests with us to make a picture out of this, or a daub, or simply a commonplace, faithful, photographic print.

For in the gum-bichromate process we cannot work with the same standards as in other processes. For example, in the silver printing process, under-exposure gives a very bad print of a dirty color without strength or contrast. With gum-bichromate, considerable under-exposure means total absence of image. One cannot say that the print is a bad one, for in this case there is no print whatever, all the coating will disappear in the developing. Similar with great over-exposure; in this case the paper remains just as it was before printing—a dull surface of black, brown or red. But whenever an image has been developed and has remained on the paper the resulting print may be good, for it can be made into a picture and a fine picture, too, if the man who works at it is an artist and knows what he is about.

My meaning is that if the color used for coating is well chosen and sufficiently deep, its nature will not be affected subsequently as it is by toning or developing from white to black in other printing processes, so most of the conditions which cause failure in silver chloride, bromide or in platinum papers are not to be taken into account with this special method, for color and depth of color have both been chosen before printing and developing. In other words, as we work from dark to light, the conditions of ordinary printing are naturally reversed. What we aim at is to keep the color that we have already applied instead of striving to build it up.

The materials are simple: gum arabic, bichromate of potash, and the cheapest of all pigments—earths. The gum need not be pure white gum, the ordinary red gum arabic works just as well as the purer samples. I have tried both and found no difference whatever in the results. Bichromate of potash can be had of any druggist. Any sort of paper is suitable provided it is sized; all drawing and water-color papers are good, so are most writing papers, but highly glazed paper is most difficult to coat properly, though it works well when this difficulty has been surmounted.

Powdered colors may be used successfully—they are cheaper than most tubes, but they are not ground so fine. To make the three conventional tints of monochrome work, the following colors are necessary:

Lampblack, umber and burnt umber, sienna and burnt sienna, Vandyke brown, bistre, yellow and brown ocre, red ocre, brown red, Venetian red, indigo. These colors are permanent. They can be mixed in different proportions, according to the taste of the worker. No colors should be used pure, the result is generally displeasing.

A saturated solution of bichromate of potash (10 per cent) is made with hot water and another of gum arabic and cold water which has to be worked up to a density marking 18 to 20 degrees by the saccharometer or densitometer. The bichromate solution keeps indefinitely. The gum solution turns acid after a few days and seems to give better results in this state. If it thickens by evaporation or gets thinner by fermentation, a small quantity of water or a denser solution must be added until it registers a new 18 to 20 degrees. Ten cubic centimeters of this gum solution are mixed with pigment and four cubic centimeters of bichromate are added to the gum and pigment. It must be understood that these measures are purely approximate. According to the depth of color or to the nature of the pigment more or less gum or more or less bichromate will have to be added. The photographer will be guided by the behavior of the sensitive mixture which must allow of rapid and even coating. For example, if he uses Venetian red as pigment the resulting mixture will be thin compared to a mixture prepared with Vandyke brown, for the coloring power of the first pigment is greatly superior to that of the latter, consequently there will be much more pigment in bulk in the second case than in the first and a few drops of bichromate and one or two drops of gum will have to be added. In reality every proportion is constantly varying in this process, the only important and unvarying factor should be the thickness of the sensitive mixture, for smooth and even coating is a necessity, and only a certain thickness will allow of proper coating. This is a matter of experience to be acquired by a few preliminary trials, though I have worked at the process for several years and it is rare indeed when I do not find it necessary to thicken or dilute the sensitive mixture before beginning to coat.

Now two methods of working are open to the photographer, either he may sensitize his paper in a 10 per cent solution of bichromate by immersion during one or two minutes, dry, and then coat with gum and pigment, adding to the mixture a proportion of water equal to the quantity of fluid that the bichromate solution would have brought if it had been added to the gum and pigment, or he may coat his paper direct with gum, pigment and bichromate in the proportions described above. In both cases the degree of thickness of the mixture must be tried before coating, and this operation must only be performed when the mixture has shown a satisfactory behavior under his preliminary trial. It is not difficult to judge. A mixture clinging to the brush and forming ridges which cannot be softened by repeated brushings must be diluted—while if it runs over the paper, refuses to set and follows the brush in waves, gum must be added.

I do not say anything about the proportion of pigment—this is a question of personal taste.

Coat your paper in full diffused light or by bright gas light. Pin the dry sheet on a drawing board, take a flat hogs-hair brush (the fan-shape seems to be the most convenient) smear the surface roughly with the sensitive mixture, taking care not to use more than is necessary for the complete covering of the sheet, or else the coating will be too thick. This rough coating is covered with ridges and irregular brush marks; do not let the marks set, but take up a goats-hair softener and give a few strong downward vertical strokes which will change the irregular ridges into vertical parallel lines—break these lines by several horizontal strokes perpendicular to the first—the lines will merge into one another and disappear. A few rapid and light touches here and there will finish the operation, which ought to be rapid and decisive.

Pin the paper up to dry in a dark place—abso-

KANKAKEE DUCKS, WATER VALLEY.
By courtesy of Frank J. Reed, Gen. Pass. Agt. Monon Route.

lute darkness is not necessary—and when thoroughly dry, expose.

Correct exposure—I mean the right exposure for the desired effect—is the delicate point of the process. It can only be obtained by comparative trials. I have seen men disgusted by their constant failures, who, as I found out later on, had never made these comparative trials on the same negative. They had tried every possible change in their way of coating and their proportions of mixture, but had never had the idea of trying two exposures—one of ten minutes and one of two hours—to ascertain how gum-bichromate paper acted under extremes. It is, notwithstanding, the only sure way. An actinometer is necessary, of course, and the bands, numbered, may be kept for future reference.

The average exposure in summer by diffused light for a thin negative should be twenty minutes to half an hour. Length of exposure is influenced not only by the quality of the light, the color and density of the negative, but also by the thickness of the sensitive coating. It is of course in direct ratio to this thickness.

To be able to fully understand the importance of control in the development of a gum-bichromate print we must realize that the film or coating on which we are going to operate is composed of a substance uniform in appearance, but entirely soluble or semi-soluble in some parts, and insoluble, or nearly, in others. If we immerse this coated paper in a dish of water and let the solvent act undisturbed on the whole surface of this coating, it will dissolve it proportionately to the extent it has previously been rendered insoluble, and it will give us a positive duplicate of the original negative. If, on the contrary, we apply the solvent irregularity to different parts of the coated paper, if we use hot water here and cold water there; if, going even further in our personal intervention, we add local friction to the dissolving action of water locally applied, we produce a positive which has not been developed in proportion to its solubility, but proportionately to the temperature of the agent used in developing and to the force and frequency of its application—consequently it is not a duplicate of the original negative as to tone and values; but the result, good or bad, of our own judgment.

In reality the technical or photographical part of the process is at an end when development begins. Development requires no chemicals, and no formula to mix them. All you have to do is to wash away, rub away, or scrape away, according to your mood, the more or less soft pigment attached to the paper. You can develop in ten minutes or several hours, wash away one side of your picture before developing the other, work with a brush, a spurt of water, or a gentle flow. So there are no rules for developing save those by which artists of all crafts ought to be guided.

The only indications which could be useful to a beginner are the following: Always develop the print out of the bath of water; if it is immersed, it stands to reason that local development is impossible. Place the sheet of paper on a glass plate propped up at one end by some sort of wooden contrivance, the other resting on the bottom of the developing tray. Always begin by cold water, and never use higher temperatures until you have ascertained that a low temperature has no effect whatever. Develop slowly, and do not let an ounce of water flow over the film without a definite intention calculated to produce a definite effect. If hot water does not reduce the heaviest shadows use a very soft, flat sable brush, but not until the print is completely developed in other parts—then work carefully, and bear in mind that the deepest blacks are the foundation of your picture, and that should they be overreduced the whole balance of the composition will be upset. Do not imagine that after having successfully (from a technical point of view) developed a gum-bichromate print you have got all that you can get out of the negative; print another proof and yet another. Try different exposures, modify the temperature of your bath, change the scheme of tone, use another batch of paper coated with a mixture of different proportions, and you will be astonished at the variety of effects thus obtained. Each one, though quite different from the others, will give a true and pleasing impression if the relative values have been kept in harmony in the various schemes of tone adopted.

Failures may be divided into four classes.

1. The coating is completely washed away in a few minutes, or, after being successfully developed, seems to lose all cohesion, and instead of drying, melts and spreads, ruining the print absolutely. Cause: Underexposure.

2. The coating is absolutely insoluble or only a trace of image is visible. Cause: Overexposure.

3. Development proceeds normally, but the whites are stained or marked with granular spots of color. First case, color-stained whites. Cause: Excess of liquid, bichromate or water in the sen-

sitive mixture. Second case, granular deposit. Cause: Excess of pigment.

4. The coating, on developing, breaks into scales. Cause: Extra thick film, to which extra exposure has not been given. We must not forget that the time of exposure is regulated not only by the color and the density of the negative and the amount of actinic light, but also by the degree of thickness of the coating. A thick coating will always produce scaly development when the same exposure has been given as if the coating was of normal thickness.

Gum-bichromate prints may be dried before a fire or over a gas stove, if the color does not exhibit any symptoms of spreading. If it is in the least tender, accelerate evaporation by fanning. As a rule, however, I prefer to let the print dry naturally, for many successful alterations in value can be made when the coating has thickened somewhat and is less delicate under the brush.

The prints when quite dry must be passed for a few minutes in a clearing bath of water and bisulphite of soda (1 per cent) to eliminate the last traces of bichromate.

Is it useless to add, before finishing, that we do not consider a photographic print to be beautiful simply because it is printed by the gum-bichromate method. We like the process and we are doing our utmost to popularize it, only because it allows of great control over tones and values and because in the hands of men who have acquired and cultivated artistic vision it can give an astonishing range of varied effects. The opening paragraph of this article may have seemed paradoxical to the reader at first sight; if he has gone through the whole of it he will acknowledge that success in the technical part of the process lies in the manufacturing of a sheet of coated paper, the coating of which is able to disappear in certain parts only under the action of washing or friction, while other parts retain their color. This paper will give us an image, but it is the artist who will do the rest. He will make the picture.

CHAPTER XXIII.

THE SENSITIZING AND USE OF PLAIN PAPERS.

When I say plain papers I mean, of course, papers without a superficial coating of gelatine or albumen. In the choice of these for salting and sensitizing there is no restriction except that of chemical purity, and no difficulties in manipulation greater than will be met with in any other printing-out process.

Bromide "matt" papers do not come under this heading, since the gelatine surface is only made "matt," or free from glaze, by the use of starch, resin or other admixture in the coating of the paper. Platinotype is a typical example of a "plain" paper, and similar results may be obtained by the use of silver salts instead of platinum, with the additional advantage of a far wider range of color and texture than is possible in that process.

Choice of Papers.—Your paper should be chemically pure and particularly free from iron spots (which, when the paper is sensitized, will spread out like asterisks), and at the same time it should be selected with an ultimate aim as to effect. The purest I have found, next to "Rives," on which platinotype is coated, and for the matter of that most silver papers, too, is Whatman, which is sold in three grades, viz.: H. P., hot pressed or smooth; N., not, and R., rough; and then come Arnold, Harding and Hollingworth, all of which may be obtained from the principal artists' supply depots without any difficulty and in various sizes. "Royal" measures 24x20 in. and Imperial 31x22 in. These sheets can be cut up to the sizes you wish to print, allowing a little margin to handle them by in salting and sensitizing.

Salting and Sizing.—Having decided upon the paper you wish to use, a salting bath is made up as follows:

Common salt...........	50 to 100 grains
Gelatine	10 grains
Water	10 ounces

But this again is a variable quantity, soft and porous papers requiring more gelatine to size them than hard, rough surfaces will take up. The bath should be used hot, so that it is thoroughly absorbed. The exact time of immersion—for the paper is put in bodily, not floated—does not matter, and it will often be found necessary to let the first sizing dry and then to give a second bath later on, that the pores of the paper may be well filled up.

You can salt half a dozen or more sheets at once, turning them over from time to time and then hanging them up by wood clips to dry.

At this stage the paper will keep indefinitely, but it is as well to keep it under pressure that it may be easier to manipulate in the subsequent process of sensitizing. The stronger the salting the weaker may be the sensitizing, and there is room for considerable variation in both, according to the character of the negative you are going to print from and the result you want to get.

The paper is now ready for sensitizing, and this is done on any of the ordinary silver baths used for albumenized papers, the standard being

60 grains nitrate of silver
to
1 oz. of water (preferably distilled)
and
15 grains of citric acid.

This, with occasional strengthening, will last for a long time kept in a dark place and in a well corked bottle.

Sensitizing.—Take the salted paper by the right hand corner and float it on the bath, using gentle pressure at the same time to exclude air bubbles (which would come out as insensitive spots in printing), leaving it floating for two or three minutes, then hang up to dry in a moderately dark room until it is ready for use.

I have found it always better to sensitize paper slightly damp, since one can get a more even coating, and the edges do not curl up in the provoking manner common to papers when dry, but care should be exercised to avoid the sensitizing solution coming on to the back of the paper.

Printing.—This is done in the ordinary manner in a pressure frame, but the image may be taken rather darker than with ordinary albumenized papers to compensate for subsequent loss in toning and fixing. But be sure to varnish the negatives before printing, to avoid staining them. I cannot explain it, but the fact remains that although I have never had staining occur with albumenized papers, with the use of strongly salted and sensitized drawing papers, such an occurrence has been frequent, and although there are several reputed cures for such staining, I have never yet found a satisfactory one.

Toning.—Any bath that will tone albumenized prints will act perfectly well with plain salted papers, but to obtain a rich red brown with what are called "juicy" depths in the shadows and undegraded whites in the high lights, use the following stock solution:

15 grains chloro-platinite of potassium
in
½ oz. of water.

Then, when the prints are to be toned, take from it one dram mixed with 4 oz. of water with a few drops, say 5 or 6, of nitric acid.

This bath will be found to tone very rapidly and it will keep fairly well. Toning being completed, wash for a minute or two and neutralize prints in a weak bath of carbonate of soda; they are then ready for fixing in the usual way.

Fixing.—Hypo-sulphite of soda..... 4 oz.
Water ....20 oz.

I look upon thorough fixing as necessary to insure permanency as is thorough washing in running water afterwards, and prints should be left in the fixing bath for at least 15 minutes before they are put in the washing trough, where they should remain for at least a couple of hours.

I came across a print on plain "Saxe" paper made by an artist at least thirty years ago and it was as fresh and bright as on the day it was made. It was a practice with this artist to dab each separate print with a sponge under running water, back and front, for a considerable length of time, and I have never seen such little change in color of silver prints as are to be noticed in his.

When prints are well washed I take it that permanency has been obtained as near as that unstable metal, silver, will allow, and although the directions for the manipulation of plain paper seem formidable enough, they are not really more so than would be required for the intelligent use and practice of any other printing-out process.

There is another method of obtaining prints on plain paper, developing an underprinted picture with a saturated solution of gallic acid or pyrogallol solution acidified with acetic acid. I would also recommend the use of a pure unbleached paper in preference to any other. This is made of linen fiber instead of cotton rags and is free from chlorine or bleach in any form.

CAMP OF NOTED APACHE SCOUT, ARIZONA, ON THE SANTA FE.

Photo by W. H. Simpson, Chicago.

CHAPTER XXIV.

USEFUL FORMULAE — WEIGHTS AND MEASURES.

DEVELOPING FORMULAS FOR DRY PLATES AND NEGATIVE FILMS.

Pyro A B C Developer.

BY WEIGHT.

A.	Water	10 oz.
	Sulphite of soda crystals	½ oz.

Add enough pure acetic acid to this to turn blue litmus paper slightly red, then add:

	Pyro	1 oz.
B.	Water	16 oz.
	Sulphite of soda crystals	4 oz.
C.	Water	16 oz.
	Sal soda crystals	4 oz.

To develop take of

A	½ oz.
B	1 oz.
C	1 oz.
*Water	8 oz.

Apothecaries' weights are intended to be used in the above formulas.

More water gives softness, and less water contrast. Use less water in cold weather.

*For double-coated plates use 18 oz. of water.

PYRO A B C DEVELOPER—HYDROMETER TEST.

A.	Water	10 oz.
	Sulphite of soda crystals	½ oz.

Add enough pure acetic acid to this to turn blue litmus paper slightly red, then add:

Pyro	1 oz.

B.	Sulphite of soda solution to test	60
C.	Sal soda solution to test	40

To develop take of

A	½ oz.
B	1 oz.
C	1 oz.
Water	8 oz.

Less of B will give a warmer tone to negative. If negatives are too yellow, use more of B. If it is found during the summer months and in the south that acetic acid softens the film too much, substitute sulphuric acid.

The hydrometers referred to are often called actinometers, and were formerly much used to test the strength of silver baths. They are seldom accurate, and it is best for each operator to make up a set of the solutions according to weight, and then, noting the reading on his hydrometer, making future solutions accordingly.

EIKONOGEN-HYDROCHINONE DEVELOPER.

No. 1.	Distilled or pure well water	32 oz.
	Sodium sulphite (crystals)	4 oz.
	Eikonogen	240 gr.
	Hydrochinone	60 gr.

No. 2. Water .... 32 oz.
Carbonate of potash............ 4 oz.

To develop take

No. 1 .... 2 oz.
No. 2 .... 1 oz.
*Water .... 1 oz.

By Hydrometer:

No. 1. Sodium sulphite sol'n to test 30. 34 oz.
Eikonogen ....240 gr.
Hydrochinone .... 60 gr.

No. 2. Carbonate of potash solution to test 50

To develop take of

No. 1 .... 2 oz.
No. 2 .... 1 oz.
*Water .... 1 oz.

More water gives less contrast and density.

EIKONOGEN DEVELOPER.

No. 1 solution:

Eikonogen .... 40 gr.
Sodium sulphite .... 40 gr.
Water up to...................10 oz.

No. 2 solution:

Sodium carbonate ....200 gr.
Potassium hydrate .... 25 gr.
Water up to.................. 10 oz.

For developing, take equal parts of **No. 1** and **No. 2.**

HYDROCHINONE DEVELOPER.

A. Hydrochinone .... 1 oz.
Sulphite of soda (crystals)..... 5 oz.

*For double-coated plates use 5 oz. of water.

than our metol-hydrochinone formula gives, is as follows:

A.	Distilled water	20 oz.
	Sulphite of soda (crystals)	1 oz.
	Citric acid	20 gr.
	Eikonogen	120 gr.
	Hydrochinone	60 gr.
B.	Distilled water	20 gr.
	Caustic potash (fresh and dry) (Or caustic soda.)	120 gr.
	Bromide potash	120 gr.

Use 2 of A to 1 of B. Can be used repeatedly. Expose somewhat longer than for the metol hydrochinone developer. Temperature of developer should be from 70 deg. F. to 75 deg. F.

Always develop to a good intensity, as plates developed with hydrochinone fix out somewhat. Rinse and fix.

FERROUS OXALATE DEVELOPER.

A two-solution of ferrous oxalate developer can be made up as follows:

No. 1.	Oxalate of potash	4 oz.
	Water up to	16 oz.
No. 2.	Ferrous-sulphate	1 oz.
	Boiled water up to	4 oz.
	Sulphuric acid	3 drops.

For use, add 1 oz. of No. 1 solution to 3 oz. of No. 2.

General Formulas.

TO STRIP FILM FROM ORDINARY PLATES.

Give negatives two coats of 2 per cent collodion. The following formula yields good results;

Negative cotton.........30 gr. (2 grm.)

Ether.............1 oz. 6 drm. (50 c. c.)
Alcohol...........1 oz. 6 drm. (50 c. c.)

Allow the first coat to dry before applying the second, and when second coating has set, place immediately in cold water until greasiness has disappeared, then place in a bath of

Sodium fluoride (com.) . 5 drm. (20 grm.)
Water..................5 oz. (160 c. c.)

When thoroughly saturated with this solution, which will take at least an hour, place, without washing, in

Water ....7 oz. (196 c. c.)
Sulphuric acid ....1 drm. (4 c. c.)

Rubber trays should be used for this and the fluoride bath. When film begins to loosen, lay a piece of writing paper or celluloid upon it as a support, and separate the two from the glass. After washing well under tap, it can be transferred to a permanent support.

The following will answer for this purpose: Rub a clean glass plate with French chalk and, after dusting, coat with

Gelatine..............2½ oz. (75 grm.)
Water.................16 oz. (500 c. c.)
Glycerine ....3 drm. (10 c. c.)

Filter, before coating, through canton flannel, and avoid air bubbles. Coat on a leveling stand as thick as the plate will hold; allow to set and dry.

CLEARING BATH FOR PYRO.

Perhaps the most effective clearing bath for abstracting the yellow color left by pyro is:

Iron sulphate ....1½ ounces
Water .... ½ pint
Sulphuric acid ....1 dram
Alum .... ½ ounce

But bear in mind that a negative is sometimes shorn of half its beauty by being robbed of its yellow tint. Take a print from it before you tamper with it.

INTENSIFIER.

The fixed and well-washed negative is allowed to remain in the following mercuric-chloride bath until the film is thoroughly whitened:

Mercuric-chloride	1 part
Potassium bromide	1 part
Water	50 parts

The bleaching being completed, the mercuric solution is rinsed off and the negative is immersed in a mixture of equal parts of saturated solution of sodium-sulphite and water. The darkening action will be seen to take place steadily and slowly, just as when ammonia is used. Wash away the excess of sulphite.

REDUCER.

No. 1.	Water	1 oz.
	Red prussiate of potassium	15 gr.
No. 2.	Water	16 oz.
	Hypo-soda	240 gr.

Take of No. 1 4 drams and add to No. 2.

When the negative is thoroughly fixed and washed, lay into the above solution until sufficiently reduced. Wash after immersion.

MOUNTANT FOR PRINTS.

Dissolve 2 oz. of gelatine in 7 oz. of water. To this add first ½ oz. of glycerine and then 3 oz. of methylated spirits. The mountant should be applied to the back of the print with a stiff brush and the print should then be placed in position on the mount and rubbed or rolled firmly down.

RETOUCHING MEDIUM.

When touching out "pinholes" or other blemishes in a negative, the reader will find some little difficulty in making the pencil "bite" the film so as to produce the desired effect. To avoid the trouble, a retouching medium should first be applied to the place where it is desired to work upon. To prepare such a medium take:

Sandarac	½ ounce
Castor oil	40 grains
Methylated spirits	3 ounces

The tip of the finger should be moistened with this mixture, and then applied to the negative and rubbed lightly thereon until it commences to grip or stick. The desired retouching may then be readily carried out.

BRASS—TO BLACKEN.

The amateur often requires to reblacken stops or other portions of the brass work of his apparatus which have seen considerable use. The old black should first be cleaned off with a piece of fine emery cloth, and the metal should then be dipped in a mixture of equal parts of the following solutions:

No. 1.	Silver nitrate	40 grains
	Water	100 minims
No. 1.	Copper nitrate	40 grains
	Water	100 minims

When the stops are removed from the above they should be allowed to dry, and then should be uniformly and gradually heated until they assume the desired black color.

TO CLEAN GLASS.

A useful recipe for a glass-cleaning mixture is the following:

Pumice stone (powdered)	2 oz.
Whiting (powdered)	3 oz.
Soft water	2 oz.
Ammonia, .880	1 oz.

This should be applied to the glass with a piece of chamois leather, and a final polishing may be given with a tuft of tissue paper.

BLACK FOR COATING INSIDE OF CAMERAS, DARK-SLIDES, ETC.

The following is a useful black mixture for coating the inside of cameras, or dark-slides, lens mounts, parts of shutters, etc., or any portion of photographic apparatus which requires a dead-black surface: Take 1 oz. of gold size and 1 oz. of lamp black, and grind or rub these together thoroughly. Then add ½ oz. of methylated spirit and 8 oz. of turpentine. It may be applied with a fine piece of sponge or a soft brush.

TO HARDEN FILM DURING DEVELOPMENT IN HOT CLIMATES.

Sulphate of magnesium	1 oz.
Water	1 oz.

Add ½ oz. to each 16 oz. of developer.

TEN PER CENT SOLUTIONS.

Strictly speaking, a 10 per cent solution is a solution which consists of a liquid having some substance dissolved therein, and of each part, by weight, of the liquid, one-tenth is represented by the weight of dissolved substance contained in that part. For photographic purposes, however, a 10 per cent solution is taken to indicate that in a fluid ounce of 480 minims there should be 48 grains of the dissolved substance. To make a 10 per cent solution of, say, pyro, take 1 oz. of this substance and add water to make up not ten fluid ounces, but nine fluid ounces, 55 minims. The advantage of such a solution is that a required weight of pyro can readily be measured out without weighing, for if 15 grains are required, then 150 minims of the solution will contain the desired amount, and may quickly be poured out exactly and without trouble.

WEIGHTS AND MEASURES.

Apothecaries' Weight.

SOLID MEASURE.

20 Grains	=	1 Scruple	=	20 Grains
3 Scruples	=	1 Drachm	=	60 Grains
8 Drachms	=	1 Ounce	=	480 Grains
12 Ounces	=	1 Pound	=	5,760 Grains

FLUID.

60 Minims	1 Fluid Drachm
8 Drachms	1 Ounce
16 Ounces	1 Pint
8 Pints	1 Gallon

The above weights are those usually adopted in formulas.

All chemicals are usually sold by avoirdupois weight, in which there are 437½ grains to the ounce.

The precious metals, such as silver and gold, are sold by troy weight, containing 480 grains to the ounce.

In changing a formula from the metric system to the apothecaries' system, the following equivalents are near enough for all practical purposes.

30 Grammes	1 Solid Ounce
30 Cubic Centimeters	1 Fluid Ounce
1 Gramme	15 Grains

In an emergency coins can be used as weights. The weights given in the following table are near enough for all ordinary purposes.

Dime	40 Grains
Cent	50 Grains
Nickel	80 Grains
¼ Dollar	100 Grains
½ Dollar	200 Grains
1 Dollar	400 Grains

By simple addition and subtraction a great many different weights can be made with these coins. For instance, to obtain a weight of ten grains, place a cent on one side of the scales and a dime on the other and then add enough of the chemical to balance it.

Avoirdupois Weight.

27 11-32 grains equal 1 drachm.
16 drachms (1 ounce) equal 437½ grains.
16 ounces (1 pound) equal 7,000 grains.

CHAPTER XXV.

HELPFUL HINTS.

Don't use a hypo tray for anything but hypo.

Look on the ground glass, not through it.

Keep films, plates and paper in a cool, dry place.

Label chemical bottles and keep them well corked.

Always dust out plate holders and dust plates well before loading. A speck of dirt will leave a transparent spot which will in turn leave a black spot on the print.

Film cartridges are dirt as well as light proof and so the film requires no dusting. Dust will, however, sometimes settle on the sections of film in the focal plane inside the camera if a long time elapses between winding the film into position and making the exposure. A famous lecturer and photographer overcomes this difficulty when cycling over very dusty roads by not turning the key until he sees a picture that he wants to take.

Dust on the film or plate after exposure does little harm, as it cuts off no light.

When in doubt, overexpose. It is easier to restrain than to force development.

Do not develop in warm water, as it is likely to cause frilling. The developer should be about 60 degrees Fahr.

A saturated solution is one in which the liquid has taken up all of the solid which it can.

Keep dry plates in a dry, cool place.

Pyro stains on the fingers can be removed by washing in a strong solution of chloride of lime and then in a dilute solution of citric acid.

A weak solution of perchloride of iron will remove yellow stains from negatives.

Old and dirty hypo solution will stain the film. Do not use it.

Do not dry negatives in a room having a close atmosphere, but give them a little draught.

Drain the hypo from the plate before washing. It sometimes causes softening of the film.

If unable to locate cause of your failure do not condemn plate, but write the manufacturers full particulars.

TABLE OF COMPARATIVE EXPOSURE.

Hour of Day. A. M.	Hour of Day. P. M.	June	May July	April Aug.	Mar. Sept.	Feb. Oct.	Jan. Nov.	Dec.
12		1	1	1¼	1½	2	3½	4
11	1	1	1	1¼	1½	2½	4	5
10	2	1	1	1¼	1¾	3	5	6
9	3	1	1¼	1½	2	4	*12	*16
8	4	1½	1½	2	3	*10		
7	5	2	2½	3	*6			
6	6	2½	*3	*6				
5	7	*5	*6					
4	8	*12						

Example.—If it is necessary to give ½ second exposure in June, 12 m., under like conditions in December, 12 m., it will require 2 seconds exposure.

In the use of a color screen no rule can be given. The color and depth of color are important factors in governing the amount of increase in exposure. A very dark screen is not to be recommended, for, besides unduly prolonging the exposure, it may also give an exaggerated ortha-

*The accuracy of these figures would be affected by yellow sunset.

chromatic effect; for instance, in a landscape it will tend to destroy the perspective and make the clouds too prominent.

Developing Light.—One thickness of ruby glass and one of orange glass, with the addition of one light of ground glass make an excellent developing light.

To Test Developing Light.—Put a plate in the plate holder in perfect darkness; then place the holder where you generally develop, draw the slide half across the plate and expose to the developing light as long as it generally takes to develop a negative; then develop the plate in perfect darkness the usual time, wash and fix. If any difference is then found between the exposed and unexposed part of the plate, it is proof that the light is not safe for very sensitive plates.

Speed of Plates.—The sensitometer number on each box of plates indicates the rapidity of the same. The higher the number, the quicker the plate. The difference between one number and the other of the same brand is 25 per cent. So, if one number requires two seconds, the next one higher would require 1½ seconds, and so with each successive number.

Plates—To Dry Quickly.—If it is desired to dry a negative with especial quickness after it has been developed and fixed, the following plan may be adopted: First thoroughly wash the negative and then drain off as much of the water as possible. Next immerse it in a bath of pure methylated spirits or alcohol for about five minutes. Then take it out, drain off the alcohol and stand the negative up on end to dry. Drying will be completed in from five to ten minutes, according to the strength of the spirit.

The warmer the air in which negatives are dried, the more intense they become.

Dark Room.—If you spill hypo or any similar substance in your dark room, don't leave it to dry up; wipe it up with a cloth at once, otherwise it will evaporate, leaving fine crystals, which will float about as dust and be sure to spoil something or other and you will look in vain for the cause.

To Clean a Lens.—First spread upon a table a clean sheet of paper, take the lens carefully apart, now dust with camel hair brush each lens on both sides; then take a clean graduate, pour in two ounces of distilled water, one ounce of alcohol and three drops of nitric acid (C. P.); mix well and with a tuft of filtering cotton dipped in this solution rub the lens on both sides, polish with a clean chamois, which is kept for this purpose only, which, when not in use, put away in a clean paper bag. After the lenses are all polished, before putting together, wipe out carefully the brass tube, then dust each lens with camel hair brush (never blow on them) and put together. A lens cleaned in this way will keep clean much longer than it would if simply wiped with a chamois.

Cleaning Bottles.—Wash with benzine or with a solution of permanganate of potash, to which has been added some concentrated hydrochloric acid. The disengaged chlorine destroys the fatty matter, which then disappears by washing in water. Bottles that have contained resinous substances: Wash with potash or soda and rinse with alcohol. Bottles having contained essences: Wash with sulphuric acid, then with water.—Wilson's Photo Magazine.

Ruby Glass—A Substitute For.—If the amateur requires a large piece of ruby glass or has the misfortune to break his ruby lamp, the following hint may prove useful: Procure two sheets of ruby tissue paper and stick one on top of the other by means of a coating of varnish, so as to form a double thickness. If a very deep ruby is required, add an extra sheet in the same way, or, better still, a sheet of orange paper.

Focusing Screen—Substitute For.—If you have the misfortune to break your focusing screen, an efficient substitute may be made in the following way: Obtain a piece of thin, clear glass, of exactly the size of the original screen. Then take some negative varnish, dilute considerably with methylated spirit and varnish the glass in a manner precisely similar to that of varnishing a negative. The glass should then be allowed to cool, and when the varnish has sufficiently hardened, the latter should be rubbed gently with the finger until it loosens in the form of a whitish powder. When this treatment has been applied all over the powder should be carefully brushed away and the screen is complete.

Cracked Negatives—To Print From.—If the reader be unfortunate enough to crack a valuable negative, he may still obtain a satisfactory print therefrom, provided the film remains uninjured. The negative should be carefully placed in the printing frame in the usual way and the latter should be covered over with tissue paper or ground glass, so as to diffuse the light as much as possible. The frame should also be continually rotated during printing. If these precautions are taken, the crack in the glass will practically have no effect on the resultant print.

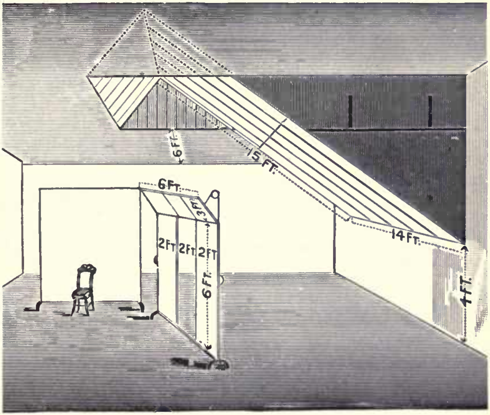
Spoiled Negatives—To Remove Film From.—

The reader may sometimes require a piece of clean glass, and such is readily obtainable by stripping the film from a spoiled negative. To do this, immerse it in a weak solution of hydro-fluoric acid and before long the film will leave the glass. If the acid solution is not available at the moment, put the negative, film side up, under the hot water tap. In a few minutes it will be in such a condition as to require but little trouble to remove it.

Stoppers—To Remove When Tight.—In the case of bottles with glass stoppers, trouble may sometimes arise through the stopper sticking and refusing to come out when wanted. Prevention is better than cure, and the way to prevent such an occurrence is to wipe just a suspicion of vaseline round the part of the stopper which enters the bottle. When, however, a stopper does stick, the neck of the bottle should be heated evenly all round, either by the friction of a piece of string drawn rapidly backward and forward, one turn being made round the neck, or by the direct heat of a taper or match. This alone will not loosen the stopper, but it causes the neck of the bottle to slightly expand and the stopper can then probably be worked loose with the finger and thumb. In obstinate cases, a stick of wood with an oblong hole cut in it to fit the stopper should be fixed thereon and a steady twisting strain applied.

HOW TO CONSTRUCT AN OPERATING ROOM.

We consider the operating room the most important one, and the first to be considered by a photographer who aims at all times to do the best work. The room should not be less than 20x40 feet, if possible larger. The skylight should be ground glass. It is astonishing what a beautiful light this will give, especially by the use of the movable screen, as shown in sketch. (See Fig. 70.) The screen is made of cheese cloth.



Operating Room.

FIG. 70.

If troubled with too much sun, it is better to shade the skylight on the outside than on the inside; it keeps the room cooler in summer. Ventilators may be placed at the highest points on each side of the skylight. The most satisfactory light, as everyone knows, is from the north, and much should be sacrificed to obtain this. Keep the light clean, as thereby more uniformly good negatives can be produced. A very good plan is to have a pipe run from the dark room to the roof and right across the top of the skylight. Have a line of holes to allow the water to shoot down upon the glass, which cools the room at the same time. This can be operated from the dark room. In winter it would be necessary to have a drain from the pipe.

General Instructions for Operating Folding Hand Cameras.—The instructions given below will have to be modified somewhat to suit the peculiarities of the camera used, but as nearly all folding cameras are of the same general construction the necessary modifications will not be material.

Hold camera in left hand. With thumb or finger of right hand press concealed button on top, which will release the bed. Lower to a horizontal position until the side arms snap into place, take the bulb and tube from its position and place over the front of bed.

With the thumb and forefinger release the small hook-shaped lever directly under shutter by a slight turn from right to left. Gently pull on same, drawing the bellows and front of camera out upon the bed until the index on left side of front indicates the desired distance, as shown on focusing scale from your position to the object to be photographed, which has previously been measured or estimated. All objects 100 feet or more away are in focus when index is set on the 100-foot mark on scale.

Take the loaded plate holder from the carrying case, insert it in back of camera in front of ground glass. Gently move until it snaps into position.

RIVERSIDE PARK, NEENAH, WIS.

By courtesy C. & N.-W. Ry.

Withdraw the slide nearest the front of the camera. Set the shutter as per instructions, composing the view by aid of the view-finder, holding the camera perfectly level. Press the bulb and the exposure is made. Insert the slide in the holder (placing the black side of handle nearest the front of camera, which is an indication that the plate in that side of the holder has been exposed), inserting the slide perfectly even—not one corner at a time. Withdraw holder by using the right hand, drawing slightly toward the rear, reverse holder and proceed as before.

Having completed the exposures desired, withdraw the plate holder from in front of the ground glass, placing it in the space allotted to it in the carrying case. Release the hook-shaped lever and gently press the front back to position within the camera box, tightening the lever by turning from left to right. Place tubing around shutter, allowing the bulb to rest on the opposite side from the view-finder. Holding the camera with both hands, gently press with both thumbs on the side arms, which will release them and close the bed to its original position.

In using the camera with a tripod, set up the tripod, place the camera on top, inserting the tripod screw in the socket of the camera, screwing tight. Open camera as per instructions when using by hand. Manipulate the legs of tripod until the camera is level. Turn button in back of camera, which will open panel, exposing the ground glass to view. Set the shutter and turn dial to letter T and press bulb once, thereby opening shutter. Look upon the ground glass and the view may be plainly seen. A focusing cloth may be used if desired, which will greatly aid in composing the view. With the right hand manipulate the front of camera by drawing the bellows forward and back until the correct focus is obtained. When instrument is supplied with rack and pinion, use same when focusing instead of the lever. (Remove focusing cloth if one has been used.) Close the panel in back of camera and press bulb once to close shutter.

Turn the dial of shutter to the required position for time, bulb or instantaneous exposure. Set shutter and make the exposure. When all exposures desired are made, close the camera as previously instructed, unscrew it from tripod and place in the carrying case.

The rising front is used when as little foreground as possible is desired. By turning the milled head screw on the side of front and raising the bellows, together with lens and shutter, the result is obtained and can be better understood by raising and lowering the lens while observing the view on the ground glass.

Always readjust the rising front to the original position before attempting to close the camera.

The entire back, containing ground glass, may be removed by pressing down on the small spring at top of same and gently drawing the back from the camera. This is used only when a roll holder is being adjusted.

The Swing Back is used to assist in bringing into focus nearby objects at the same time as those at a distance, and to correct distortions. Should it become necessary to tip the camera in a downward position to get the views, swing top of back out and bottom in. If camera is tipped upward, reverse position of swing, the top in and bottom out. The plate in consequence is nearly perpendicular and the distortion is obviated. It would also apply when back is reversed for upright pictures, the plate in a vertical position, for photographing tall buildings, churches, etc., when it becomes necessary to tip camera up, press top of back in and bottom out. The side swing is used when photographing parallel objects. For illustration, when by the side of a long bridge, when all cannot be brought into focus. By swinging one side of the plate nearer the lens, the other farther from the lens, the correct focus is obtained. To operate, open the end door and press the two concealed buttons at the rear, opening the top of the camera. With one hand release the swing and with the other hand grasp top of the swing and move to the desired position.

The Horizontal Swing is manipulated by pressing the lower catch on bottom of camera and with the other hand grasp the swing at the bottom and move to desired position. Always straighten the back or swings after using and before attempting to close the camera.

The Principal Object of the Tele-Photo, or long-draw camera, is that objects at a distance can be made nearly double in size in the picture. This is accomplished by unscrewing the front combination of the lens from the shutter, using the back lens only. The use of the rack and pinion and focusing on the ground glass will be necessary.

A WORD TO PROFESSIONAL AND AMATEUR PHOTOGRAPHERS.

The incomparable opportunities and advantages offered by the great railway lines of the United States to both professional and amateur photographers in the pursuit of interesting and imposing subjects deserve, par excellence, their most earnest and serious attention.

Anyone interested in the instructive and profitable art and science of photography cannot fail to be impressed with the kaleidoscopic variety and marvelous scenic effect of the subjects which can be secured, at a comparatively trifling expense and with the highest degree of comfort and convenience along the lines of our great railway systems, as their sumptuous trains are speeding on the wings of the wind over great stretches of matchless country. First, over vast plains of green velvet sward; then skirting rugged mountains which bathe their feet in limpid streams; next the labyrinths of the canyon echo the thunder of the iron horse; then again it shoots out of the zone of the cataract's roar; now, in quick succession, through glens and dales it flies, past placid lakes, and onward, plunging into dense forests, hung with moss through which the noon day sun never filters. Then the train mingles its rumble with the hum swelling from the giant structures of industry, as it rushes by village and town and into the heart of great cities.

A knowledge of his own country's inexhaustible resources cannot be too powerfully urged upon the amateur photographer, who actuated by the love of his art, is searching for magnificent subjects, *be they for stereopticon work, lantern slides or advertising purposes;* and it is along the lines of our great railways that these subjects can be had with a facility which is a source of perpetual wonder and amazement to those, even, whose lives are spent in constant travel and change of scene. With an earnest conviction that a lasting benefit will be conferred upon the amateur photographers who have not yet sought this most fertile of all fields for the successful pursuit of their art, the author has reproduced in this work a number of photographs taken by enthusiastic and successful amateurs along the lines with which the following gentlemen are officially connected, and through whose gracious courtesy he has been permitted to present the views: Mr. W. B. Kniskern, C. & N. W. R. R.; Mr. F. A. Miller, G. P. A., C. M. & St. P. R. R.; Mr. W. H. Simpson, Adv. Agent, A. T. & S. F. R. R.; Mr. Frank J. Reed, G. P. A., Monon Route; Mr. George A. Cullen, G. W. P. A., Lackawanna Line; Mr. A. H. Hanson, G. P. A., Illinois Central R. R.; Mr. George J. Charlton, G. P. A., C. & A. R. R.; Mr. O. W. Ruggles, G. P. A., Michigan Central R. R.; Mr. M. L. Robbins, G. P. A., Southern Pacific R. R.

Manifestly, then, from a careful study of these photographs as represented in this work, it will readily be perceived that it is the amateur who devotes his leisure time to travel who is most favored with both opportunity and success. Not only are the scenes which we reproduce in this work happily selected, but they are beautiful in detail and execution, portraying with wonderful fidelity a few of the myriad transformation scenes in landscape, water, industrial progress and the types of human and animal life, with which our great land abounds in such generous profusion. Notably among this splendid group of amateur photographs, which the author has introduced into this work with an abiding confidence that their excellence and high order of merit will engender in his readers a desire to travel and stimulate and encourage ambition in all young aspirants to excel in this beautiful art, is a series of Indian pictures which we owe to the skill of Mr. W. H. Simpson, of the A. T. & S. F. R. R., who secured the subjects during a summer outing with his family over that line.

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