TO OUR CUSTOMERS

IN EVERY POSTOFFICE in every state in the United States there are families who are our customers and we supply a large majority of these families with practically everything they eat, wear or use—everything needed for personal use, for the home, the farm, the office or the factory. In buying from us these families are saving about fifteen million dollars annually, and this tremendous saving is matched by an equal advantage in quality, for it is the fundamental law of our business that quality must never be sacrificed to reduce price. We have the most highly perfected methods of buying, making and marketing ever devised by any business institution. We insure highest quality and lowest price by our perfect control of the source of supply, reaching back to the raw materials in many lines, supplying carefully selected materials to carefully selected factories either owned or controlled by us, watching every step in the making through the eyes of our own trained experts; putting into the goods every possible improvement in quality, taking out of the goods every item of unnecessary cost.

WE HAVE ADOPTED EVERY IDEA, every device, every method of proved value in order that our customers may enjoy the best possible service. We endeavor to give service that is even better than you might reasonably demand. Fair criticism of our service, our goods and our business methods is sincerely invited. In fact, we are largely dependent upon such criticism for the correction of errors and the improvement of our methods. When we receive criticism or complaint we not only adjust the difficulty specified, but we investigate the cause of the complaint and we take steps to make a repetition of the same trouble unlikely. Our customers rightly expect the best goods, the best service, the best treatment; we desire to give you all these and more. We have endeavored to make the above statements so clear that our customers will fully understand our purposes and will feel free to bring any faults to our attention and be assured of prompt and satisfactory action.

SEARS, ROEBUCK AND CO., Chicago, Illinois.

COMPLETE INSTRUCTIONS

IN

PHOTOGRAPHY

By F. M. NEEDHAM

A GUIDE FOR THE BEGINNER AND BOOK OF REFERENCE FOR THE EXPERIENCED PHOTOGRAPHER, WITH THIRTY-SIX ILLUSTRATIONS

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CONTENTS.

INTRODUCTION

In this little volume we shall entirely avoid all the complicated theories of the chemistry and optics of photography, and confine ourselves simply to those facts and principles which everyone must be familiar with in order to produce good pictures. There is plenty of time to take up the scientific theories of photography when you have learned the fundamental rules of exposure, development and printing.

Photography undoubtedly offers a more attractive field, either for pleasure or business, than anything else at present open to consideration, and its great popularity is probably due, in no small measure, to the simplification of the various processes, the perfection which has been attained in the manufacture of cameras, dry plates, sensitized paper, and the various other materials and apparatus used, all tending to make the production of photographs a simple and easy matter.

In these days the lover of the beautiful secures in a few moments exact likenesses of the choicest views of nature, which formerly could be obtained only in a slow and laborious manner by those favored few gifted with the ability to draw or paint. What could be more treasured in after years than pictures of friends or family, the old home, with all its fond memories and scenes of past pleasures?

The modern photographic outfit places the ability to make such pictures in the hands of everyone, and we believe that the time will soon come when a person unable to operate a camera will be as rare as one unable to read.

Before taking up the subject of photography in detail, the author wishes to particularly impress upon his readers the importance, in fact, the imperative necessity for the most careful and watchful attention to details. Success in photography is dependent upon the little things. The principles involved are simple and easily mastered, but there is always a right way and a wrong way to do everything. Photography is simply a branch of those great sciences,

chemistry and optics, in which there is no guesswork, no chance, every result being in accordance with fundamental principles and laws which are inexorable. Like causes always produce like results. and when you make a negative which does not prove successful you may rest assured that in some detail, apparently unimportant or perhaps entirely overlooked, you have transgressed these natural laws, and a repetition of the difficulty is avoided only by carefully ferreting out the cause of the first failure.

HOW TO SELECT AN OUTFIT.

As this book may fall into the hands of some who have not yet purchased a camera, we have endeavored to give such information as shall make the selection of an outfit easier for those who have had no experience in photography; so if you are about to invest in an outfit, we advise you to carefully read over the descriptions of the different forms of cameras as given in the following chapter, noting carefully what is said in regard to the kind of work for which each style is suitable, and then after carefully studying the description of cameras and complete outfits as given in our catalog, taking into consideration, also, the amount of money which you wish to invest, you should have no difficulty whatever in deciding which oufit to order.

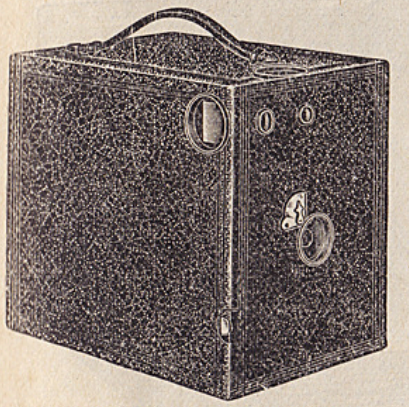
Many who order cameras without fully investigating the subject beforehand, find, as soon as they become familiar with the work, that some other style, size or kind would have been more suitable for their purpose. We believe, however, that anyone who makes a selection with the aid of the suggestions given here, together with the very complete and careful descriptions of the goods listed in our catalog, will be sure to get an outfit which will prove entirely satisfactory and perfectly suited to the purpose contemplated.

CHAPTER I.

CAMERAS.

Essentially a camera is simply a light-tight box with a piece of glass, called the lens, in one end and a means of supporting the sensitive plate or film in the other end. Rays of light, reflected from the object to be photographed, pass through the lens and are projected against the plate where they impress upon its sensitized surface the likeness of the object.

The box constituting a camera may be constructed entirely of wood or metal in a rigid manner, or it may be constructed partly of leather, cloth or rubber, in such a way as to permit its being folded into a more compact form when not in use, and it may be fitted with various adjustments and accessories; but no matter how complicated the camera may appear at first sight, a slight examination will demonstrate the fact that essentially it is simply a light-tight box with a lens in one end and a means for holding the dry plate or film in the opposite end.



THE CONLEY SENIOR, A BOX CAMERA.

All cameras may be divided into four general classes, the simple hand cameras, frequently called Box Cameras, the Folding Hand Cameras, View Cameras and Portrait Cameras. There is an infinite variety of makes, forms and styles of cameras, but they can all be classified under one or the other of the above heads.

In taking up for consideration these different forms of cameras, it will be impossible for us to touch upon the details of manipulation, such as the operation of shutters, methods of adjusting, etc., as these details vary in different makes and, moreover, small instruction sheets covering these particular points are always sent with each camera.

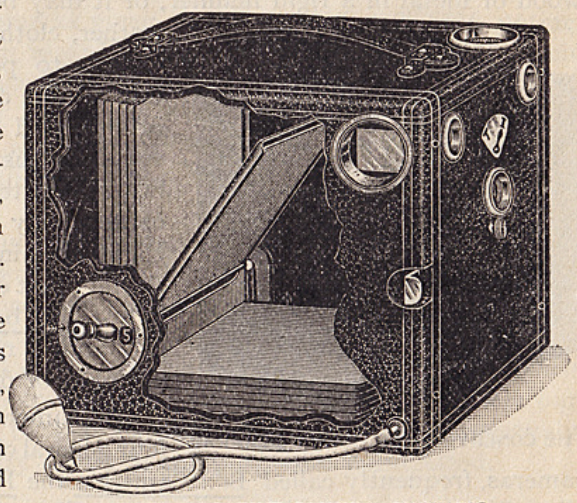
Box Cameras

The simple Hand Camera or Box Camera is by far the most popular and most universally used of all cameras. This is undoubtedly due, first, to its simplicity of operation, and, secondly, to the low price at which such cameras can be purchased.

Although a box camera is capable of producing fine pictures within certain limits, there are many kinds of work beyond its capacity, and many pictures which cannot be made at all with a box camera are easily made with a camera more complete in its adjustments.

There are two principal forms of box cameras, known as plate holder cameras and magazine cameras. In the plateholder camera the sensitive dry plate upon which the picture is made is placed in what is known as a plate holder, and this plate holder, with the plate in it, is inserted in the back of the camera when a picture is to be made. Each plate holder holds two plates, and the plates must be put into the holder in the dark room.

The Magazine Camera is so constructed that a large number of plates, usually twelve, can be put directly into the camera itself and exposed, one after the other, thus doing away with the use of plate holders.



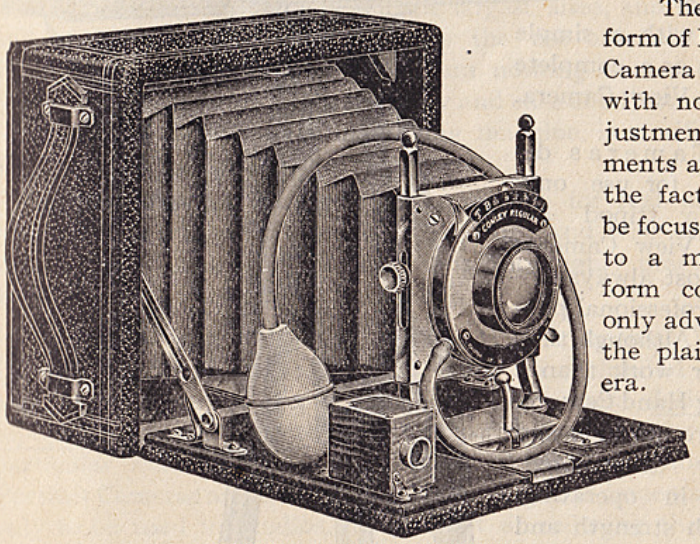
CONLEY MAGAZINE CAMERA, SHOWING INTERIOR ARRANGEMENT

The most popular and undoubtedly the best magazine camera is the Conley Magazine, and our illustration shows the manner in which the plates are held and manipulated inside the camera.

A Box Camera is about the best instrument for a beginner who desires a simple yet good camera at a very small expense. Box cameras are usually provided with universal or set focus lenses, that is, lenses not requiring to be focused and therefore mounted immovably in the camera front. Such cameras offer special advantages to the beginner, or to those who do not wish to go too deeply into photography, as it is not necessary to adjust the focus each time a picture is taken.

Folding Hand Cameras

The Folding Hand Camera is the next step above the Box Camera, and consists essentially of a front part supporting the lens and a rear part with adjustment for holding the sensitized plate in position, these two parts being connected by a rubber or leather bellows, which folds like an accordion, making it possible to fold the camera into smaller space for convenience when not in use. The principal and most important advantage of the folding hand camera lies in the fact that the distance between the plate and the lens may be altered at will; in other words, the camera may be focused.



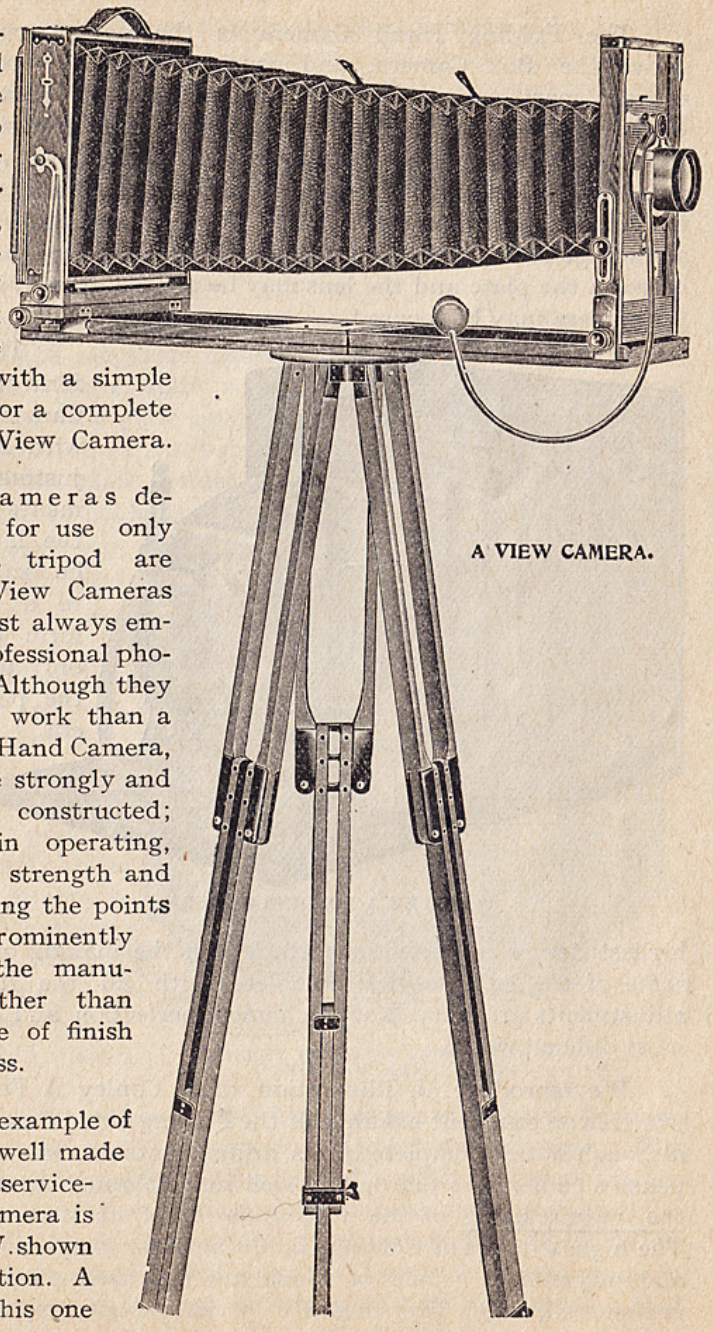
CONLEY A FOLDING CAMERA.

The simplest form of Folding Hand Camera is provided with no special adjustments or improvements and, therefore, the fact that it can be focused and folded to a more compact form constitutes its only advantages over the plain Box Camera.

In the more complete folding cameras, however, is reached the highest degree of perfection attained in the making of cameras, and some of the latest styles, complete with all the most improved adjustments are marvels of mechanical perfection and capable of the most difficult work.

We reproduce an illustration of a Conley A Folding Camera, which is an excellent example of the Folding Hand Camera, and which, although not as complete in its adjustments as some of the more expensive cameras, is thoroughly well made throughout and fully meets the requirements of the vast majority of amateur photographers. The highest types of Folding Hand Cameras, complete in every detail and adjustment (some of which are not used once in a hundred exposures), might very properly be called photographic luxuries.

The Folding Hand Cameras are designed to be used either with or without a tripod, and are suitable for any class of work which may be done either with a simple Box Camera or a complete Professional View Camera.



A VIEW CAMERA.

View Cameras

Cameras designed for use only with a tripod are called View Cameras and are almost always employed by professional photographers. Although they do no better work than a good Folding Hand Camera, they are more strongly and substantially constructed; convenience in operating, together with strength and durability, being the points kept most prominently in view by the manufacturers, rather than mere elegance of finish or compactness.

The best example of a thoroughly well made substantial, serviceable View Camera is the Model B. W. shown in our illustration. A camera like this one

can be used for any kind of work which either an amateur or professional photographer would ever have occasion to do.

We cannot too strongly recommend the View Camera to both amateur and professional for general photographic work. It combines ease of operation, completeness of adjustment, strength and durability to a degree not reached in other styles of cameras. The bellows is made amply long, the swings possess great latitude, the front has a wide range of movement, all adjustments are easy to get at, and therefore convenient to manipulate. The style of construction permits the use of extreme wide angle lenses, or any kind of rapid rectilinear or anastigmat lenses, even the largest sizes, and the ample size and strength of the front permits the use of the smaller types of portrait lenses. In a View Camera nothing that will add to its convenience of operation, its accuracy and ease of adjustment, in short, to its effectiveness as a picture taking machine, is sacrificed for mere elegance of appearance or compactness.

A View Camera is a businesslike camera for real photographers who are seriously interested in their work and who want an outfit that is, above all other considerations, thoroughly practical in every detail.

Portrait Cameras

Portraits can be made with either a regular View Camera or Folding Hand Camera, and in a limited way even with a simple Box Camera, but the camera designed especially for the purpose has points of superiority for this particular work, and in photographic studios or galleries regular Portrait Cameras are usually employed. As these cameras are designed only to be used in studios, no attempt at reducing them in size or weight is made, so they are always large and heavy, and must be supported on what is known as a camera stand, a device so arranged that the camera may be quickly raised, lowered or tilted to any desired angle, and for convenience in moving the instrument about the gallery, the stand is usually furnished with small wheels or casters.

As before stated, however, just as good portraits can be made with a View Camera as with a Portrait Camera. It is merely a question of convenience in working, and many professional photographers who do both portrait work and outside work and who do not care to invest in two cameras use a View Camera for both purposes. While the View Camera readily adapts itself to either line of work, the Portrait Camera, owing to its size and weight, is suitable for use only in the studio.

CHAPTER II.

LENSES AND SHUTTERS.

As previously explained, the lens is the piece of glass in the front of the camera and is the most expensive and the most important part of the outfit. The quality of work done with a camera depends entirely upon the lens, and therefore, in selecting your outfit care should be exercised to secure one containing a good lens. As the quality of the lens cannot be judged in any way by its appearance, and as a beginner in photography is entirely incapable of judging a lens, even by an actual trial, it is usually necessary to take the dealer's word regarding this point, and thus the advisability of dealing with a house whose goods are known to be exactly as represented is apparent.

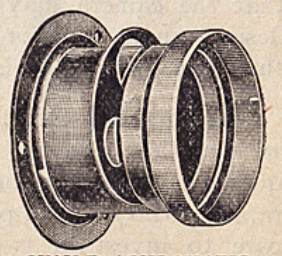
Photographic lenses may be divided into five general classes, single lenses, double or rapid rectilinear lenses, anastigmat lenses, wide angle lenses and portrait lenses.

Non-Achromatic Single Lenses

The cheapest photographic lens made is a single convex lens, just like a common magnifying glass or like the lenses in spectacles which very old people wear. Such lenses are used only in the very cheapest cameras and as they are not accurately ground and not properly corrected, they distort the picture, and as they are not achromatic they separate the rays of light into colors, thus blurring the picture.

Achromatic Single Lenses

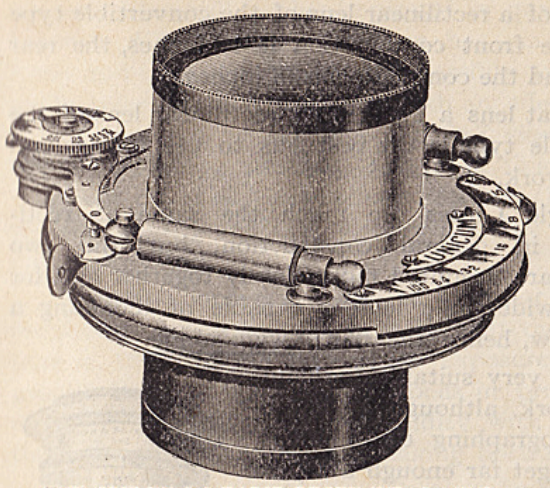
The Single Achromatic Lenses are composed of two simple lenses, one double convex, the other plano convex, cemented together, thus apparently forming a single lens. Such a lens does not separate the rays of light into colors and will therefore form a sharp, clear picture. Such cameras as the Conley Sr. Box or the Conley Magazine Camera are provided with single achromatic lenses.



SINGLE ACHROMATIC LENS WITH REVOLVING DIAPHRAGM.

Rapid Rectilinear Lenses

A Rapid Rectilinear Lens, which is a double lens, consists of two single achromatic lenses mounted in opposite ends of a brass tube. They are called rectilinear because they render the straight lines of a picture without distortion, the word rectilinear being derived from the Latin words for straight and line.



THE CONLEY F:8 RAPID RECTILINEAR LENS.

A rapid rectilinear lens, as already explained, consists really of two lenses which are spoken of as "combinations," the lens in the front of the tube being known as the "front combination," the other as the "rear combination." The better grades of rectilinear lenses are so designed and constructed that the separate combinations may be used alone, which is a desirable quality, as the single combinations possess a much greater focal length than the complete lens, and the efficiency of a photographic outfit is much increased by having available lenses of different focal lengths.

Each combination of a double lens consists of two or more pieces of glass which are firmly cemented together with an invisible cement (balsam), thus apparently forming a single lens.

In a general way, rapid rectilinear lenses are divided into two classes, "symmetrical" and "convertible." A symmetrical lens is one in which the front and rear combinations are of the same style of construction and the same focal length; in other words, the front combination and rear combination are exactly alike, and it is from this fact that the lenses are spoken of as symmetrical. In a symmetrical lens the single combinations usually have a focal length of about double that of the complete lens.

Convertible lenses are lenses in which the front and rear combinations are of different construction and consequently of different focal lengths, and with a convertible lens the user has at his command three different focal lengths, namely, the complete lens, the

front combination alone, and the rear combination alone. Of course, in different lenses the relative focal lengths differ but, taking the lens furnished with the Conley Double Extension Camera in the 5x7 size, we have an example of a rectilinear lens of the convertible type in which the focus of the front combination is 18 inches, the rear combination, 14 inches, and the complete lens, 8 inches.

Next to an anastigmat lens a good rapid rectilinear lens of the symmetrical or convertible type is the best lens to use for general all around photographic work.

Wide Angle Lenses

Wide Angle Lenses are much the same as rectilinear lenses in general construction, but the two combinations are mounted more closely together and for this reason a wide angle lens is capable of including a much wider extent of view, hence the name wide angle.

These lenses are not very suitable for landscape or outside view work, although in certain cases, such as the photographing of buildings, where it is impossible to get far enough away to include the whole of the building with a rectilinear lens, the wide angle lens becomes a necessity.

MONARCH WIDE ANGLE LENS.

Wide angle lenses are especially desirable for photographing interiors; in fact, they are practically indispensable for this work, as a single achromatic or rapid rectilinear lens does not include a sufficiently wide angle of view to make a good interior.

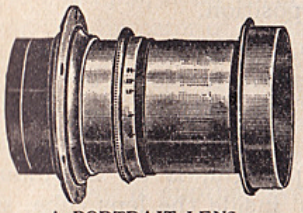
Anastigmat Lenses

Anastigmat Lenses represent the highest degree of perfection in lenses and possess points of superiority over the rapid rectilinear lenses which make them very desirable. As compared with rapid rectilinear lenses, the anastigmat lenses possess greater speed, better definition, and entire freedom from astigmatism. Definition is that property of a lens which enables it to make sharp, clean cut pictures, and while fine definition may be obtained with an ordinary rectilinear lens by using a small diaphragm, which, of course, necessitates a longer exposure, the anastigmat lens will give good definition even with the full opening. Anastigmat lenses are suitable for all kinds of photography and may be described as "universal" lenses, as they are adapted to landscape work, architectural subjects, interiors, groups, portraits and copying. The large working aperture makes them particularly suitable for very rapid instantaneous exposures and for

portrait work. A few years ago anastigmat lenses could only be purchased at very high prices, placing them beyond the reach of many photographers, but during the last few years these lenses have not only been still further improved in quality, but the competition between different manufacturers has gradually brought the prices lower and lower until now it is possible to purchase a strictly high grade genuine anastigmat lens with an effective aperture as great as F:6.8 at prices for the 4x5 and 5x7 sizes ranging from $20.00 to $35.00, including shutter. Lenses of this style and quality a few years ago could not be purchased for less than $50.00 to $75.00. The modern anastigmat lens is in every way a triumph of optical and mechanical skill.

Portrait Lenses

Portrait Lenses are also very similar in construction to rectilinear lenses, but are so made that they are very rapid, that is, they require very short exposures. Portrait lenses usually have a long length of focus in proportion to the size of the plate, and the great rapidity with which they work makes them especially suitable for making portraits.


A PORTRAIT LENS.

Portrait lenses are not to be recommended for anything except actual portrait work indoors. As before stated, all other good qualities are sacrificed in order to obtain great speed and they are not very rectilinear and do not possess much depth of focus. Good portraits can be made with rapid rectilinear or even with single achromatic lenses, the only disadvantage being that a slightly longer exposure must be given than would be necessary with a regular portrait lens.

Focal Length of Lenses

The focal length of a lens is the distance from the ground glass to the optical center of the lens when focused on some distant object. The greater the focal length, the narrower becomes the angle of view, hence the single lens, which usually embraces a narrow angle of view, has a long focal length, and the wide angle lens, which embraces a large extent of view, has a very short focal length.

When the focal length of a double lens is mentioned, it is always understood, unless otherwise specified, to be the equivalent focus, by which is meant the distance from the optical center of the lens to the ground glass when it is focused on a distant object. The optical center of the lens is not usually the same as the actual or mechanical

center except with simple convex single lenses; hence, the term "equivalent" focus as applied to double lenses, meaning that the lens has a focal length equivalent to that of a single lens which would produce on the ground glass an image of a given object at a given distance exactly the same size as would the double lens. In the case of portrait lenses, which are very large and bulky, the back focus is often stated so that purchasers can readily tell whether the camera on which the lens is to be used has sufficient bellows capacity to accommodate the lens. The back focus is the distance from the back of the lens to the ground glass when focused on a distant object.

Diaphragms or Stops

The Diaphragm or Stop is the means of regulating the amount of light which passes through the lens during an exposure. Usually in the old style single lenses or wide angle lenses, there is a round piece of metal with a number of holes of different sizes in it, so placed that any one of these holes or openings may be revolved to the center of the lens and the size of the opening regulates the amount of light admitted. Such stops are known as revolving diaphragms, because they are revolved to bring the desired opening into position.

Rectilinear lenses of the old style were usually provided with a set of loose diaphragms or stops, that is, separate pieces of metal, each with a hole in the center, which were inserted in a slot in the lens tube. Loose diaphragms are known as Waterhouse diaphragms.

Another style, known as the Iris diaphragm, is an ingenious device of thin metal or hard rubber leaves inside the lens tube, so arranged that a round opening is left in the center, the size of which can be varied as desired by turning a lever on the outside. The Iris diaphragm is, of course, the most convenient and satisfactory style, as there are no loose pieces to lose or mislay, and it can be instantly adjusted to any desired size. The effects produced by the different styles of diaphragms, Revolving, Waterhouse or Iris, are, of course, identical, and the only differences are matters of convenience in operating or elegance of design and finish.

Use of Diaphragms

The use of diaphragms can best be illustrated by an experiment. Set the camera up and with the largest stop, or none at all, in the lens, focus sharply upon some object about 20 or 25 feet away. Upon carefully observing the image upon the ground glass, you will note that objects quite close to the camera, and probably, also, objects at a considerable distance away, are blurred, that is, not sharply focused. Now, put a rather small stop in the lens and probably the first thing you will

observe is that the image is not nearly as bright as it was. There is less light coming through the lens. But look closer and you will find another change: those portions of the view that were before out of focus or fuzzy are now sharp and distinct.

A little experimenting here will show you that the smaller the stop is, the sharper, clearer and more distinct the picture is, and this may lead you to ask, why not use the smallest stop all the time? In reply, we will call your attention to the fact that the image, although sharp, grows correspondingly darker and dimmer as the stop is made smaller, and as it requires a certain invariable amount of action by light in order to produce the picture, you can readily understand that the smaller the stop is, the longer the exposure must be. It therefore becomes practically impossible, except under very unusual conditions to make a snap shot or instantaneous exposure with a small stop or diaphragm.

Size of Diaphragms

The size or diameter of the stop is usually designated by its relation to the focal length of the lens. For example, if the focal length of the lens is 8 inches and the diameter of the largest stop is 1 inch, the focal length divided by the diameter of the stop gives us eight and the stop is called F:8; F. standing for focal length. In a lens having the largest stop F:8, the next size is F:11, that is, equal in diameter to one-eleventh of the focal length, and the next size is F:16, etc.

There is another system of designating the stops, known as the U. S. system, in which a stop equal in value to F:8 is called No. 4. F:11 equals No. 8, etc.

The following table gives the relative values of the F. system and the U. S. system of making stops:

F:4 equals	No. 1	F:22 equals	No. 32
F:5.6 equals	No. 2	F:32 equals	No. 64
F:8 equals	No. 4	F:45 equals	No. 128
F:11 equals	No. 8	F:64 equals	No. 256
F:16 equals	No. 16		

The size of each successive stop is such that it will require just twice as long an exposure as the one preceding it; for example, if for the No. 4 stop the correct exposure is 2 seconds, the No. 8 will require 4 seconds; No. 16, 8 seconds; No. 32, 16 seconds; No. 64, 32 seconds; No. 128, 64 seconds, etc.

A knowledge of the values of the different stops and their relation to each other is necessary in determining correct exposures and should be carefully studied by anyone using a camera.

Depth of Focus

The experiment of focusing on a certain object with the largest diaphragm in the lens and finding other objects which are closer to or farther from the camera, out of focus, will also illustrate another qualification of lenses, known as depth of focus, or the extent to which both near and far objects can be brought into focus sharply at the same time.

Depth of focus depends entirely on the size of the diaphragm and the focal length of the lens. The smaller the diaphragm is, the greater will be the depth of focus, and the shorter the focal length of the lens is, the greater the depth of focus will be. Conversely, the larger the diaphragm or the longer the focal length, the less depth of focus the lens will possess. An increase in the focal length or in the size of the diaphragm is necessarily accompanied by a corresponding decrease in the depth of focus. Lenses, even of entirely different styles of construction, always possess depth of focus to exactly the same extent if they are of the same focal length when used with stops of the same size. For instance, if we take an ordinary rapid rectilinear lens with a focal length of 8 inches and make a negative with it, using, for example, stop F:32, and at the same time we make another negative with a fine anastigmat lens of 8 inches focal length, again using stop F:32, both negatives will show depth of focus to exactly the same extent. If we take two lenses of unequal focal lengths and use them both with stops of the same value, say for example, F:16, the lens having the shorter focal length will show the greatest depth of focus. If we take two lenses of the same focal length and use one with a large stop and the other with a small stop, the picture made with the small stop will show the greatest depth of focus.

Depth of focus, which is the capacity of a lens to give sharp images of objects situated at different distances from the camera, must not be confused with definition. Depth of focus depends only on focal length and size of stop, and is the same with all lenses where these two factors are the same. Definition, which is the ability of a lens to produce sharp, clear, crisp detail, is a test of quality and is possessed to a much greater degree by fine lenses than by cheap lenses. The finest definition is yielded by the modern anastigmat lenses. Rapid rectilinear lenses give good definition, but not as good as does the anastigmat lens.

From consideration of the foregoing statements, it is apparent that any increase in the working aperture of a lens must necessarily be accompanied by a corresponding decrease in depth of focus. or. in

other words, the larger the stop, the less the depth of focus will be. It is also evident that great depth of focus is easily obtained with any lens by using a very small diaphragm; but this, as explained in the paragraph below regarding speed of lenses, means a corresponding increase in the length of exposure.

It must also be borne in mind that great depth of focus is not always desirable. For example, when photographing a group, it is much better if the background is not sharp. Only the figures themselves in the group should be in sharp focus, and the background and other non-essential details should be made as inconspicuous as possible by having them out of focus. Many landscape pictures are much more artistic if only the important or interesting portion of the picture is sharply defined, and other parts, possibly the extreme distance, are slightly out of focus, thus giving greater prominence to and emphasizing the essential or important parts of the picture.

The Speed of Lenses

The length of exposure, light and other conditions being equal, depends entirely upon the size of the opening in the lens as compared with the focal length, and this naturally brings us to the consideration of one of the most important qualifications of a lens, viz., its speed or rapidity. It will be readily understood that the lens with the largest opening in proportion to its focal length will be the most rapid, that is, will make pictures with the shortest exposures, and speed is a very desirable feature. The largest opening, sometimes called the aperture, of a single achromatic lens is usually from F:12 to F:15, while a good double or rectilinear lens usually has its largest opening about F:8; so it is very apparent that a rectilinear lens is much faster, that is, requires much shorter exposure than a single lens. To put it into plain figures, a lens working at F:8 will require less than one-third as long an exposure as one working at F:15, all other conditions being equal. This, of course, applies only when working with the largest stop. If both lenses are stopped down to the same size opening, say F:32, for example, then the same exposure is required with each.

The largest opening of a wide angle lens is usually about F:15, and sometimes as small as F:22; so wide angle lenses are necessarily slow.

Anastigmat lenses are much faster than rectilinear lenses, the most popular types usually working at F:6.8, which makes them about 30 per cent faster than the ordinary rectilinear lens working at F:8. In actual practice they make an even better showing than this as

compared with rectilinear lenses, because, owing to their better defining power and flatter field, they can be used at full aperture in cases where the rectilinear lens would be still further stopped down.

Portrait lenses are the fastest of all lenses, all other qualities being sacrificed for the sake of speed, and usually work at from F:3.5 to F:5.5, which is from two to six times as fast as rectilinear lenses, from ten to fifteen times as fast as single achromatic lenses, and fully twenty times as rapid as the average wide angle lens.

Speed in a lens is especially important when making snap shot or instantaneous exposures, as the extreme shortness of the exposure must be made up or compensated for by an ability to admit a large volume of light, owing to the short time in which the light is allowed to act upon the plate.

Bearing in mind the extremely short time in which light is allowed to act upon the plate in an instantaneous or snap shot exposure (only a small fraction of a second), and remembering that a certain amount of action by light is absolutely necessary in order to impress the picture upon the plate, the necessity of using a rapid lens, that is, one with a large opening, thus admitting lots of light, will be apparent. The fact that a shorter exposure is necessary with a lens which admits a large volume of light may be illustrated in a crude way by the operation of filling a vessel with water through a pipe. The vessel can be filled entirely full with a small pipe, but it will take a much longer time to do it than would be required with a large pipe. In other words, the pressure of water being the same, the larger pipe will fill the vessel much more quickly than the smaller pipe. In the same way a picture can be made in a very much shorter time with a lens having a large aperture than it can with a lens having a smaller aperture.

Single achromatic lenses are rapid enough for ordinary snap shot work when the light is brilliant, but a double or rectilinear lens is, of course, better, and there are many occasions when the light is not quite bright enough to make a good snap shot with an achromatic lens and yet bright enough to make good negatives with a rectilinear lens. The still greater rapidity of the anastigmat lens makes it possible to secure fully timed negatives on dark, cloudy days when snap shots would be impossible, even with the best rapid rectilinear lenses.

With a wide angle lens snap shots can only be made under the most favorable circumstances. In spite of the fact that the wide angle lens is slow, it is a very valuable addition to an outfit, being

especially suited to photographing interiors. As time exposures must be made anyway, when photographing interiors, the slowness of the wide angle lens is no disadvantage, and the wide extent of the view embraced is a great advantage, as single achromatic and rectilinear lenses do not embrace a wide enough angle to show all that is usually desired in an interior view. Owing, however, to the wide angle embraced, these lenses, to a certain extent, distort and spoil the perspective of the view.

Actual Diaphragm Values

In the preceding paragraphs we have explained that the speed of a lens depends upon the size of the aperture as compared with the focal length, but we cannot measure the effective aperture and focal length directly with a rule except in the case of simple lenses, consisting of only one piece of glass or one combination. With a perfectly simple convex single lens we will assume that the diameter of the largest stop or diaphragm is 1 inch and that, when the camera is focused on some very distant object, the distance from the optical center of the lens to the ground glass is 16 inches. We then say that the value of the largest stop, that is, the full aperture of the lens, is F:16; in other words, the diameter of full aperture is equal to one-sixteenth of the focal length and, therefore, this lens is said to have a speed of F:16.

Now, this same principle holds true when we come to double lenses of the rectilinear, wide angle, anastigmat and portrait types, but with double lenses the F. value of the opening cannot be determined correctly by direct measurement with a rule in inches or fractions of an inch. To appreciate this fact, we must remember that the speed of a double lens depends upon the amount or volume of light which it transmits. A single lens transmits a volume of light exactly equal to the diaphragm in diameter, but a double lens transmits a volume of light that is actually greater in diameter than the diaphragm through which it passes. This is due to the fact that the rays of light, as they enter the lens, are refracted, causing them to converge, and the diaphragm, which is located between the front and rear combinations of the lens, allows a cone of light to pass through, which, before its refraction, was greater in diameter than the diaphragm itself.

With single lenses the diaphragm is placed in front of the lens and only the actual volume of light which passes through the diaphragm can be transmitted by the lens, but in double lenses the

diaphragm is placed inside the lens between the front and rear combinations, and the light passes through the front combination first, which by refraction converges it before it reaches the diaphragm and enables it to pass through an opening of less than its own original diameter.

Now, to determine the speed of a lens, we must have these two factors: first, the exact equivalent focus of the lens; second, not the exact diameter of the diaphragm itself, but the diameter of the cone of light which it will transmit. The equivalent focus of a lens is the distance from the optical center of the lens to the ground glass when the lens is focused upon a distant object. With simple lenses we can measure this directly with a rule, because the optical center and the mechanical center coincide, but in a double lens the optical center and the mechanical center do not, as a rule, coincide, and while the actual optical center can be determined by a complicated mathematical computation, it is unnecessary to do so, as there is an easy and simple way to determine the equivalent focus of a double lens and also the actual F. value of the opening, which we will now explain.

To Measure the Speed of Lenses

To measure the speed of a double lens, in other words, to determine the true F. value of the largest opening, we proceed as follows: first, focus very carefully and accurately on a very distant object and mark on the bed of the camera the exact point to which the bellows is extended; second, focus on some small article at a distance which will enable you to make the image on the ground glass exactly the same size as the object itself, and perfectly sharp, with full aperture. A strip of white paper or a rule forms a handy object for this purpose, and great care must be exercised to make the image on the ground glass absolutely the same size as the object itself and perfectly sharp. Now, again, mark on the bed of the camera the point to which the bellows is extended, and the distance between this point and the point to which it was extended previously when focused on the distant object, is the exact equivalent focus of the lens.

It will readily be understood that this work requires a long bellows camera, such as the No. 1 Conley View or the Conley Double Extension Camera, and to insure accuracy in marking the points to which the bellows is extended, some point on the bed of the camera must be selected where a small mark or scratch can be made on the movable portion to exactly coincide with the immovable part. Then

when the bellows is extended and the second mark made, the exact measurement between the two marks is easily secured.

Third, make a small round hole with a needle exactly in the center of the septum of your plate holder, and put the holder into the back of the camera, the same as when making an exposure, but without the slides in and remove the ground glass. Extend the camera and clamp it tightly at the point where it is in focus on a very distant object (this point being already marked on the camera bed), and see that the camera front is so adjusted that the lens is exactly opposite the hole in the septum of the holder, that is, exactly centered. Now take the camera into the dark room, place a bright light right back of the hole in the septum and accurately measure the diameter of the circle of light which will be seen on the front of the lens. The equivalent focus of the lens, obtained as above directed, divided by the diameter of the circle of light gives the exact F. value of the opening.

This circle of light may also be measured by placing the back of the camera opposite a bright window and covering the front end of the camera with a focus cloth, the same as when taking a picture, the circle of light being visible only when all other light is cut off so far as possible, the same as when viewing the image on the ground glass.

Example: Suppose that by the method just described we find the equivalent focus of a lens to be 9⅝ inches and the circle of light on the front of the lens 1⅜ inches in diameter with full opening. 9⅝ divided by 1⅜ equals 7; hence, the speed of the lens is F:7. As another example, suppose the equivalent focus is 8½ inches and the circle of light 1¼ inches in diameter. 8½ divided by 1¼ equals 6 4-5, or written decimally, as is customary, 6.8; that is, the speed or full working aperture of the lens is said to be F:6.8.

Air Bubbles in Lenses

Purchasers of fine anastigmat lenses are sometimes unnecessarily alarmed by finding a number of small air bubbles in the glass, but these bubbles should occasion no misapprehension, as they do no harm whatever.

In the manufacture of anastigmat lenses, very special qualities of Jena glass are used, varieties of glass which differ widely in optical qualities and chemical composition from the ordinary flint and crown glasses used in the construction of cheaper lenses. The manufacture of these special grades of Jena lens glass is attended with great technical difficulties, and it has been found practically impossible to produce glass of the required qualities entirely free from small air

bubbles, but as these air bubbles have no influence upon the optical qualities of the lens, they are not regarded as faults.

In considering the matter of bubbles in lenses, we must bear in mind these facts: first, in making anastigmat lenses it is absolutely necessary to use these special and peculiar grades of lens glass; second, these special varieties of glass always contain at least a few small air bubbles; third, these bubbles have no practical effect upon the working quality of the lens. From a consideration of these three facts, it is evident that the presence of air bubbles in a lens is of no importance whatever and may be entirely ignored by the user of the lens.

In the manufacture of ordinary rapid rectilinear lenses, single achromatic lenses, wide angle lenses, etc., it is possible to use the commoner varieties of crown and flint optical glass, the making of which is a more simple matter than the production of the special glass for anastigmat lenses, and no difficulty is found in producing these cheaper glasses without bubbles.

While occasional pieces of the special Jena lens glass are found free from bubbles, such pieces are rare, and a complete lens entirely free from air bubbles (if sold as an anastigmat lens) might well be regarded with suspicion, as complete freedom from bubbles would indicate that a cheaper glass had been used in its construction and that it was not a genuine anastigmat lens.

Kind of Lens to Purchase

It is an excellent plan to have more than one lens, but if you are limited to one, let it be an anastigmat, unless such a lens costs more than you care to invest, in which event a good rapid rectilinear should be selected. A wide angle lens makes a very valuable addition to an outfit, but is, of course, suitable for only certain classes of work, and, although it will enable you to make many pictures which your regular lens would not make in a satisfactory manner, it could not be depended upon for all around work.

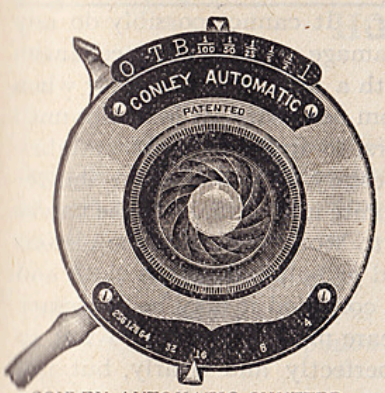
Portrait lenses, being suitable only for portrait work, are seldom used by any but professional photographers, and then only in the studio.

The Shutter

The Shutter is the mechanism or device, by means of which the opening to admit light through the lens is opened or closed in making an exposure. There is an infinite variety of shutters on the market, almost every manufacturer having a different style, but the object attained in all cases is the same;

simply a device for admitting light through the lens to make the exposure.

The shutters on simple hand cameras are usually operated by pushing a button, and on the folding hand cameras the same result is obtained by the more convenient method of squeezing a rubber bulb. A shutter operated by a bulb is said to have pneumatic release, and this method of operating the shutter is not only very convenient in all cases but is particularly desirable when making time exposures as the danger of spoiling the picture by jarring the camera is avoided.



CONLEY AUTOMATIC SHUTTER.

The Conley Automatic Shutter, which we show in our illustration, is one of the latest and most complete shutters now made, being provided with Iris diaphragms and giving, with one pressure of the bulb, automatic exposures of from 1-100th of a second to a full second, or, by two pressures, time exposures of any desired length. The shutter of an ordinary hand camera should be as simple in construction as possible, to avoid the danger of becoming out of order, and should be arranged to give either time or instantaneous exposures, and, if possible, should be automatic to the extent of resetting itself after each exposure, so that it will always be ready for business.

Care of Shutters

Shutters are rather delicate pieces of apparatus and must be handled with due care. Even the very best of them, owing to the more or less complicated mechanism and the delicacy of the various adjustments, is liable to become out of order. When a shutter gets out of order it is almost invariably best to return it immediately to the maker without attempting any repair work on it. Even a good mechanic, unless he has had actual experience in the repairing of shutters, is very apt to do one of these instruments more harm than good.

Never put oil on any part of the shutter. At first thought it may seem unreasonable not to oil a piece of mechanism when it fails to work freely. It seems natural to suppose that oil will make any mechanism work more smoothly and freely, but oil produces quite the opposite effect when applied to a photographic shutter. Among the most important parts of a shutter are the pumps, sometimes

spoken of as the valves. If oil is applied to the pump of a shutter it makes the pump practically airtight and completely prevents it from working. If oil is applied to the inner mechanism of the shutter it will within a short time inevitably reach the thin hard rubber wings, and as soon as these two wings have a little film of oil on them they adhere tightly together and the shutter cannot be operated until it is taken all apart and every trace of oil carefully and laboriously wiped off each individual piece.

Once more we caution every user of a camera not to put any oil of any kind on any part of the shutter. It cannot possibly do any good and is almost certain to do great damage. The inside mechanism of the shutter is properly lubricated with a graphite lubricator when the shutter is made, and it is very seldom necessary, at least not until the shutter has been in use several years, to apply any further lubricant of any kind, but when it is necessary to lubricate the shutter nothing should be used but the best graphite lubricator. If the valves or pistons stick in the pumps and fail to work smoothly, the pistons should be removed and carefully cleaned or polished with a cloth and a little rouge. If the pistons are much corroded it may be necessary to polish them on a buffing wheel, but care must be exercised not to scratch them, as they must fit very perfectly and nearly, but not quite, airtight. After polishing them a very small amount of graphite may be applied as a lubricant. The easiest way to do this is to simply rub the pistons a little with the lead of a soft lead pencil. Just make a few marks on them with a soft lead pencil, and this will put enough graphite on to make them work smoothly. Do not oil the shutter.

CHAPTER III.

ADJUSTMENTS OF CAMERAS AND HOW USED.

Box cameras are provided with no adjustments whatever, aside from the shutter, so this chapter will be of interest only to those having folding or view cameras, or to those who contemplate purchasing such cameras later.

The adjustments most commonly in use are the vertical swing, the side swing, the rising and falling front, the sliding front, the rack and pinion focus movement and the reversible back.

The Vertical Swing

The most important adjustment of a camera is the Vertical Swing, or swing back, as it is frequently called.

In Fig. 1 we illustrate a camera tilted upward, as is frequently necessary when photographing buildings, and it will be noted that the back of the camera has been swung forward, so that it is still in a perfectly vertical position, that is, straight up and down. In Fig. 2 we show the camera pointed downward with the vertical swing again brought into play, so that the back is still perfectly straight up and down.

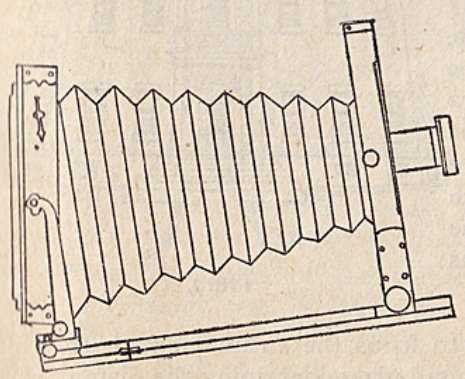


FIG. 1.

When a camera is provided with vertical swing only, and not the side swing, it is said to be single swing.

Sometimes in photographing a building it is necessary to tilt the front of the camera up in order to get all the building on the plate, and if the camera is not provided with a swing back, you get a distorted picture, as shown in Fig. 3; the sides of the building converging toward the top. If provided with a swing back, this difficulty may be entirely avoided, as, no matter how the camera is tilted, the back can be adjusted until it is perfectly straight up and down, that is, parallel with the building, and the picture will then be without distortion.

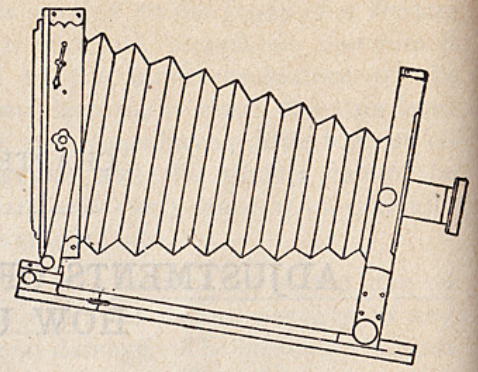


FIG. 2.

The Side Swing

The Side Swing is an adjustment of the camera, whereby the back may be swung sidewise, that is, either one side or the other brought closer to the lens.

Fig. 4 is a top view of a camera, showing the back swung to one side, thus illustrating the movement known as side swing

Sometimes in photographing a landscape, or more especially when photographing street scenes, one side of the picture will be very much closer to the camera than the other. In such cases it becomes difficult to focus the entire view sharply, as when the near part is sharply focused, the distant part will be out of focus and vice versa.

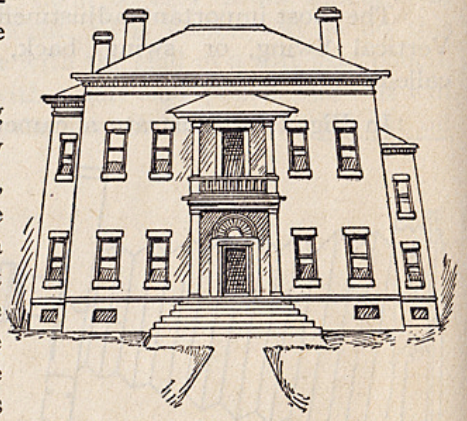


FIG. 3.

The side swing enables us to focus the entire view sharply, as we can bring that side of the ground glass containing the distant part of the view a little closer to the lens. The side swing is frequently valuable when photographing interiors, as one side of the view is very apt to be closer to the camera than the other.

The Double Swing

When a camera is provided with only one swing it is always the vertical swing and the camera is spoken of as single swing. If it has both the vertical swing and the side swing it is called double swing.

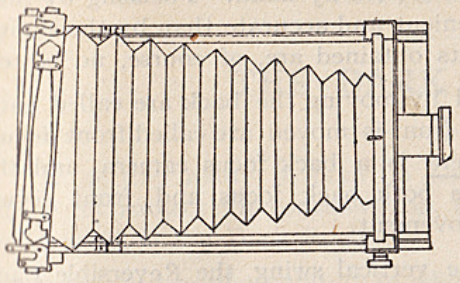


FIG. 4.

The vertical swing is very much more frequently used than the side swing, and many photographers consider the vertical swing sufficient for all ordinary purposes. A double swing camera, however, is very convenient at times, particularly in architectural work, interiors, and the photographing of small articles, such as merchandise, etc., where considerable maneuvering is sometimes necessary in order to get the subject exactly true on the plate.

The Rising and Falling Front

The rising and falling front is an adjustment which permits the front of the camera carrying the lens to be moved up and down, as shown by the dotted lines in Fig. 5. When the front of the camera is raised or lowered in this manner, the picture on the ground glass moves with it, and as the camera itself remains level, the picture is not distorted, and the arrangement of the camera, which may have been carefully leveled up, is not disturbed. The rising and falling front also enables the operator to regulate the relative amount of sky and foreground, upon which the artistic appearance of a picture frequently depends.

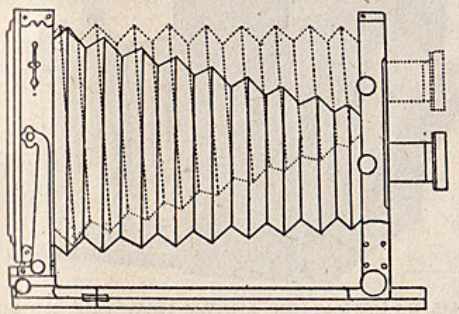


FIG. 5.

The Sliding Front

This movement of the camera front, while not a very important one, is at times very convenient. It enables the operator to move the front from side to side, and, just as with the rising and falling front, the picture on the ground glass moves with it. In this way objects on either one side or the other of the view may be included or excluded without disturbing the camera.

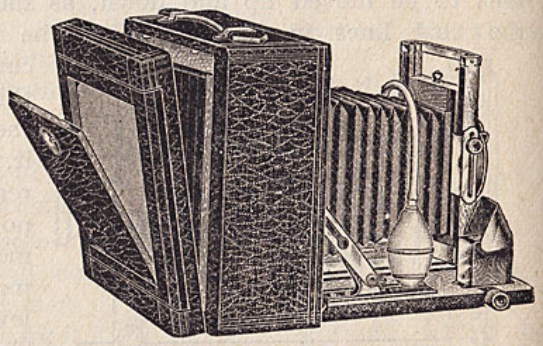
The Rack and Pinion Focus Movement

The Rack and Pinion Focus Movement is a device to afford a convenient means of focusing, the operation being accomplished by turning a milled head screw, instead of sliding the front or back of the camera by hand. Focusing by rack and pinion is much more convenient and accurate than by the sliding movement, although the results obtained are, of course, no better.

Cameras which are focused by moving the back are called back focus, and those in which the front is moved are called front focus. The Conley No. 2 View Camera is a back focus camera, and the Conley No. 1 View Camera is both back focus and front focus, with rack and pinion focus movement.

The Reversible Back

Next to the vertical swing, the Reversible Back is one of the most desirable adjustments with which cameras are provided. Nearly all cameras take pictures which are longer one way than the other, the most common sizes being 4x5, 5x7, 6½x8½ and 8x10. As ordinarily used, the picture is taken the long way of the plate. For example, in the 5x7 size the picture is 7 inches wide and 5 inches high.



THIS ILLUSTRATION SHOWS HOW THE REVERSIBLE BACK IS DETACHED WHEN CHANGING THE CAMERA FROM HORIZONTAL TO VERTICAL PICTURES.

It is frequently desirable, however, to make the picture the other way of the plate; that is (again taking the 5x7 as an example), 5 inches wide and 7 inches high, and it is in making this change, from horizontal to vertical views, that the reversible back is brought into use. The back of a camera is that part of the camera into which the plate holder is inserted, and a reversible back is one which is detachable from the camera and so made that it will fit in either a vertical or horizontal position. This enables the operator to change quickly from vertical to horizontal pictures, or vice versa, without disturbing the adjustment of the camera.

CHAPTER IV.

THE DARK ROOM.

In getting ready to take up photography, the first and most important subject for consideration, aside from the selection of the outfit itself, is the Dark Room.

Any work in photography in which it is necessary to handle dry plates, whether it be merely loading the holders or developing the plates, must be done in a perfectly dark room, lighted only by a ruby lamp. Any room which can be made perfectly dark will answer, but a closet with no windows and only one door will usually be found the easiest to make perfectly dark. An ordinary room, with the doors closed and the curtains down, although apparently quite dark, will not do for photographic work, as the light streaming in through cracks in the door or elsewhere will instantly ruin the plates. The room must be absolutely dark. At night an ordinary room may be made dark enough by closing the doors and drawing the curtains; but, even then, care must be taken to see that moonlight or light from street lamps does not get in, as it takes very little white light to ruin the plates.

Method of Lighting the Dark Room

We must, however, have some means of lighting the dark room sufficiently to see what we are doing, and, fortunately, the dry plate is only very slightly sensitive to red or yellow light, so what is known as a ruby lamp, or dark room lantern, is used. This is simply a lamp or lantern provided with a deep red or ruby glass, and made perfectly tight so that no white light can get out. Light which affects the dry plate is called actinic, and light which does not affect the dry plate is called non-actinic. Both red and yellow light are practically non-actinic, therefore either a red or yellow glass is used in the dark room lantern, or sometimes both red and yellow, which is better still. It must be remembered, however, that there is no such thing as light which is absolutely non-actinic. Even the red and yellow light affects the plate slightly and, therefore, care must be