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THE LEICA MANUAL

A Manual for the Amateur and Professional Covering the Field of Miniature Camera Photography

by WILLARD D. MORGAN

Contributions Editor
Life Magazine . . . .

HENRY M. LESTER

Cinephotographer

and Contributors

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of chapters, and the many friends working with the miniature camera who have submitted photographs and helped to formulate the scope of this Manual.

Barbara Morgan

for planning typographical arrangement

Ruth Lester

for collaboration in the editing of the volume.

Heavy on the Bass — Paul Bradley II

Elmar 50mm lens, 1/100 sec., f:9, Agfa Superpan Film

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Montage Barbara Morgan

THE LEICA COMES OF AGE

MANUEL KOMROFF

The age of the old "woolly" salon print is over. Is it possible that this sweet, soft, mushy bit of sentiment is now in the scrap-heap? Yes, it is gone forever. Perhaps some old boy clinging to the dear old horse-hair past will still reach down and drag out from under the bed a few mussy examples of "pictorial art" to show you. But do not laugh. In the presence of death you should be respectful. And the death of an ideal takes longer than the death of a man. Sentiment dies hard. And while we may still occasionally see examples of the fuzzy salon print they are growing rarer and their day is definitely over.

How is one to account for the rapid decline and death of a whole school of photography, a school that held sway for so long and during the most important time in the development of photography? Was it killed from the outside or was it poisoned from the inside? What were the main factors that led to so definite a revolt?

I believe that there were two main factors that hastened the advent of modern photography. The first of these was a decided change of the times that followed immediately after the war. Modern art had come into its own, modern architecture was announcing a new shell for the new life as different as the skyscraper was from the classical Gothic cathedral. Automobiles that had been built on vertical lines were dropped low and streamlined on the horizontal, in the kitchen we threw out the old agate ware, in the bathroom chromium and showers became the order, in the bedroom the lace curtains were discarded, color was added to the living room and murals to the nursery. Radio replaced the old phonograph, modern movies—the old melo-drama, sunshine and vitamins—the old brown school of medicine, and as for women:—the hand that rocked the cradle now steers the car and the old modest blush now became frank rouge with lips that smoked a cigarette on the street.

Yes, life changed quite quickly. And as life changed the surroundings changed. Values were different and meanings different. Ten million men dead in a war that reached no victory and no conclusion could not help but change the lives of those who survived. And this surely was one of the factors that did away with the old school of photography.

The other factor was a piece of engineering. A small camera was introduced to the world in the year 1925. To many of the old photographers it looked like a toy designed for a lady's handbag. But on closer examination it bore all the evidence of a keen precision instrument designed and manufactured by the ablest technicians of a world-famous microscope company. It had certain important innovations. It used a long strip of motion picture film, it could take pictures in rapid succession, and it borrowed from the war the range finder which did away with the guess focusing of the old ground glass. A great scope of shutter speeds and extra rapid crystal sharp lenses together with its size and ease of manipulation made this camera into an instrument of modern expression that dealt the final blow to the old "imitation art" school of photography. This camera was the Leica!

Amateurs welcomed the Leica with open arms and their results were far from disappointing. Professionals, a little slower to give up their well tried boxes and methods, soon realized that this instrument opened up a new photographic vista and here at last was a definite extension of the pictorial horizon. Many who had picked up the Leica as a possible handy accessory to their great battery of equipment found in a year or two that they had definitely abandoned the large expensive sizes and were working exclusively with the miniature Leica. And not only did they find that the Leica was capable of doing much that the old view plate box was capable of doing but that it could do many things that the large camera could never do. It was possible to get pictures quickly in court rooms, in the dark of the theatre, at night on the street, a bird in its flight and a thousand and one more frozen and revealing records of our rapidly passing American scene. Speed and frankness are a characteristic of our time. The Leica with its freedom of expression became, almost overnight, the pocket note book of passing events.

As time changed photography felt the need for change. The Leica made that change possible. Modern photography was born through necessity. And the instrument was put forward to make possible and record the new, the immediate, the complex and varied life of our time. Look at the pictures. They tell the story. Words seem inadequate and unnecessary. Reading is a difficult fatiguing task. A thousand words will often tell much less than a single photograph. And the ease with which this is captured has opened a new means of expression to many. A single press of the button and that whole complicated network of reality is trapped and recorded on a strip of celluloid. The record is complete and permanent. What the eye has failed to see it has captured and what the memory might forget it remembers.

It is no wonder that in the dozen years that have passed since 1925 the miniature principle put forward by Oscar Barnack, the inventor of the Leica, has taken so strong a hold on the public. It is this invention that has made possible the new photography.

But before we press the button we might remember that the two characteristic inventions of our age have been telegraphy and photography. From the telegraph grew the telephone, wireless, and radio. From photography grew an age of bad portraiture, silly snapshots, and vulgar movies. Realism, that stark naked child of our century, fared much better with the electrical inventions. The optical inventions retained a hang-over from our dreamy romantic age.

Boatmen — Charles R. Frazier

Photographs were made soft and sweet. A bad school of sentimental photography held the stage for several generations. Perhaps the reason for this is the fact that art is much more conservative than science. A false notion in the mind of man can often be altered by a single experiment, but his aesthetic sense, controlled mainly by his emotions, is slow and difficult to change. Photography, although most startling at first, was very slow to take its proper place in our realistic age.

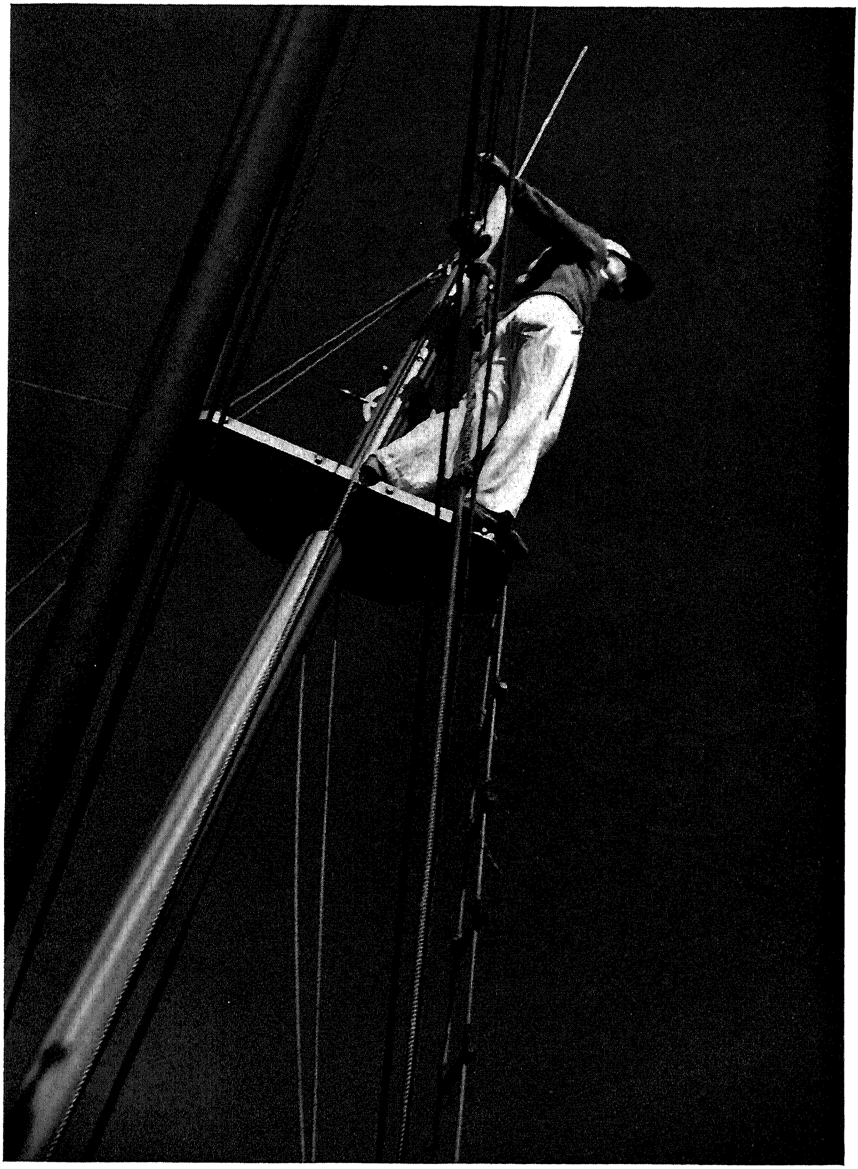
In painting, the revolt against sentiment and tradition occurred many years ago. Impressionism came like a blast and recorded a new emotional sense; one which was more harmonious with our age. And long before impressionism and our present-day school of candid-camera photography, distinguished artists used the hard facts of reality as a subject for their art. Daumier, Goya, Gavarni, Courbet, and Delacroix were only a few of the distinguished names. Somehow or other it took many years for photography to see the world in the light of these artists. It was stupidly slow.

A new photography is not born as the result of a new device or invention. A new photography comes into being through a new view point, through a new angle of life and through a philosophy that is different. It is the instrument that follows the thought and it is the need that creates the machine.

But a new instrument at once demands a different handling and new methods of photographic manipulation must be devised to meet new problems. A strip of modern miniature film five feet long cannot be developed very easily in the old plate tray. Neither can the old fashioned borax developer be effectively used on a negative that is not much larger than a postage stamp and make it stand a severe enlargement.

Ingenuity and invention however has not been lacking. For each month during the past ten years some little progress has been made and something new has been brought forward. And this volume, THE LEICA MANUAL, is the compiled synthesis and full record of this photographic innovation and progress. It is more; it is a one volume encyclopedia filled solid with information tested through the exacting laboratory of experience. No secrets are withheld. And nothing that has been found useful for the amateur or the professional has been omitted.

Intricate subjects, such as the chapter on optics, have been presented in this volume in a simple and informative manner so that the Leica photographer may be better acquainted with the lenses that



The Lookout Rudolf H. Hoffmann

Elmar 90mm, 1/60 sec., f:9, No. 2 Filter, Du Pont Superior Film he is using. The developing formulas and processes are the very latest and best that the laboratories have brought forward. Many of these have been revised and several new ones added for this edition. And many of the other chapters also have been brought up to the last minute all with a single object in view, to make this volume the full and complete unabridged companion and guide to the new photography. The technique and principles described in the pages of this book embrace all cameras in the miniature field.

This book is the result of invention, research and experience all carefully organized, tabulated and compiled. Many men and the work of many years are here presented for those interested in the practice of the new photography. The information is accurate and you may safely follow any advice given with the promise that your pictures will at once be better.

It will be noted that only standard formulas and thoroughly tested procedures have been included. There are many ephemeral processes and formulas which catch the interest of miniature camera workers every year, their popularity however being short lived. For lack of intrinsic merit they become soon forgotten. As this book goes to press there is no new technique or formula available which supersedes in merit and practicability the material already included.

This volume has been made possible by a fortunate combination of editors. Willard D. Morgan had been for many years head of the Leica division of E. Leitz, Inc. New York as well as founder and editor of ''Leica Photography.'' He has seen the ''toy'' grow into the little giant of photography. And what is more he has seen it from the inside. Questions and problems came to him daily from many parts of this country and from many outside countries. And the answers to all are contained in these pages. And today as one of the picture editors of Life Magazine he continues to add to this latest edition the results of his new photographic experience.

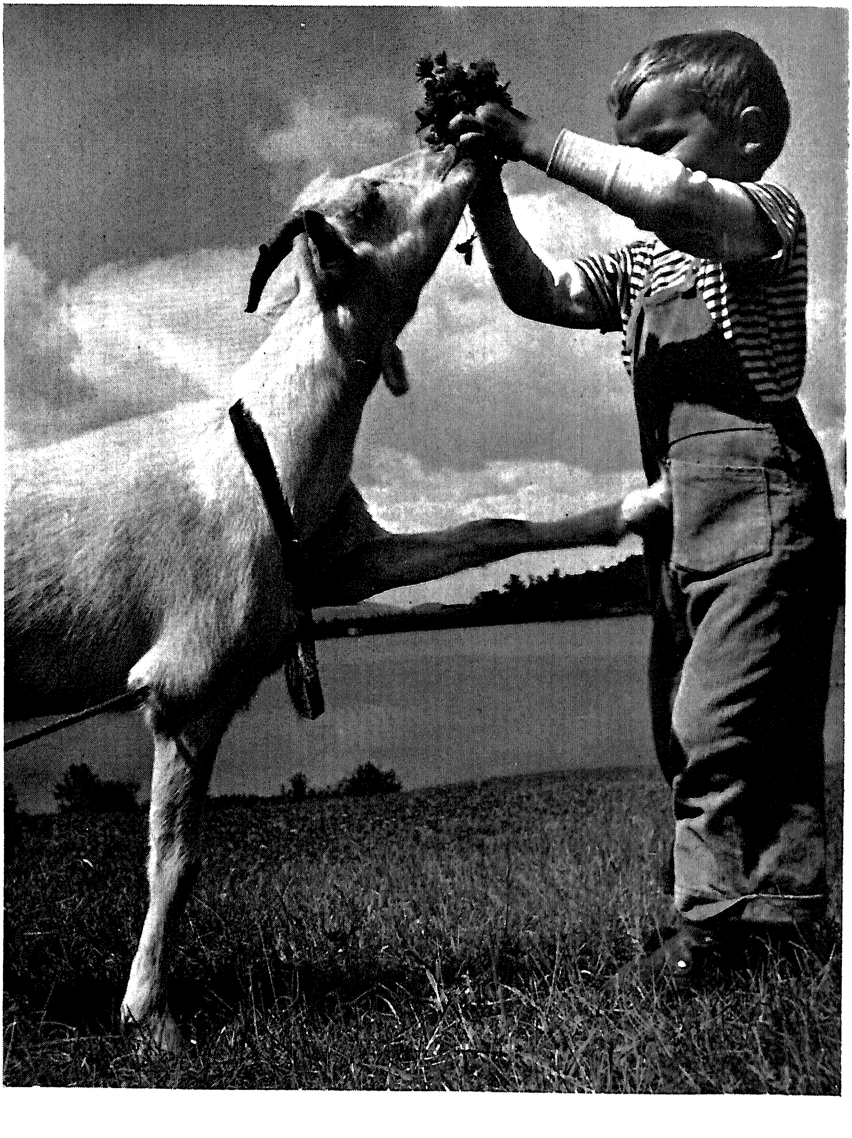
Henry M. Lester who was at one time instructor of miniature photography in the Brooklyn Institute of Arts and Sciences has served an apprenticeship of many long years in the laboratory and as a professional photographer. He was one of the very first in America to see the unique and practical side of the Leica and to use it successfully in direct competition with the commercial studios. He has taken hundreds of pictures in operating rooms of hospitals, in factories and in the broad field of general photography. As most of his work was done for visual instruction or for reproduction his methods had to be certain and his results sharp. And every shred of his varied and full experience has been woven into these pages.

Both these men have been long exposed and developed to the new photography from its very beginning. And here is the printed result. Turn the pages over casually and you will see at a glance that the combination has been a happy one. The contributors of the special chapters are all recognized experts in the field in which they write.

Do not be afraid of the many attachments that are described for the Leica. It is necessary that this volume should be as complete as possible for each attachment has its special use, and some day you may require one or more for some special photographic work. The Leica camera with a 50mm lens, a good exposure meter and a strip of fine grain film are all you need to start with. You will find this minimum of equipment sufficient to make all the pictures in the general field of photography. But a thorough understanding of the basic principles and the latest methods of handling are essential and this volume has been designed for that purpose.

A chapter by Anton F. Bauman is included for the purpose of giving a new Leica photographer a definite perspective upon which to get his bearings before reading the other parts of the LEICA MANUAL. By being carried through the actual work and technique of one photographer the reader will find specific information which he can use immediately. The reading of this chapter too will arouse many other questions which are more fully answered throughout the book. For these reasons it is suggested that this chapter be read first before delving into the matter deeper.

To make the book as complete as possible the editors have included some very special chapters such as Eye Photography, Dental, Photomurals and Aerial Photography. The person interested in general photography may never be required to employ any of the techniques described in these chapters but a careful reading of these specialized pages will disclose a good deal of information that is certain to increase the reader's photographic knowledge and prove of great value to him at some future time. Better pictures are not made by people who know less but by those who know more. As your photographic knowledge increases so will the horizon of your vision expand and your photographs will bare the evidence of this enrichment.



Feeding Time

Elmar 35mm, 1/60 sec., f:9, Green Filter, Du Pont Superior

Willard D. Morgan

LEICA AND ITS AUXILIARY EQUIPMENT

WILLARD D. MORGAN **CHAPTER I**

When we first look at the Leica camera many questions naturally arise regarding its construction, operation, and results which may be expected from its use. Such a small camera as the Leica requires a special technique which is different from other cameras. After all, any camera consists of a lens and a light-tight box containing the film. From this basic principle many cameras have been developed, incorporating hundreds of different special features which tend to make the operation of the camera more easily adapted to special uses.

In the case of the Leica, an entirely new photographic field was entered with such a radical change in camera design that immediately many old habits had to be revised in order to understand the possibilities of miniature camera work. The Leica camera required the use of 35mm motion picture film, the use of fine grain developers, an appreciation of the value of short focal length lenses and their possibilities in securing photographs which were radically different.

As the Leica camera was developed through the various successive stages from the early Model A to the Models B, C, D, E, F and the present Model G with shutter speeds from 1 to 1/1000 second there naturally developed a tremendous interest and demand for information bearing on miniature camera work. Such information assisted in helping all miniature camera users to band together and work in this new photographic field. In fact, many people using the Leica camera actually belong to a fraternity by themselves. Evidence of this fact is to be seen in the numerous miniature camera clubs which have recently been formed as well as the personal interest among small camera users, and the large amount of space given to miniature cameras in the photographic magazines.

In developing the technique of miniature photography, it has been necessary to do considerable experimental work and also produce many written articles covering the important phases of this type of photography which requires a technique unfamiliar to the average person occasionally using a box camera. Naturally, the users of other than miniature cameras may be confused upon their first introduction to the possibilities of miniature camera photography. They will hear discussions about this and that highly corrected lens, resolving power, circle of confusion, depth of focus. various different orthochromatic and panchromatic films with their advantages and demerits. The religion of fine grain will be ever uppermost.

Although the people who are actually using the miniature camera are deriving immense pleasure from their particular work, it may be that the outsider will look upon such a field as a chaotic world. Miniature camera users will talk about enlarging negatives the size of a postage stamp up to 16 x 20 inches or more. While many workers in this field enjoy the experimental angle, **it is true that over 90% of the miniature camera users are interested in simply producing good photographs.** Most of us make our Leica enlargements either the postcard size or the 5 x 7 inch size. Beyond this size, we enter the field of salon prints or enlargements which may be used for mounting and hanging in the home.

For example, a Leica user in Indiana writes the following after talking with one of the uninitiated miniature camera users:

"About 90% of the camera users of today are not interested in wonders. They do not possess the skill of the expert. They are interested in a camera that will perform well in the hands of the ordinary man in the street, the man who is willing to pay the price of a good camera but lacks the skill of an expert. Does the Leica meet this condition? My opinion is that it surely does."

What to Photograph with a Leica

Photographing with a Leica can be one of the simplest and most effective means of making a perfect negative. On the other hand a Leica user can become so involved with his camera, accessories, and a multitude of ideas about miniature camera photography that he may lose sight of the original idea behind the Leica. **The Leica was produced to simplify photography and make the actual use of this camera so convenient that it would be indispensable.** After all why not use our Leica camera functionally and become familiar with the many intriguing uses to which this camera may be applied.

Before starting to take pictures with our Leica let's stop a moment and become familiar with the photographic possibilities open to the miniature camera user.

1. Because of the small size of the Leica it can be concealed in the pocket and later used for making pictures in practically any place where there is sufficient light to make an exposure. You may catch the unposed positions of people in a railroad waiting room, or the information clerk carefully explaining some route to a customer. The theater, night club, public gatherings, street scenes, and everywhere people meet there will be pictures for the Leica user to make. Such photographs tell their own story, and show in a moment that the photographer must have had a miniature camera and worked quickly in order to make the exposure.
2. Use the Leica for making twenty or thirty successive portraits of the same person and thus catch a more complete interpretation of character. These views will portray a wide range of interesting expressions instead of the usual one-view portraits which are made with the larger cameras.
3. This same idea of making sequence pictures can be used for photographing children who are forever scampering about. Catch these colorful expressions of the youngsters and arrange the resulting pictures in an attractive series in your album.
4. When traveling with the Leica you will find that it is easier to take many more than the ordinary number of pictures and thus give a more complete record of your trip. With the cost of film so small there is no reason why many hundreds of interesting pictures cannot be obtained, even on a short trip of only a few days.
5. At the horse races, athletic events, yacht races, and other similar events the Leica will fit into the occasion without being in the way and thus take the edge off an otherwise glorious time.

There are naturally many other uses for the Leica. One of the pleasures of owning this camera is to discover some of these uses for oneself and thus satisfy one's creative instincts in producing something a little different from "the boys with the big cameras." In this book the writers have endeavored to present their photographic methods as well as to convey some of the pleasures to those who are seeking new discoveries and a more complete understanding of miniature camera photography. To begin with, let's start with the equipment itself.

Know Your Leica

As the Leica has been constructed quite differently from most cameras we should become more familiar with the important working parts. Let's take a Leica in our hands and look at it . . . wind and release the shutter . . . set the speed dial at various stops . . . pull the lens barrel out and lock it by a slight turn to the right . . . turn the focusing mount of the lens and watch the images move out of focus or into focus through the range finder which is coupled with the lens . . . open and close the iris diaphragm of the lens . . . study the depth of focus scale at the base of the lens mount . . . try the slow shutter speeds on the Model F or G Leicas . . . move the counting dial to zero after winding the shutter . . . move the small lever between the winding knob and the time setting dial to **R** or reverse . . . pull up and turn the rewind knob, then push it back into position and change the lever back to **A** or advance . . . adjust the compensating eyepiece of the range finder for distances under 15 feet . . . open the baseplate . . . remove the take up spool and film magazine . . . try loading and unloading several times before replacing the baseplate . . . then go back to winding and clicking the shutter, and at the same time focus on actual objects and imagine that you are making actual pictures.

All this may at first seem complicated but once you have gone through this routine the actual operation of the Leica will seem extremely simple. You will become familiar with a new type of camera which has been built to eliminate the usual amateur photographic troubles, such as double exposures, out of focus pictures, under-exposures because of slow lenses or failure to stop rapid motion because of slow shutter speeds.

To make Leica pictures it is not necessary to own the very latest model camera with all the interchangeable lenses, filters, cases, and a hundred other accessories which could be used. No, all this equipment is for those who can afford it and also for use when they have advanced to the point where more specialized photography is required with the Leica.

Fig. 5 Leica Model F or G Equipped with 50mm f:2 Summar lens. Model G Available in Chrome Finish Only

Your Beginning Leica Equipment

All you need as a beginning Leica user is: a Leica camera equipped with one of the 50mm lenses, an exposure meter, and several rolls of film. With this outfit you can take thousands of excellent pictures and never miss the use of additional accessories. Many fine pictures are still being made with the early Leica Models A and C. The basic idea of the Leica has never changed since the day it was first introduced to the public in 1924. Therefore it is unnecessary to be disturbed by the haunting thought that it takes a fortune to operate a Leica. On the contrary, once the camera is purchased the operation cost is drastically cut when compared to the larger cameras.

How to Make Your First Leica Picture

When preparing to make your first Leica picture there are a few important points to observe as follows:

1. Place the film magazine containing the unexposed film into the camera after removing the base plate and take up spool. Figure shows the position of the film when properly loaded.

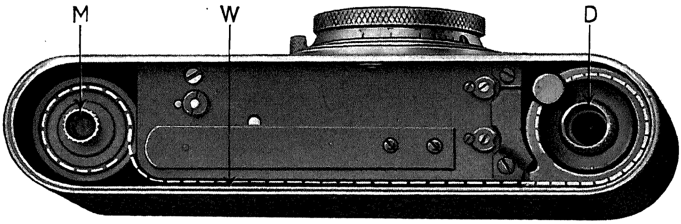


Fig. 6 Dotted Line Shows Correct Position of Film when loaded in the Leica camera. M—Take up Spool, W—Film, D—Film Magazine

2. Check to make certain that the reversing lever, located between the winding knob and the speed dial, is at **A** or advance. (This lever is moved over to **R** after all the exposures have been made and the film is to be rewound into the original magazine.)
3. Turn the winding knob and click the shutter twice in order to pass the film which was exposed to light while loading. Then wind the shutter a third time and also set the counting dial at picture number one opposite the small arrow. If preferred the counting dial can be set at zero after the second wind of the shutter. Then after the shutter has been released the camera is ready for making pictures.

   Each time the shutter winding knob is turned, when there is film in the camera, the rewinding knob turns in a reverse direction (counterclockwise), thus indicating that the film is properly passing to the next exposure. If this is not the case the film leader should be wound back off the take-up spool and the film reloaded into the camera.

4. Determine the correct exposure with the Leicameter, or any other reliable meter.
5. Set the shutter speed on the dial by slightly lifting and turning to the proper position required. Before setting the shutter speed turn the winding knob one complete turn. In the case of the Model F or G Leicas the slow speed dial is set at any desired stop between 1 second and 1/20th of a second after the top dial has been set at 20-1 which represents 1/20th to 1 full second on the slow speed dial. When 1/20th is to be used on the Models F or G set both dials at the figure 20.
6. **Pull out the lens barrel and lock it into position by a slight turn to the right,** in case one of the 50mm lenses is in use.
7. Set the iris diaphragm to the proper opening which has already been determined by using the exposure meter.
8. Secure exact focus by looking through the range finder eyepiece and at the same time rotate the lens barrel back and forth until the two images coincide. (The earlier Models A, C, and E Leica

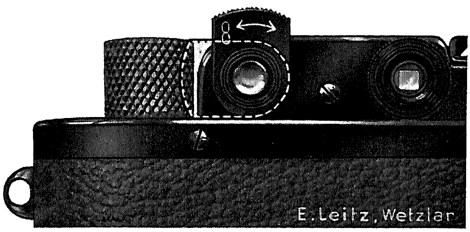


Fig. 7 Rear View of Range Finder and View Finder. Note Magnifying Eyepiece on Range Finder Adjustable for Sharp Focus on Near Objects under 15 Feet When in Upright Position

cameras do not have the built-in range finder with automatic lens coupling as in the later models. However these earlier models may be converted to a later model, or a separate range finder may be used for determining the distances.) When only one image is seen through the range finder the subject is in exact focus. Shift the eye to the right (when holding the camera horizontally) and compose the picture through the viewfinder. When you are ready to make the picture, press the release button gradually and thus make the exposure. **You have now taken your first Leica picture!**
9. Keep on taking pictures until you have used up the entire roll of 36 exposures. Try various shutter speds, outdoor and indoor views. Place your Leica in its case or in your pocket, then see how fast you can whip it into action and at the same time **remember the points which are essential for making a picture.**

1. Determine the exposure
2. Pull out and lock the lens in position
3. Set the lens diaphragm stop
4. Turn the shutter winding knob one complete turn
5. Set the shutter speed dial
6. Look through range finder and determine focus
7. Shift your eye to the view finder and compose picture
8. Gradually press the shutter release button and make the exposure.

10. **Caution** . . . When pressing the release button with the forefinger avoid jerking the camera by abruptly pushing the release. Instead, hold the finger on the release and gradually squeeze the button down, similar to the gradual trigger squeeze which is so essential to accurate shooting with a gun. Place thumb of right hand under the base plate to counteract the downward action of the forefinger. Wherever possible it is best to use shutter speeds of 1/40th or 1/60th of a second or faster when the camera is held in the hands, in order to avoid any possible motion during exposure.
11. When you reach the end of the film-roll the shutter winding knob will not turn . . . **don't force it** and try to squeeze another exposure onto the film. Instead, just move the reversing lever to **R** and rewind all the film back into the film chamber. The base of the release button will turn during this procedure and will stop the moment the film pulls away from the take up spool in the camera. The film magazine may be removed from the camera after the winding has been completed and the reversing lever moved back to **A** or advance.
12. Each time the shutter winding knob is turned, when there is film in the camera, the rewinding knob turns in a reverse direction (counterclockwise), thus indicating that the film is properly passing to the next exposure.

Loading the Leica Film Magazine

The Standard Leica Film Magazine, sometimes referred to as model B, has been constructed to hold about 5¼ feet of 35mm cine film which is sufficient to make up to 36 double frame exposures, 24 by 36mm in size. This cylindrical magazine contains three parts: the outer shell $\mathbf{B^1}$, the inner shell $\mathbf{B^2}$, and the center spool $\mathbf{B^3}$. The guide groove on the inner shell and the pin inside the outer shell opposite the safety spring, assists in opening and closing the film magazine.

To assemble the magazine first insert the center film spool into the inner shell with the tip of the film in the opening of the spool chamber. It is a good plan to bend back the tip end of the film in order to make it easier to pull the film out of the magazine, and also to prevent the film from drawing back into the magazine before loading into the camera. Next, introduce the inner shell with spool into the outer shell with both rectangular openings together and open. When the inner shell comes to a stop turn it to the left or anti-clockwise until the safety spring clicks into the locked position. Before the chamber is closed pull the film out several inches. The film magazine can only be opened after the safety spring has been slightly lifted and the inner shell turned to the left or clockwise. The inner shell is then withdrawn and the film removed either in the daylight or in the darkroom, depending upon the film packing used.

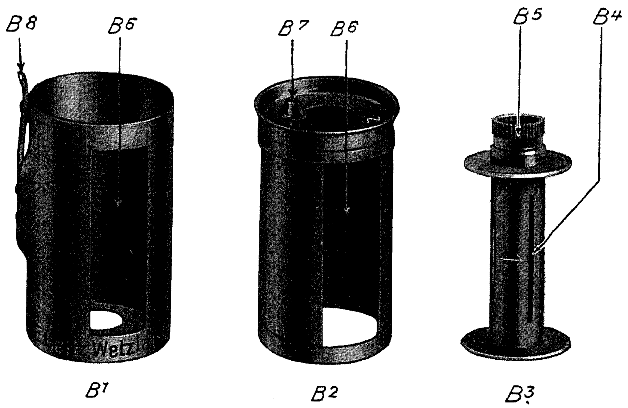
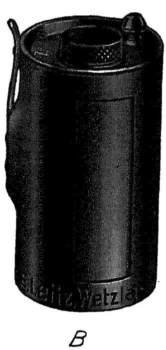


Fig. 8 The Model B Leica Film Magazine



B = Complete Spool Chamber Model B

B1 = Outer Shell

B2 = Inner Shell

B3 = Center Spool

B4 = Slot of Center Spool

B5 = Milled Knob of Center Spool

B6 = Slots of Spool Chamber

B7 = Knob of Spool Chamber

B8 = Safety Spring

The Outside Parts of the Models F and G Leica Cameras

1. **Winding knob**...one complete turn winds shutter, advances film to the next picture, and registers one count on the dial 7 at base of knob.
2. **Shutter release button**...with protective bushing which may be unscrewed and a Wire Release screwed over the release button.
3. **Shutter speed dial**...for setting speeds from 1/20th to 1/500th of a second and time exposure. Dial 10 is used for setting the slower speeds between 1/20th and 1 second. Winding knob 1 must be wound one complete turn before setting speed dial. Once this dial is set it need not be changed for successive exposures unless the shutter speed is to be changed. Leica Model G has an additional shutter speed of 1/1000th of a second.
4. **Clip**...for holding Universal View Finder, Stereo Attachment, Level, Reflecting View Finder, Angle View Finder, and other attachments. A small engraved arrow on one flange of this clip indicates the shutter settings.
5. **Built-in range finder**...which has an interior mechanism connecting with the lens mount for determining correct distances and focus.
6. **Rewinding knob**...which is pulled up and turned to rewind the exposed film back into the film magazine.
7. **Counting dial** ..which automatically records each photograph taken. On this counting dial there are two small lugs used for turning the dial, anti-clockwise and against the direction of the arrow on the winding knob, to the zero mark.

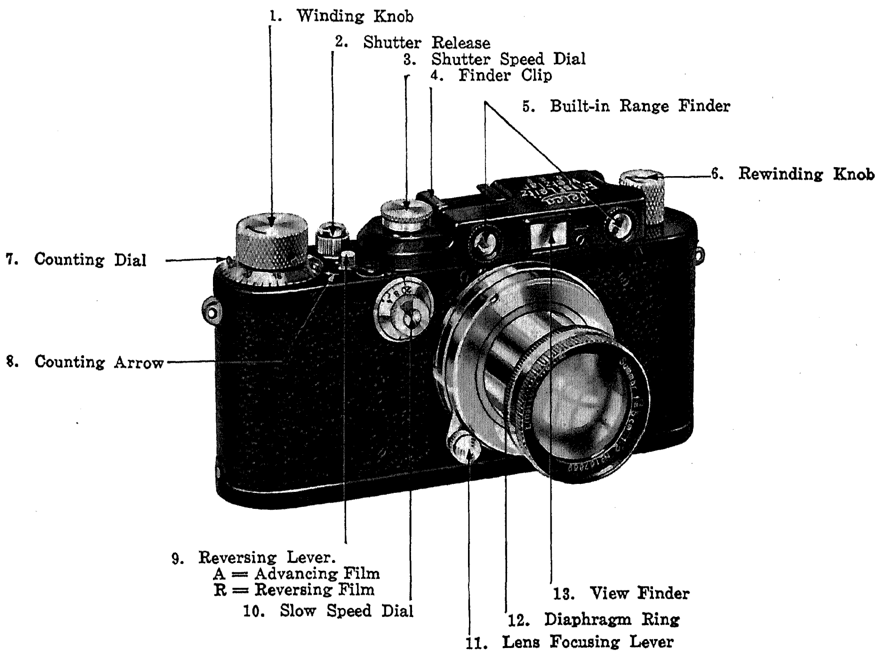


Fig. 9 Outside Parts of the Leica Camera

8. **Counting arrow**...indicating the number of photographs taken.
9. **Reversing Lever**...which disengages the automatic coupling of film advance and shutter mechanism when the exposed film is to be rewound back into the film magazine. When this lever is set at R it operates somewhat similarly to a clutch on an automobile by disconnecting the camera mechanism. Keep the lever at A while making exposures.
10. **Slow shutter speed dial**...which turns to change the shutter speeds between 1/20th and 1 full second. There is also a time exposure setting on this dial. Speeds between 1 second and 1/8 second are continuous.
11. **Lens focusing lever**...which is pressed, to release the lens mount from the infinity setting, and moved back and forth while the eye looks through the range finder until the double image of an object comes into focus and only one image is to be seen.
12. **Knurled diaphragm ring**...with diaphragm markings which is turned for setting the proper lens opening in the Summar f:2 lens. The 50mm Elmar and Hektor lenses have the diaphragm settings on the front of the lens mount.
13. **View Finder**...which includes the full area of the image registered by the 50mm lenses. The Universal View Finder covers the picture areas of the other Leica lenses.

The Interior Mechanism of the Leica

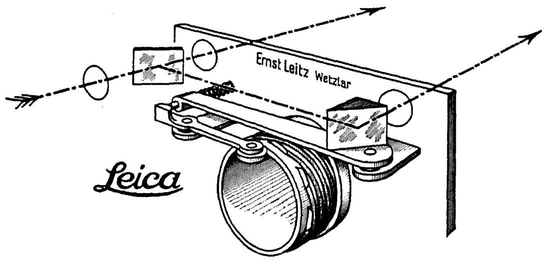


Fig. 10 Diagrammatical view of the Leica short base built-in range finder.

The two arrows point toward the object which will be in exact focus when the image coming through the right hand movable prism is projected and coincides with the image which is seen through the prism mirror on the left. As the lens turns, the base of the mount moves in or out and thus moves the small lever which is attached to the right hand prism.

Daylight Loading and Unloading Film Cartridges

It is more convenient to secure Leica films already loaded in film cartridges. The Agfa, Eastman, Gevaert, Mimosa, and Perutz films are packed in complete magazines ready for instant use in the Leica. These film cartridges are daylight loading and unloading and greatly simplify the film loading process. Figure — shows this type of film cartridge in position.

Occasionally one wishes to remove the film roll after half a dozen or more exposures have been made. This may be necessary when a different film is required or when some of the exposed section of the film is to be developed. Before rewinding the film, note the number of exposures taken. Then, after moving the rewind lever to R, raise and turn the rewind knob until the film pulls loose...**then stop** in order to prevent the film leader from going back into the film chamber. Remove the film magazine with the two or three inches of the film leader still outside of the magazine. Later this same film roll may be replaced in the camera, winding and

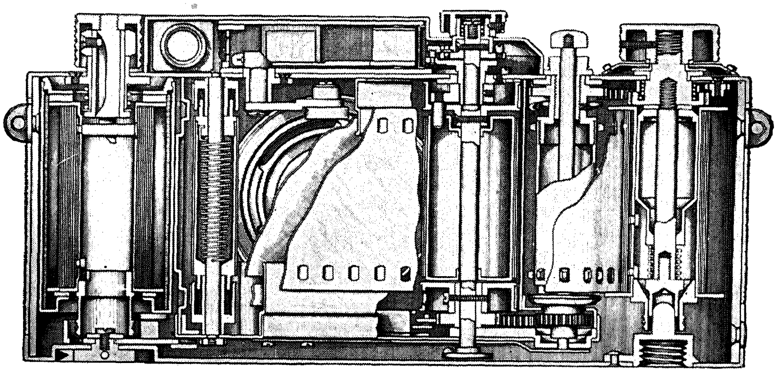


Fig. 11 Back cross-section view of the Leica showing focal plane shutter, film, and all the actual working parts of the camera in cross-section

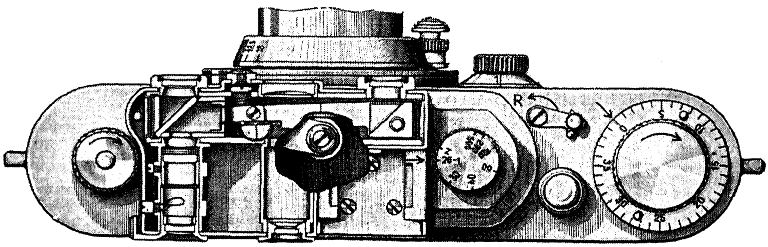


Fig. 12 Looking down on cross-section view of range finder and view finder housing. Note position of range finder prisms, the right prism is moved by the bar which contacts the flange of the rotating lens mount

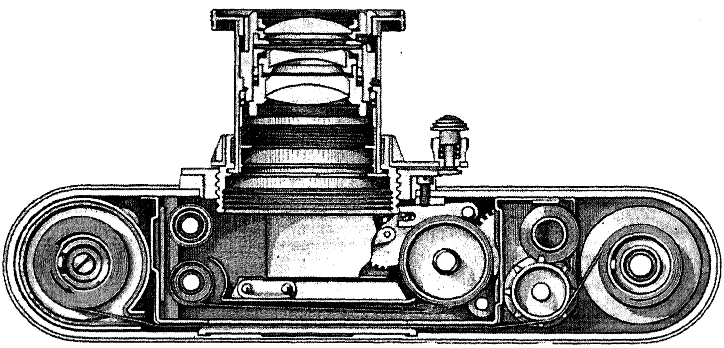


Fig. 13 Top cross section view of the Leica showing position of the film, focal plane shutter, lens, and other working parts

clicking the shutter as many times as necessary to move the exposed portion of the film through the camera. The lens cap should naturally be left over the lens during this process.

If it is desired to remove the exposed portion of the film for immediate development the camera is taken to the darkroom and the film cut. This is facilitated through the use of a special Film Cutting Knife, which is a narrow metal blade with a V shaped notch on one end. The edge of the film between the take-up spool and the sprocket is engaged in the notch of the knife, and then the latter is run down to the width of the film. The take-up spool containing the exposed film is removed from the camera and the film loaded into a developing tank. A new leader is cut on the remaining unexposed film and it is reloaded into the camera.

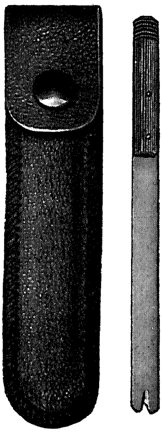


Fig. 14 Film Cutter

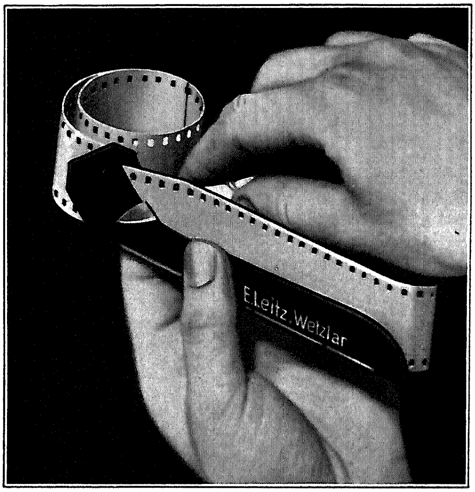


Fig. 15 Method of Cutting Film End Which Projects from Magazine and Inserts into Take Up Spool when Loading the Leica camera

Loading Bulk Film

Bulk film may be purchased in almost any length from 15 feet to 1000 feet at prices ranging from 2 to 8 cents per foot. As the Leica will expose 8 pictures per foot of film it is an easy matter to figure out the amount of bulk film required after allowing for the few frames which are lost at the beginning and end of each Leica loading.

When loading the Leica film magazine with film from a large roll it is necessary to carry out all operations in complete darkness, unless the proper safety lights are used. In the case of fast panchromatic films complete darkness is essential. Therefore it is best to practice loading the film magazine in daylight with a short piece of film in order to become completely familiar with the operations. You can even shut your eyes during this practicing.

When cutting film from the larger roll care should be taken to correctly taper the end of the film which attaches to the spool and also the leader end which is partly cut away as shown in the illustrations. A Film Trimming Guide is available for this cutting.

When the Film Trimming Guide is used for cutting the spool end of the film, the guide is opened and the film inserted through the narrow slot with the emulsion side down. Let the end of the film project slightly beyond the end of the guide, close the trimmer and then cut the film as shown in the illustration. **Always make certain that no finger prints are left on the emulsion side of the film.**

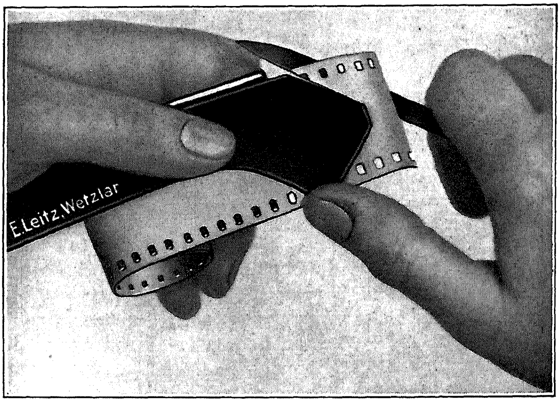


Fig. 16 Method of Cutting Film for Inserting into Magazine Spool

Now place the other end of the five foot length of film into the Trimming Guide as shown in figure 16 and make a longer cut in order to make it easier to load the film into the camera later. **It should be noted that no cut is made through a perforation on the film edge.** The Film Trimming Guide has two pins which engage in the perforations and hold the film in the proper cutting position. Place the film into the guide with the emulsion side facing the two pins. The film ends can be cut with a scissors without a Trimming Guide after a little practice.

Winding the Film

In order to make it easier to wind the film spool with fresh unexposed film a Hand Film Winder and also a stationary Mechanical Film Winder are available. The operation of these winders may be studied from the accompanying illustrations. The Hand Film Winder is slipped into the bottom of the center spool and engages the cross-pin for turning.

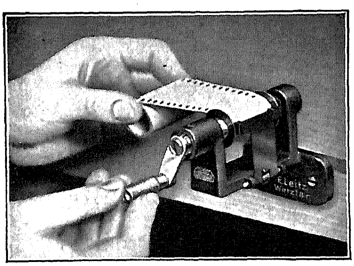


Fig. 17 Loading Film Spool by Means of a Mechanical Winder. Also for use with Model FF Spools

The Mechanical Film Winder should be attached to a table or heavy block of wood. A slit core receives the film spool ready for the film winding process. After the film end has been fixed to the center spool, the film should be wound tightly during the turning of the handle. Do not attempt to pull the film and thus tighten the film already rolled on the spool . . . this will produce scratches.

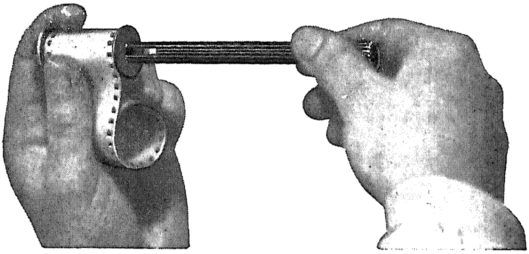


Fig. 18 Hand Film Winder

The Earlier Leica Models

Although the first Leica model was made by Oscar Barnack in 1914 it was not until 1924 that actual production began with the introduction of the Model A Leica without the interchangeable lens feature. This camera contained all the basic features which are to be found in the latest Model F Leica, with the exception of built-in range finder and slow shutter speeds. During the ten years between 1925 and 1935 new improvements on the original design created new models: Thus:

1. A camera with Compur shutter instead of the usual focal plane shutter was introduced as the **Model B Leica.**
2. Interchangeable lenses brought out the **Model C Leica** (also known as Model I outside of the U. S. A.)
3. A built-in focusing range finder adapted to couple to the various interchangeable lenses produced the **Model D Leica** (also known as Model II).

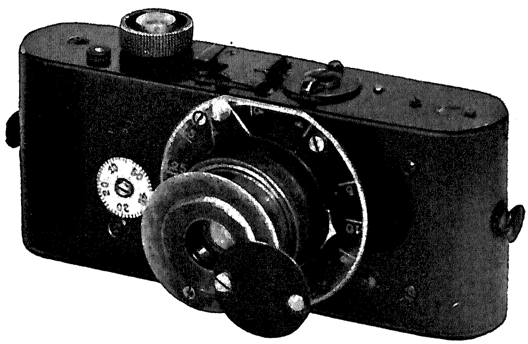


Fig. 19 The Pioneer Leica Constructed in 1914 by Oscar Barnack

4. A horizontal Short Base Range Finder and the pull-up type of rewind knob identify the **Model E Leica** (similar to Model I).
5. An additional slow shutter speed mechanism, with speeds down to 1 full second, was added to the Model D type and thus created the **Model F Leica** (also known as the Model III).
6. By the addition of a 1/1000th of a second shutter speed the present **Model G Leica** (also known as the Model IIIa) was produced.

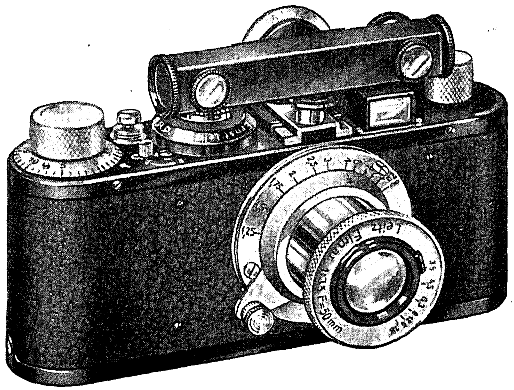
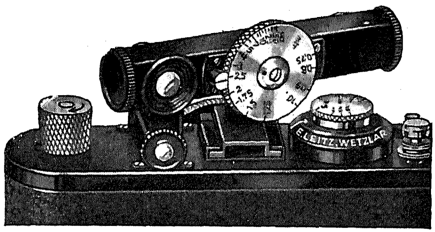


Fig. 20 The Model E Leica with Fokos Range Finder

Fig. 21 Detail of Leica Showing Fokos Range Finder in Position. Range Finder may be Turned When Making New Shutter Adjustments



Note. Outside of the United States the Model C Leica is known as Model I, the Model D as Model II, the Model F as Model III, the Model G as Model IIIa, and the Model FF as the 250 Exposure Leica. It will be noted that the original Model A Leica was simply known as the Leica Camera without a model number.

7. With the addition of film chambers to hold up to 33 feet of film 250 Exposure Model FF Leica was introduced.
8. Finally, the Single Exposure Leica was made to meet special requirements.

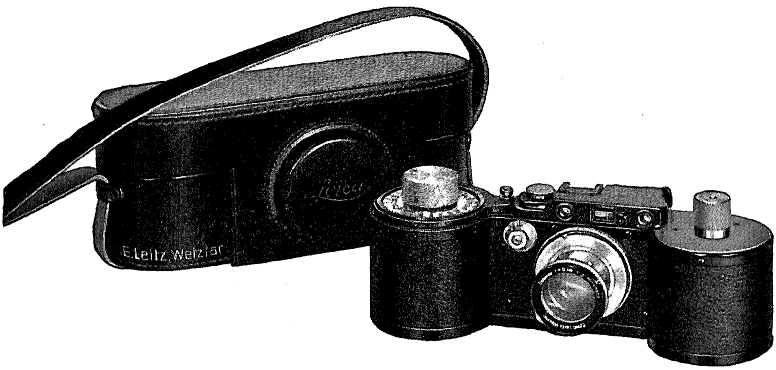


Fig. 22 The 250 Exposure Leica Model FF

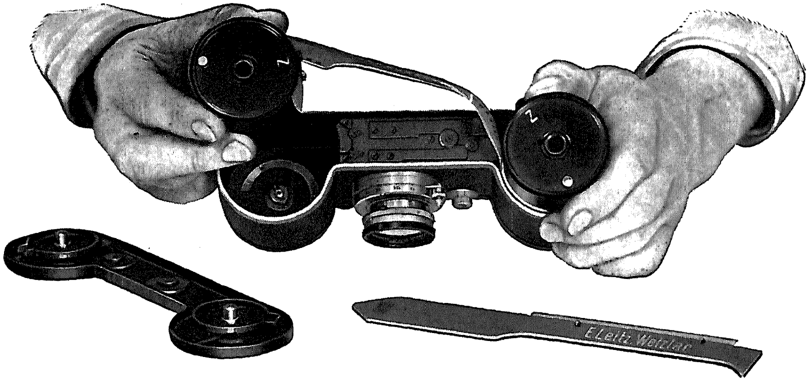


Fig. 23 Loading the Leica Model FF. After Exposures Have Been Made Film is not Rewound. Note Special Film Trimming Guide

This brief summary of the various Leica models will be of special value to many people who intend to purchase either new or used Leica cameras. The latest direction book which is supplied with every new camera contains information about the operation of the Leica. This information can be applied to all Leica models. Therefore it will not be necessary to reprint detailed descriptions and directions on these cameras. One of the remarkable features of the Leica is the fact that it is possible to convert any of the earlier models to the very latest model. This fact alone is really a tribute to the inventor who was able to design the basic features of the Leica so perfectly.

Leica Accessories

Along with the development of the Leica there naturally came the production of many accessories which served to extend the use of the camera into many new photographic fields. With the introduction of various interchangeable lenses there was a need for the Vidom Universal View Finder. The various enlargers made it possible for the average amateur to make excellent enlargements from his Leica negatives. Stereo, copy, micro, panorama, and other attachments came in rapid succession to round out the universal use of this camera. Most of these accessories are carefully described in the various chapters to which they relate. However a few of the important accessories not illustrated elsewhere in this book are shown in this chapter.

Vidom Universal View Finder

As the direct optical view finder in the Leica is only used for the 50mm lenses it is necessary to use the Vidom Universal View Finder for all other interchangeable Leica lenses. This finder contains an adjustable diaphragm which is easily moved by turning a calibrated ring to include the field of view of any Leica lens. The diaphragm is rectangular and the sides retain the standard 2 to 3 proportion of the Leica negative size when changed for any field of view. Thus if the Vidom Finder is used with a 90mm lens the calibrated ring is turned to the figure 9 (opposite the long line) and the adjustable diaphragm will then include the exact field of view between 30 feet and infinity. When taking close-up pictures between 3½ to 6 feet set the figure representing the focal length of the lens opposite the short line on the finder. For distances between 6 and 30 feet set the figure between the two index lines.

A parallax adjusting lever is located at the rear base of the Vidom Finder with calibrations of 3½, 5, 7, 15 feet, and ∞ or infinity. As the finder is attached to the top of the Leica and not directly behind the lens this parallax adjusting lever is used to make the proper inclination of the finder in order to include the exact field covered by the lens. Thus this finder is used by many Leica owners for taking close-up photos with the 50mm lenses. The direct view finder already attached to the Leica does not have this parallax adjusting feature.

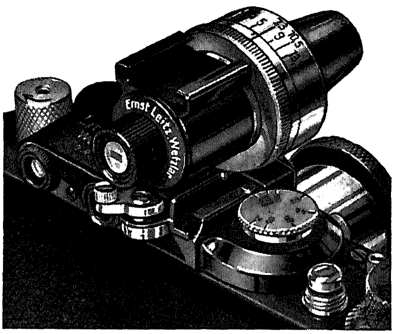


Fig. 24 Vidom Universal View Finder Used for Determining Field of View of the Various Leica Lenses

The eyepiece of the Vidom Finder rotates in a 90 degree arc in order to keep the image right side up when using the camera in the horizontal or vertical positions. When using this finder to photograph rapidly moving objects it is best to keep both eyes open in order to make it easier to keep the object in the center of the finder.

Another valuable use of the Universal Finder is in determining the field of view in pictorial photography without the camera. By sighting through the finder one can easily determine if there is a picture worth taking without the necessity of removing the camera from the case. Such a convenience is of special value when working with the longer focal length lenses.

Rasuk Direct Vision View Finder

A non-optical direct view finder, known as the Rasuk, is recommended for certain types of sport, newspaper, theatre, and general pictures. This finder consists of a rotating metal masking frame and a peep sight for centering the images. A removable reducing mask is used with the 105mm and 135mm lenses. When this mask is removed the frames cover the fields of view included in the 35mm, 50mm, 73mm, and 90mm lenses.

The rear peep sight has a small rectangular opening for use with all lenses except the 105mm and the 135mm lenses. A small round peep sight is moved into position for using the Rasuk Finder with these 105mm and 135mm lenses.

The rear sighting frame can be slightly raised or lowered for obtaining the proper parallax adjustments. There are three engraved marks of 3½, 7, and ∞ (infinity). For close-up pictures between 3½ and 7 feet the parallax adjustment is quite necessary in order to include the exact field of view. Leica users who wear glasses may find this finder of special value as it may be a little easier to follow the objects and properly frame the picture. With a little practice both eyes may be left open when the Rasuk Finder is in use. This is of particular value when following a fast moving object. With both eyes open the object may be seen very quickly before it comes into the field of view for photographing, and thus the final picture will be taken with the object in the correct position.

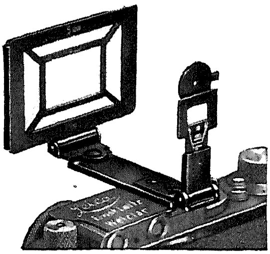


Fig. 25 Direct Vision Frame Finder Attached to Leica

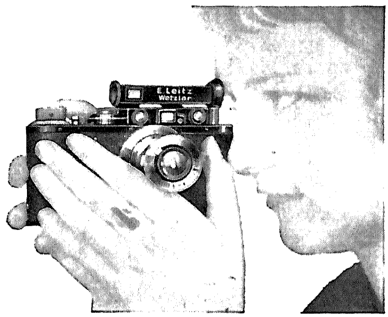


Fig. 26 Wintu Angle View Finder

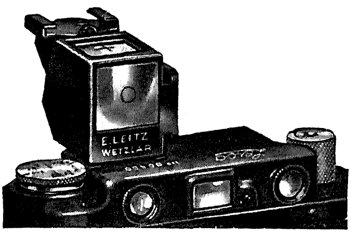


Fig. 27 Reflecting View Finder for use with All 50mm Lenses

Wide Angle View Finder

Although the Universal View Finder includes the field of the 35mm wide angle lens there are times when the smaller wide angle direct view finder is used. This wide angle finder is about the same size as the 50mm finder on the Leica, with the exception that it covers the 35mm lens field. Leica users will find this Wide Angle Finder very useful when the 35mm lens is to be used a great deal, because the camera and additional view finder can easily be slipped into a pocket when not in use.

The Wintu Angle View Finder

We are all familiar with the way in which most pictures are taken by pointing the camera directly towards the subject with the operator also facing in the same direction. By using the Wintu Angle View Finder the conventional picture taking methods are abandoned with the Leica held at a right angle to the direction in which the operator is facing. In other words, you can take the picture around a corner and not attract attention or have the people, to be included in the picture, assume unnatural poses or expressions. This finder is also of particular value for making candid camera pictures.

To mount the Angle View Finder on the Leica it is only necessary to slip the metal bracket into the clip on top of the Leica, then move the small angle prism over the range finder eye-piece. By sighting through the small angle prism the object can be quickly focused when using the Model D, F, or G Leica with the built-in range finder. After focus is secured shift the eye to the eye-piece of the Angle View Finder.

There is also an Angle View Finder (Winko), without the angle prism, for use with the Leica Models A, C, and E. With a little practice an Angle View Finder will be of great value to the traveler, candid camera worker, and the general photographer.

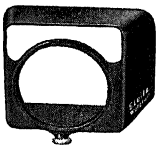


Fig. 28 Sunshade for Summar 50mm lens

Fig. 29 Sunshade for Elmar 50mm and 90mm and Hektor 50mm and 135mm lenses

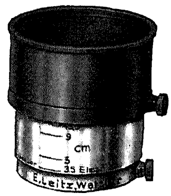


Fig. 30 Adjustable Sunshade

Sunshades and Their Use

Whenever possible it is advisable to use a sunshade or lens hood on the Leica lenses. Such protection eliminates any possibility of stray light from entering the lens and thus causing a slight halation on the film. This fact is true of any photographic lens, and the larger the aperture the more important it is to use a lens shade to cut off the strong side lights which have no photographic value.

Leitz supplies a small metal sunshade for the Elmar and Hektor 50mm lenses as well as the 90mm and 135mm lenses. An adjustable sunshade is made which can be used for the 50mm lenses and also the longer focal lengths with the exception of the 73mm, 90mm Thambar, 105mm and the 200mm lenses, which are already supplied with their own shades. This adjustable shade has engraved markings for each focal length and the proper setting is quickly made. There are also special lens shades supplied for the 28mm, 35mm, Summar and Xenon 50mm lenses.

Correction Lenses for Range Finder and View Finder

Persons who wear eyeglasses find it difficult at times to focus with the aid of the range finder or to see the entire field in the view finder, because the eyeglasses prevent them from placing their eyes close to the camera. This difficulty can be overcome by the use of special Correction Lenses on the eye lenses of both the range finder and view finder.

The Correction Lenses embody the same correction as that contained in the eyeglasses worn by the Leica user. When these special lenses are placed both on the view finder and the range finder, it is not necessary to wear eyeglasses and the eye can be placed close to the camera. The Leitz Co. has in stock the necessary Correction Lenses to correct nearsightedness and far-sightedness (myopia and hyperopia). It is but necessary to obtain the prescription of one's eyeglasses from the optician or optometrist and the proper Correction Lenses will be supplied. These screw into the eye lenses of both the range finder and the view finder.

Special lenses to correct astigmatism are also obtainable. However, it is necessary to secure them on special order. In this case the prescription for the eyeglasses must also be furnished.

When to Use the Wire Cable Release

When making either time or instantaneous exposure the Wire Shutter Release is of special value. For example, this release is indispensable for making exposures in photomicrography, all types of close-up copy work, and wherever exposures are to be made where it is essential not to jar the camera. The Wire Release is screwed over the release button of the Leica after the metal protective bushing has been unscrewed.

When it is advisable to operate the Leica at a distance of 10 or 20 feet the longer corresponding wire releases are recommended. For example, the 20 foot release may be used to release the Leica shutter after the camera has been set to photograph a bird or possibly when the photographer wishes to be included in the picture.

Slow Timing Device

Owners of the Leica Models A, C, E, and D may adapt their cameras to the slower shutter speeds between 1/20th and 1 second by using the Slow Timing Device. As it is cheaper to secure one of these attachments than to have these earlier Leica models converted to the Model F, there is a definite advantage in using one of these Slow Timers.

This Slow Timing Device is screwed directly to the release button of the Leica. To operate: wind the shutter of the Leica and set the shutter speed dial to Z the same as for a time exposure. Next, set the Slow Timer by turning the two knobs of the Timer clockwise until the dial comes to a stop. To set for the proper speed lift the longer part of the metal band slightly and turn back or forth until the index line at its outer edge points toward the speed required.

The shutter is released by pressing the release button, located on the side of the Timer, either with the finger or a Wire Release. Press the release down slowly and hold the finger there until the shutter has opened and closed, in order to avoid shaking the camera during the short moment when the shutter is open.

On some of the older cameras the release button varies slightly in height, thus it may be necessary to make a slight adjustment on the Slow Timer before it will operate correctly. To make this adjustment simply use a screw driver and turn the large screw head, located in the hollow shaft of the Timer, to the right or left until the proper release is secured. If the release button of the camera is too low the adjusting screw of the Slow Timer may not have sufficient pressure upon the shutter release button . . . in this case the screw is turned anti-clockwise. If the button is too high, the rotating levers in the attachment do not work properly, consequently the shutter opens only half way and remains open. In such a case the adjusting screw is turned clockwise. Once the proper adjustment has been made for your camera the Timer will need no additional change.

Rapid Winder

There are many occasions when the Leica user may wish to take successive pictures within a very short period of time in order to record continuous actions. The Rapid Winder has been made to serve this purpose. With this attachment extremely interesting picture series may be made of dancers, animals at play or running, children, wrestlers, and rapidly moving objects of all kinds.

The Leica Rapid Winder replaces the base plate of the Leica camera. A trigger is pulled after each exposure is made. This trigger action causes the film to be wound and the shutter set at the same moment. With Leica Cameras from serial No. 1, up to and including No. 111,449, the small pin which holds on the base plate must be changed to a larger pin to accommodate the Rapid Winder which also necessitates a new base plate. A new winding spindle and winding knot must also be supplied as these cameras are not equipped with a notched winding shaft. Cameras numbering from 111,449 up to and including 159,000 must be supplied with a new winding shaft and knob for the shaft.

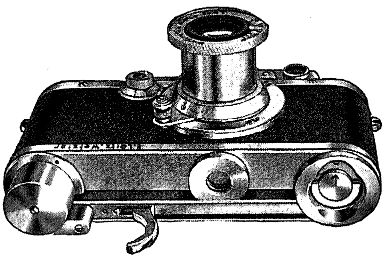


Fig. 31 New type Rapid Winder with trigger action which fits over base of Leica.

Protective Cases for Leica Equipment

All Leica equipment should be kept in protective cases when not in use. Such protection will keep your equipment looking better and also prevent the camera or lenses from receiving scratches or hard knocks. Sand and dust will be kept out. Too much emphasis cannot be laid upon the importance of keeping all Leica equipment neatly fitted in their proper cases.

There are Eveready cases for the camera only. Soft leather cases for the Camera only and for individual lenses. Then there are a number of combination cases available for the camera, additional lenses, and other extra equipment such as filters, view finders, and extra film magazines. All color filters should likewise be kept in soft leather cases or the original filter box to prevent scratching and the collection of dirt on the glass surface.

Optical Short Distance Focusing Device "Nooky"

This new and ingenious attachment extends the usefulness of the automatic focusing principle of the Leica beyond its present range. Heretofore the shortest distance for which the setting of the lens could be secured automatically was 3½ feet. By unscrewing the lens from the camera and screwing the "Nooky" into its place, and subsequently attaching the lens by its lugs to it, sharp focus can be instantly secured on all objects from approximately 40 inches to within 18 inches of the camera.

The "Nooky" attachment can be used on models D, F, FF and G Leica Cameras. It is intended for use with 50mm lenses and two models are available, one for the Elmar 50mm lens and the other for the Hektor and Summar 50mm lenses.

As this issue goes to press, it is available for the Elmar 50mm lens. Later it will become available in models for other 50mm lenses.

In using this device outdoors, as for details of plants, flowers and insects, one should focus quite critically and take care that in shifting the eye from the range-finder to the view-finder the camera should not be moved out of focus. When you are only 18 inches away from your object the movement of an inch forward or backward makes a difference. Outdoors as well as indoors stop down as much as you are able so as to take in the fullest depth possible, and allow for any error in focusing.

A framing mask is incorporated into the optical range finder part of this device which ingeniously and automatically compensates for the shift of field due to parallax

At the short distances for which this attachment is intended

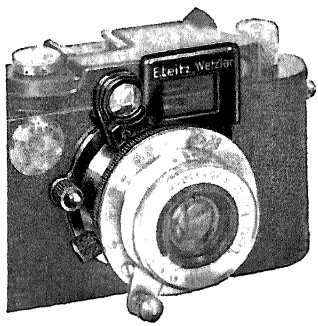


Fig. 32 Optical Short Distance Focusing Device "Nooky"

the depth of focus is obviously very small. It is extremely important in focusing the lens to employ only the center of the field measured through the range finder when the double edge of the framing mask enters the field of vision. Unless very short exposures are called for due to inadequate illumination it is important to stop down the aperture of the lens to at least f:4.5 to increase its depth of focus. The following table gives the approximate depth of focus at the various settings of the lenses and at various distances as well as approximate size of the field covered at the various distances:

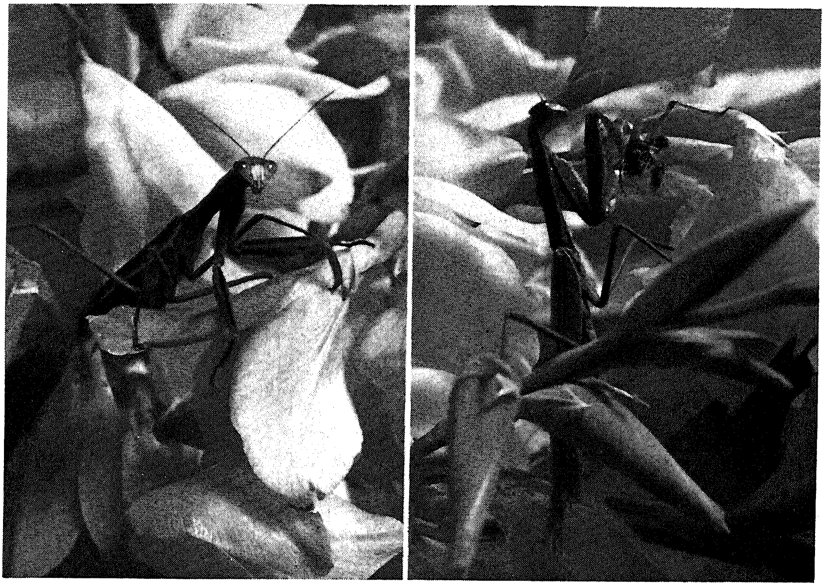


Fig. 33 Praying Mantid James M. Leonard
Elmar 50mm with "Nooky", 1/30 sec., f:9, Agfa Superpan Film

DISTANCE: Object to lens Inches	DEPTH OF FOCUS AT LENS STOPS: f: 3.5	4.5	6.3	9	12.5	18	APPROXIMATE FIELD COVERED: Inches
	Inches						
39½	3½	4¼	5¾	9	12¾	18½	16½ x 24¾
35½	2½	3¼	4½	6½	9	13¼	14½ x 21¾
31½	1¾	2½	3½	5	7	10¼	12¾ x 19¼
27½	1½	1¾	2½	3¾	5¼	7½	10¾ x 16¼
23½	1	1¼	1¾	2½	3½	5½	9 x 13½
19¾	½	¾	1¼	1¾	2½	3½	7¼ x 10¾
17¾	¼	½	1	1¼	2	2¾	6¼ x 9½

Above figures are rounded off to nearest ¼″.

Synchronized Flash Unit

Heretofore synchronized flash photography with the Leica was not practical because of the fact that the Leica has a focal plane shutter and the foil flash lamps available have a very short peak.

At bulb (Z) or slow speeds such as 1/20 or 1/30 second good results were possible but at the higher speeds, due to the short peak of the foil lamp, only a portion of the negative would be well exposed and the rest of the negative extremely under-exposed. A new bulb has now been introduced, in which the active material is a special hydrolanium wire and which has a relative long peak. This makes possible the use of synchronized flash guns with the Leica since fully exposed negatives may be obtained at high speeds. Accordingly, a Synchronized Photoflash Unit is being supplied for the Leica.

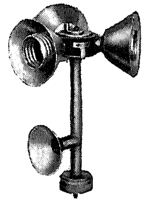


Fig. 34 Synchronized Photoflash Unit and Also Special Attachment for Holding Three Photoflash Lamps

This Unit consists of three main parts—a semi-cylindrical shell which is fastened to the right end of the camera and which serves to support the unit; a battery pillar to which is attached the receptacles for holding the flash lamp and a small testing lamp, and a synchronizing head. Synchronization is dependent upon the shutter speed dial on top of the camera, which bears a direct relation to the movement of the shutter. A special metal cap with a cut-out portion fits on the shutter speed dial. The shutter of the camera is first wound, the dial set to the speed desired and then the special cap placed over the dial so that the engraved arrow on the cap lines up with the dial on the accessories clip of the camera.

The synchronizing head fits into the accessories clip of the camera. On its underside, which rests over the shutter speed dial, are two small contact points. One rests on the special metal cap and the other lays in the cut-out portion of the latter. On pressing the shutter release contact is made when the shutter speed dial revolves and the contact point laying in the cut-out portion of the special metal cap touches the latter. This gun cannot be used at 1/1000 second since the shutter speed dial is slightly raised when set at this speed.

If a lamp is inserted into the gun before the shutter is wound, the lamp will be flashed. As a guard against this the small test lamp remains lighted as long as the shutter remains unwound. There is also a special head available for holding three lamps, which is interchangeable with the single lamp head. After one lamp has been flashed a turn of the special head places the next lamp into position.

Panorama Photography

The Leica may be adapted for this type of photography through the use of a Panorama Tripod Head. This is a special tripod head which allows the camera to be turned so that the required individual pictures can be taken to make the finished panorama photograph. Since the number of photographs necessary to make a panorama varies with the focal length of the lens to be used, different rings are supplied for the various Leica lenses. With the exception of the rings for the 135mm and 200mm lenses, each ring has two scales, for horizontal and vertical pictures. (The rings for the 135mm and

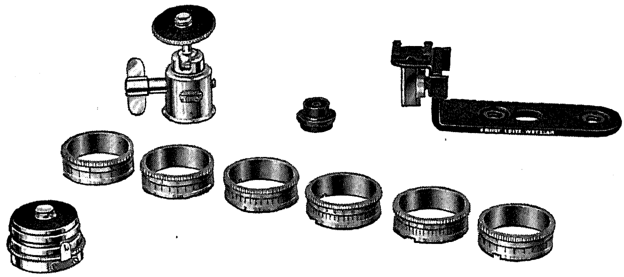


Fig. 35 Accessories for Panorama Photography:
Ball Jointed Tripod Head, Spirit Level, Angle Bracket and Panorama Tripod Head with interchangeable graduated rings for various lenses

Fig. 36 Complete Panorama Outfit Assembled for Horizontal Pictures

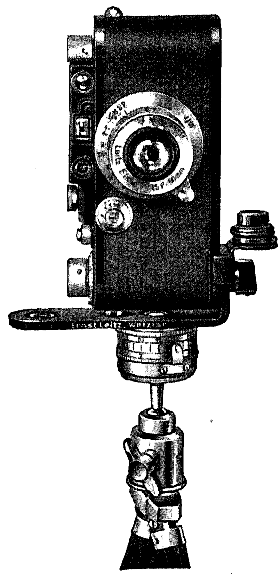


Fig. 37 Complete Panorama Outfit Assembled for Vertical Pictures

200mm lenses only have a scale for horizontal pictures.) The difference in the number of pictures necessary, according to the focal length of the lens, can be seen by the fact that with the 28mm lens 6 horizontal pictures are required to make a complete 360° panorama and with the 200mm lens 36 horizontal pictures are needed.

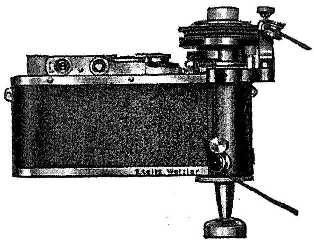


Fig. 38 Remote Release and Shutter Winder

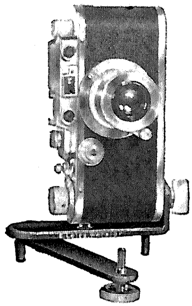


Fig. 39 Table Tripod with Adjustable Setting

Besides the Panorama Tripod Head, additional equipment is necessary to successfully engage in this type of photography. A special Angle Bracket is required for centering the lens over the pivotal point and for using the camera vertically. For leveling the camera and locking it in that position, a Ball Jointed Tripod Head should be employed and a Spirit Level will also aid in this work. The latter is fitted into the clip of the camera for horizontal pictures, or the clip of the Angle Bracket for vertical pictures. It is also obvious that a good sturdy tripod is a necessity, and in addition it is advisable to use a cable release to avoid jarring of the camera.

When making the panorama, the lens to be employed should first be determined. This depends on the subject. Interiors, where little room is had for backing the camera, will require short focal length lenses, whereas distant outdoor scenes call for the use of long focus objectives. Next, the farthest and nearest points in the picture, which are to be sharp, are determined and the lens set accordingly. Re-focusing for individual pictures cannot be done since this will alter the relative size of the pictures. A dependable exposure should also be used for each individual exposure, and the camera should be adjusted so that it is perfectly level.

Remote Release and Shutter Winder

This device enables the Leica to be operated from a distance and is therefore of interest to nature photographers, or others who may find occasion to operate the camera through remote control. It consists of a semi-cylindrical shell which is attached to the winding knob side of the camera. A lever on this shell lies over the shutter release button. The second essential part of the apparatus is a winding drum which is secured to the winding knob of the camera. Strings are attached to both the winding drum and the lever lying over the shutter release button, and the strings may be 10, 20 or more feet in length according to specific requirements.

Pulling the string attached to the winding drum will give the winding knob of the camera a complete turn and a pull on the second string releases the shutter. It is thus possible to expose an entire roll of film at a distance from the camera.

An important point to observe in the use of this apparatus is that a sturdy tripod be employed and that it be firmly secured by attaching weight to its legs or through other means. It is also advisable to use long focal length lenses, which enable the camera to be at a greater distance from the subject, so that the latter is less likely to be disturbed by the clicking of the shutter.

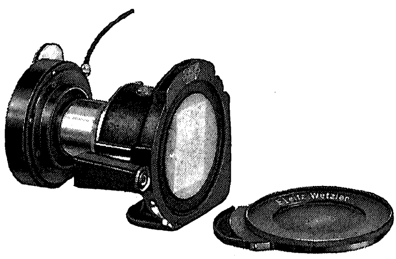
Adjustable roller guides control the direction of the pulling strain and to facilitate matters it is advisable to use strings of different colors.

Single Exposure Leica

The Single Exposure Leica was introduced to meet the demand for making single negatives instead of the strip of exposures on the ordinary roll of Leica films. This camera consists of a small housing which is the exact depth, from lens flange to film surface, as the regular Leica camera models. A removable ground glass plate, film holder, Ibsor shutter, and one of the Leica lenses completes the outfit. Some of the advantages and uses of this camera may be mentioned as follows:

1. **Used as a lens tester.** The distance between lens flange and ground glass is 28.8mm which is exactly the same as the distance between the lens flange and film surface in the regular Leica models. The exact field of view of the various lenses can be quickly checked by focusing the images upon the ground glass of the single Exposure Camera.

Fig. 40 Single Exposure Leica. Note Film Holder, View Finder and Shutter



2. **For use in photomicrography.** Single micro pictures can be quickly made with this camera and developed in a small tray either for testing exposure, filters, or for making permanent records. Use this camera without a lens but with a 6cm extension tube between the Single Exposure Leica and the eyepiece of the microscope, with a black cloth around the tube to exclude stray light. The camera is mounted on a rigid support beside the microscope. Such an arrangement makes a very inexpensive photomicrographic outfit, and insures perfect results.
3. **As a copying camera.** Any type of copy work can be done with this Single Exposure Leica by using an adjustable mounting and the vari-

ous extension tubes or the front lenses. If desired, it is possible to obtain various fixed distances with the lens which can later be shifted to the regular Leica for making pictures on the longer strip of film.

4. **For making portraits.** It is quite easy to compose portraits on the ground glass of this camera before changing to the film holder and making the exposure. The 1.2cm extension tube can be used for close ups when necessary. If one of the 50mm lenses is used the collapsible feature of the lens barrel can be adapted to obtaining proper focus.
5. **Also for general photography** where only one picture is to be made at a time, especially where it is necessary to test exposures, color filters, and films before using the regular Leica camera.

To set up and operate the Single Exposure Leica proceed as follows:

1. Attach the camera to a tripod, Sliding Arm of the copy attachment, or any other rigid support.
2. Screw in one of the interchangeable Leica lenses and fit the Ibsor shutter over the front of any lens except the 73mm, Thambar 90mm, and Xenon 50mm, which have a diameter larger than the others. If the Ibsor shutter does not fit tightly, simply press down the cut flange until a tight fit is secured over the lens.
3. Attach the wire cable release. Usually there is a small pin which comes attached to the shutter; this is used for making exposures by setting the shutter and inserting the pin into the small hole on the face of the shutter, and then removing the finger from the shutter setting lever. The shutter remains closed, but the moment the pin is withdrawn the shutter will open and close at the proper speed setting. A string can be attached to the pin so that the operator can easily get into his own picture after pulling out the stop pin and making the exposure.
4. Next see that the ground glass is clipped into position with the ground side of the glass facing toward the lens. Then secure the proper focus by moving the lens mount around and watching the image on the ground glass.
5. When exact focus has been secured replace the ground glass with the single film holder. **Pull out the dark slide** covering the film. Make certain that the shutter is not open over the lens while withdrawing the slide. Then make the exposure, replace the slide, and remove the film holder.

When preparing the single cut films for this camera it is a good idea to wind the 35mm film in an opposite direction, with the emulsion side out, and left that way for a few hours or several days before using. After this treatment it will be found that the film lies much flatter and it is easier to cut into single exposure lengths. It is also advisable to cut all the film required at one time and keep the pieces between single black papers in a light-tight box or envelope until used.

Use the width of the dark slide as a guide for cutting each individual film. The width of this slide is the exact length of the film for one single exposure in this camera.

Development of these single films can be carried out in a small tray. A special holder is available for developing the single films. This consists of a metal frame into which the film is slipped. A handle is attached to the frame.

Summary

Many other accessories for the Leica camera will be described in the following chapters. There are also many circulars giving directions and booklets available from the Leitz Company on the various Leica attachments. Directions are supplied with every accessory when purchased. Therefore the greatest emphasis in this book has been laid upon the actual use of these accessories. The reader is invited to carefully study all of the following chapters, even though he may be interested in only one or two subjects. By reading about the way in which the Leica is applied to other uses, it is possible to pick up many suggestions which can be applied to one's own particular field of Leica photography. Also by reading these various chapters you will obtain a more complete idea about the scope of the Leica and thus be able to understand and offer suggestions to your Leica associates who may be working in these more or less specialized fields of photography.

Fig. 41 Suntan — Richard C. Wood

Elmar 50mm, 1/100 sec., f:9, E. K. Panatomic Film

Hopi Indian Child

Anton F. Baumann

Elmar 90mm, 1/40 sec., f:4, E. K. Panatomic Film

MY LEICA TECHNIQUE

ANTON F. BAUMANN **CHAPTER 2**

My entire photographic work is built up on experiences gained from the practical use of the Leica camera. Of course, I went through the period of composing pictures according to those "golden rules" on the ground glass of my 8 x 10 camera, but since that time many new rules govern the composition because we now have for one and the same camera a battery of lenses from a super wide angle lens of 28mm, to a telesystem of 200mm.

Selecting Film and Developer

When, a few years ago the first supersensitive panchromatic films appeared, and this film in conjunction with ultra fast lenses produced surprising results under unusually bad light conditions, many Leica photographers assumed erroneously that this was the only good film for *all* purposes. Although I too use this film occasionally, I do not believe that it is a film for universal purposes. It is essential for snapshots under artificial illumination, for stage and news photography under unfavorable light conditions, but I do not use it for all other purposes.

In the first place it is impossible to obtain, with superspeed film, the same degree of sharpness which we can expect from a slower film, even if we develop this fast film in the best fine grain developer and the enlargements really show no grain. We must remember that the sensitivity of the film increases with increasing size of the original silver bromide grains. If the size of each silver bromide grain is larger, we must necessarily have a smaller number of grains per square unit of area. What we call "grain" in an enlargement is really nothing else but the positive image of the spaces between clumps of grains in the negative. A fine grain developer may prevent the "clumping" so that each silver grain is in the place of the original silver bromide grain and the spaces between them are too small to be seen in the enlargement. But the original amount of silver bromide grains and their size determines the ultimate sharpness of the picture and it is well known that an inlaid mosaic picture composed of a great number of very small stones will show finer detail than one with fewer and larger stones.

Thus, a fine grain developer cannot increase the resolving power of a film. In fact, critical observers may have noticed that a negative on superpan film, developed in a normal developer, may produce an enlargement which, although showing more grain appearance, seems to be sharper than an enlargement made from a negative on the same type of film, developed in a superfine grain developer. Thus, my continuous aiming at ultimate sharpness is one of the reasons why I do not use superpan films for all purposes.

Since for some purposes superpan film, such as Agfa Superpan, Eastman Kodak Super X, Dupont Superior, etc., is essential, we must say something about its development. There are three kinds of developers for high speed films which can easily be distinguished:

The first type is composed with the aim of yielding the finest grain possible. These developers generally require double or triple over-exposure and thus they make us lose one of the most desirable qualities of the supersensitive film, viz., its very quality of being supersensitive. These developers generally contain paraphenylenediamine and glycin. (See page 143.)

The next type aims to avoid too much reduction of the sensitivity of the film and sacrifices a small amount of its fine grain producing properties. These developers have also paraphenylenediamine and glycin as essential ingredients but they are slightly more active through the addition of a certain amount of metol. (See page 143.)

The third type combines the advantages of both previous types, viz., finest grain and highest utilization of the sensitivity of the film. Several Leica photographers have succeeded in discovering such developers after many years of tedious and patient experimenting, often by following the road of trial and error. But their super fine grain developers are not commercially obtainable and their formulas are generally their secrets.

And now, let us mention the other reason why I do not consider superspeed films as suitable for universal purposes, and why, very often, I prefer medium speed film.

I am particularly fond of taking outdoor close-up portraits. For this type of picture I need a negative material which reproduces distinctly and sharply one of the most important parts of the portrait, the key lights. I found that only the medium speed film is capable of doing that to any complete satisfaction. In other words, we prevent the shadow portions adjacent to the highlights, from spreading into one another. But also for photos at greater distances, the increased resolving power of the medium speed film is a great advantage. The sensitivity of these films (Panatomic, Finopan, Perpantic) is fully sufficient for all ordinary purposes. After all, we need not expose for a portrait or a landscape 1/500 of a second at f:12.5.

If we would attempt to develop these medium speed films in a developer which was originally compounded for a superspeed film, we would do wrong. The result would be a negative of too much contrast. We must realize that a superspeed film inherently yields negatives of less contrast and requires a developer which is so compounded that it has a tendency of boosting the contrast. The medium speed film, however, yields inherently more contrast and has a beautiful brilliant gradation. Therefore, it demands a developer which works somewhat softer.

Only under one condition could we succeed in producing suitable negatives on medium speed film, developed in a developer for high speed film: if we over-expose two to three times and reduce the time of development correspondingly. But that is not necessary inasmuch as there are developers especially compounded for medium speed film which do not require over-exposure. These commercially obtainable developers are packed as powders. I used extensively one product of the Tetenal Works known as Ultrafin S. F. and recently the Edwal Laboratories, upon my suggestion, perfected the so-called Minicol developer. Another developer for the same use is Eastman Kodak Ultra Fine. Even the complete novice cannot help producing good negatives if he uses medium speed film, exposed according to the Leicameter and develops it in one of the two above mentioned solutions. On my trip throughout the United States, I made over 2,000 exposures and almost 99% of them were made according to this rule and turned out to my complete satisfaction. With the exception of three time exposures under extremely unfavorable conditions, I did not use the tripod once, and altogether I used only one roll of superspeed film. I had to develop all my films while on the road in hotel bathrooms. Therefore, I was compelled to use ready made developers. The negatives which I obtained were not only satisfactory from the standpoint of development, but they were also sufficiently clean. I always use the Correx tank in which I develop two films at a time, back against back, with the emulsion side out.

Filtering Solutions

One of the most important rules for the miniature photographer is utter cleanliness. I have had no trouble in avoiding dust which might adhere to the emulsion while it is drying. But these dust particles are not the only reason why we often have to submit to the tedious task of spotting the enlargements. Another equally undesirable source of dirt is to be seen in particles which we find in the developer and the other solutions. Therefore, I always filter the developer, the fixing bath and the hardener, every time before I place the film into these solutions. To simplify my work while on the road, I generally add the chrome alum hardener directly to the fixing bath. Those who do not believe in the necessity of filtering the solutions should make the following experiment: expose one roll of film, cut it in half, develop one half in a new filtered solution and the other half in an unfiltered, used solution. When you make the enlargements you will be surprised to find that those pictures obtained from the first half require practically no spotting whereas the others will make you spend a long time in cumbersome spotting.

Washing the Film

After the films have been thoroughly washed, I hold them under the cold shower, the emulsion side toward the water spray and the base gliding over the back of my one hand while the other hand gradually pulls the film along. Where no shower is available, a laboratory flask with sprayer may serve equally well. One hand always presses against the film base to hold the film against the spray. I never use chamois leather or sponges for cleaning the film. After the film has been hung up for drying, I remove with a moist piece of absorbent cotton the water drops which might still adhere to the base side of the film. The films are hung for drying in a clothes closet and the door is closed so that no dust is whirled around by air currents. After the film has dried I cut it into strips of four to six negatives and keep it between folded pieces of clean white paper. Thus each film strip is always flat, which is a great help in making enlargements because it seems that the danger of Newton rings becoming visible in the enlargement is thus avoided. By keeping films in rolls they have a tendency to curl and buckle and the center portion of the strip presses against the flat surface of the condenser thus causing Newton rings.

The selection of the medium speed film was made to obtain negatives of utmost sharpness. In enlarging them we must aim again for utmost sharpness. That is why the enlargers are so constructed that the excellent Leica objectives can be used in them. The Elmar 50mm seems to be most suitable for enlarging purposes. The resolving power of the lenses is higher than that of the films, so that enlargements lacking in sharpness can be due only to incorrect focusing or vibration during the exposure of the paper.

Incidentally, it has been reported that two film manufacturers (Agfa and Perutz) have perfected new types of films with a maximum resolving power which is four times as high as that of the films used at present for the Leica camera. Their sensitivity is relatively high, about 21° Scheiner. They will enable the photographer to take full advantage of the resolving power of the Leica lenses. At the same time they will not require complicated fine grain developers.

Since utmost sharpness of the negative is so important, I may mention that a steady hand to hold the camera is a necessity. Those who are not well trained in holding the camera steady should try to avoid exposure times longer than 1/60 of a second. The depth of focus of the lenses of shorter focal lengths is such that we need not close the iris diaphragm more than f:6.3, at which opening, such short exposure times are generally possible under normal light conditions. Only certain types of architectural motifs with detail from the immediate foreground to infinity, may necessitate a further closing of the diaphragm.

Selecting Lenses and Their Various Uses

And now a few words about the selection of lenses for the camera. My own experience has been that with three lenses having focal lengths of 35mm, 50mm, and 90mm, we are well equipped for the great majority of photographic tasks. The lenses of 50mm have the standard focal length and if we select the Summar f:2 or the Xenon f:1.5 we can take pictures under almost any light conditions. I have a particular liking for the 35mm lens not only for candid photos where its

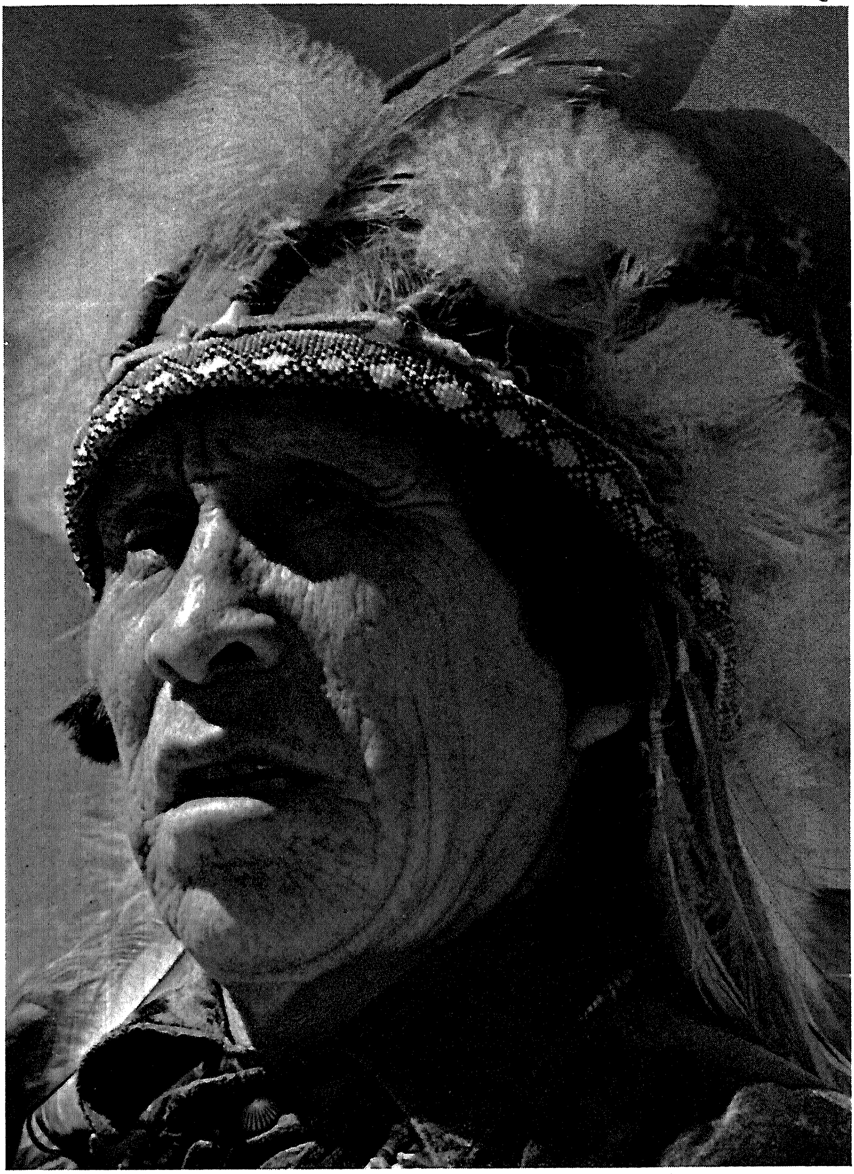


Fig. 43 "Sam", the Medicine Man Anton F. Baumann

Elmar 90mm lens, 1/60, f:6.3, No. 1 Filter, E. K. Panatomic Film great depth of focus is often a blessing, but also for landscape photos with extensive cloud formations in the large sky portion or for architectural photography for which the lens was originally designed. For close-up portraits I use the 90mm lens. If I would use the 50mm lens lens at such distances where the danger of unnatural perspective would not exist, the subject would appear too small on the negative. Since I always aim to make full use of the entire area of the negative in the enlargement, I must select the lens accordingly.

The 90mm lens is also suitable for photos at longer distances. Lenses having still longer focal length, the 135mm Hektor and the 200mm Telyt, are more or less designed for special purposes such as the photography of animals from a distance, sport events, etc. The Mirror Reflex Box, permitting the observation of the image up to the moment the picture is taken, is a valuable accessory for these two long focus lenses. Their depth of focus is greatly reduced but this may be of particular advantage where a background out of focus helps to accentuate the effect of the subject. The correct balance of the range of depth of focus is of great importance. In some cases the impression of the third dimension can be emphasized by using a short focal length lens and selecting a good foreground on which the camera is sharply focused, whereas the background is ever so slightly off in regard to sharpness. On the other hand, if there is nothing in the foreground or if the objects in the foreground have been neglected by focusing to infinity, such photos often have a flat appearance.

Filters

I am opposed in principle to the use of filters of too much density. The modern Panchromatic films have a color sensitivity which is so well balanced that only slight corrections by a light yellow or light green filter may become necessary. If, for instance, I take an outdoor portrait against the blue sky, I use a light yellow filter No. 1 to have the sky appear darker than the key lights in the features of the subject. (See page 49.)

For landscapes with green colors predominating, I use the graduated green filter. The upper half of this filter is green to "hold back" the blue of the sky, the lower half being clear for better detail of the landscape, thus reproducing clearly all distant details, balancing them with the sky, and preventing the foreground from getting too dark.

Really dense filters like the Leitz Red Filter No. 1 are of advantage only for haze penetration into considerable distance. Such photos, by the way, can often be taken on Panchromatic film and do not require special Infra Red sensitive films. Only in some cases, when the sky shows only a very faint pale blue color, these denser filters can be used to slightly suppress the light coming from the sky portion into the negative to balance the photographic effect.

Enlarging Leica Photographs

Many Leica users still see unsurmountable difficulties in enlarging their negatives. Of course, everybody has to gain a certain amount of experience in order to produce uniform results in enlarging negatives of different characteristics in regard to contrast and other properties. But everything pertaining to technique can be learned systematically, and a few words of advice and explanation may help to eliminate difficulties which the beginner may encounter.

The first point of importance is the selection of the correct type of enlarger. About this point a few words may be in order. When somebody shows me an enlargement which is not sharp, my first question is: "What type of enlarger did you use?" All Leitz enlargers are built on the principle of *diffused* light. They are equipped with an opal bulb and, as you know, the opal glass diffuses the light in all directions. You cannot see the filament, you see only one large, uniformly illuminated surface. Incidentally, the ideal type of bulb should be much larger than the area of the negative. But in order not to make the size of the bulb too bulky we may use an auxiliary lens which, so to speak, acts as a magnifier for the surface of the lamp. This lens, however, is not to be confused with the regular condenser system of another type of enlarger which uses *directed* light. (In contrast to the above mentioned *diffused* light.)

In an enlarger with directed light we have a **concentrated** light source and a **clear** glass bulb. Before this bulb, we have a regular condenser system consisting of two plano-convex lenses, which has the task to focus the light source (the filament of the bulb) in a definite plane which is so located that in the plane of the enlarging paper we have **uniform** illumination even though the filament may **not** emit uniform illumination. This is accomplished if the condenser system focuses the filament in the plane of the iris diaphragm of the objective of the enlarger.

Let us emphasize once more: in the condenser enlarger the condenser system must create a definitely focused image of the light source, whereas in the diffused light enlarger, the illumination system is **afocal.** The diffused light enlarger requires an objective of excellent correction, since the diffused light passes through its entire aperture. That is the reason why we use either the standard Leica objective Elmar 50mm or a special objective of the same focal length, well corrected for this purpose and in a special mount the special enlarger lens: Varob.

Formerly, the condenser enlarger with **directed** light was used almost exclusively. Since in these enlargers each point of the negative was illuminated by light traveling **in only one** direction even the minutest surface scratches, either on the emulsion side or the film base side (rear side), became visible in the enlargement.

Contrary to this very unfavorable situation, it is the very principle of the diffused light enlarger that each point of the negative is illuminated by light traveling **in many different** directions and the diffusion of the light eliminates the appearance of the surface scratches.

Furthermore, the enlarger with directed light **increases** the contrast of the negative and in order to obtain an enlargement of **normal** gradation, we need an extremely **soft** negative.

Contrary to this condition, the diffused light enlarger reproduces faithfully the contrast of the negative so that in the plane of the enlarged image we have the same gradation as in the negative. Of course, we can still change the contrast in the enlarged print by using different degrees of contrast in the printing papers.

And now a few words about the use of **the iris diaphragm in the enlarger:** The general rule is: the smaller the enlargement, the more we should close the diaphragm. Closing the diaphragm does not result in an increase of sharpness, but it permits us to increase the time of exposure and therefore give us a better control. If we make big enlargements (larger than 8 x 10 inches) we should leave the diaphragm fully open. This gives us the advantage that we can further reduce the appearance of grain. When it is difficult, because of one's eyesight, to obtain critical focus the lens should be stopped down one or two stops after the preliminary focusing with the lens wide open.

How to Look at Enlargements

For testing the quality of the negative I make an enlargement on 8 x 10 inch glossy paper with ferrotype finish. This enlargement is examined most critically to see if it comes up to expectation and, if it does, the negative can readily be enlarged even to the largest dimensions. Many people erroneously believe that when a negative produces a sharp enlargement of 8 x 10 it might possibly produce an enlargement lacking in sharpness if it is enlarged to possibly 20 x 30 inches. Naturally, if we look at this enlargement from the same distance at which the 8 x 10 enlargement has been examined, we might discover a certain degree of softness. This cannot be considered as a lack in sharpness. Who wants to look at an enlargement of 20 x 30 from the same distance at which an 8 x 10 enlargement is viewed? Apart from any other consideration, one would obtain an entirely wrong perspective. In amateur photo circles abroad, the suggestion was made to mention on each exhibition print the correct distance from which it should be viewed. It is interesting to learn how this viewing distance was computed. Let us assume that the picture was made with a lens of 50mm focal length and the ratio of enlargement was 10x. We multiply the focal length of the lens of the camera by the ratio of the enlargement and the result is the viewing distance which will yield the correct perspective. If, however, we are too close to the print when viewing the huge enlargement, I believe that the slight appearance of graininess would be the least disturbing factor. This disturbance would be more than compensated by the clean and brilliant appearance of the highlights, which is particularly noticeable on enlargements made from negatives

Fig. 44 Grand Canyon Anton F. Baumann
Elmar 35mm, 1/200, f:6.3, No. 1 Filter, Agfa Superpan Film

on medium speed film. Again I wish to emphasize that I practically standardize on this material and use super-speed films only where super-speed is necessary.

Exposure and Development

As a paper developer I selected only commercially obtainable products, such as the well-known Eastman D-72 (see formula on page 202). I also obtained good results with Developer No. 102 made by the Edwal Laboratories in Chicago, and Quinolin made by Fink-Roselieve in New York City, as well as paper developers made by the Agfa Ansco Corporation. These developers, with the exception of Quinolin, have a tendency to produce an enlargement of relatively high contrast, whereas Quinolin produces somewhat softer enlargements.

If we select a type of enlarging paper which is available in three degrees of contrast: soft, normal and medium, and have two different types of paper developer, we actually have at our disposal six different gradations for the enlargement and this should be sufficient for almost any type of negative.

It is well known that a correctly exposed enlargement should be developed for one and a half to two minutes. Therefore, I always avoid exposing the paper to the relatively bright green yellow light of the darkroom lamp during the first minute of the developing. Thus, I eliminate any possibility of fogging the paper and obtain brilliantly white highlights. Final inspection of the enlargement is made by letting the darkroom light shine through the paper in order to see whether the shadows are sufficiently developed.

The paper goes from the developer into the short-stop bath (a weak solution of acetic acid (see page 186) and then it is placed in the fixing bath for a suitable time, during which the pictures should be stirred at frequent intervals (see page 210 for formulas).

Which materials? As mentioned, for all enlargements of 8 x 10 inches I use a glossy paper with the final ferrotype finish. For enlargements of 20 x 30 inches, however, I prefer paper with a slightly rough surface (semi-matte).

Simplify matters. At any rate, the Leica owner should avoid complicating his system of working by shifting too often in the selection of his papers and developers. I know that there was a time when the Leica fan wanted to impress friends who visited his darkroom with an enormous array of bottles. I use only one to two bottles of positive developer (for paper and slides), one bottle of concentrated hypo, one bottle of fine grain developer for medium speed film and another one containing fine grain developer for high speed film. Aside from the usual acetic acid for the short-stop bath, that is all.

After all, the final result is the best test and I am exceedingly anxious to see that every Leica owner follows a simple technique.

Getting rid of dust. A few final remarks about the retouching and spotting of Leica enlargements may be advisable. In spite of utmost cleanliness and care, small grains of dust may be enlarged with the film. In this case I refer to dust particles which have slipped in between the surface of the film and the condenser of the enlarger. Quite often dust particles "bake" into the film emulsion during the process of drying.

Most of the loose dust particles can be removed from the surface, whereas those impurities which have adhered to the emulsion during the process of drying are a much more serious matter. Further details concerning this matter will be found in that part of this article covering the developing of films. (Page 48.)

Materials for spotting. For removing spots on glossy enlargements I use a very fine Japanese brush and genuine black India ink. I control the degree of black or gray by increasing or decreasing the concentration of the ink solution, by rubbing a hard piece of ink in a small pool of water on a glass plate. For spotting semi-matte or matte surfaces I always employ special spotting pencils, which are made in various degrees of hardness so that any tone of black or gray can be obtained.

Making Lantern Slides

Quite often Leica owners ask me, "Why lantern slides?—Why not enlargements on paper?" Those who asked such questions found their answer when attending our lectures and seeing the Leica lantern slides projected. It seems that many Leica owners believe that projecting lantern slides is of value only to lecturers but not for the amateur. Quite the contrary, however, for the enthusiastic Leica owner can derive great pleasure from making and projecting lantern slides. Suppose he returns from an extensive trip and wishes to show his friends his personal impressions and adventures. Nothing is more fascinating than a get-together for projecting lantern slides. Aside from this, the projected picture has a great educational value, for the photographer can see all his photos greatly enlarged and he can judge the pictorial effect in the composition much better than any other way. Finally, we must not forget that if you have a great number of pictures, it is much cheaper to make lantern slides by contact printing than to make giant, or even medium size enlargements. When I started with the Leica, I immediately realized the value of lantern slide projection, and studied the projected image of my photos. Thus, I discovered many mistakes and many possibilities of improvement which had escaped me by viewing my enlargements.

Films or glass slides? Upon first thought it seems as if printing Leica negatives on positive film strips were the least expensive and most convenient method of obtaining transparent positives, since on a film strip of 4 ft., thirty pictures can be printed. On the other hand, we are greatly restricted inasmuch as positive film is available only in one degree of contrast. When printing on film strips, we can only compensate for differences in density of the negative through the time of exposure, but we cannot compensate variations of contrast. As long as we deal with negatives where the time of exposure varies only within the straight portion of the density curve, a variation of the time of exposure when printing is fully satisfactory as a compensating measure. If, however, we find on the negative film strip effects due to over-exposure or under-exposure, mere variation of the exposure time in printing cannot lead to a uniform result. We must resort to glass lantern slide plates, which are available in two grades (medium and contrast). With these plates and two different types of developer we can actually produce four different degrees of contrast. By printing on contrast positive plates and developing in D-72 developer (see formula page 202), diluted 1:1, it is possible to obtain satisfactory results even if the negative is very weak. On the other hand, a negative of extreme contrast will yield a fine positive of good gradation if printed on a medium plate and developed in Quinolin diluted 1:6 or 1:8.

It is advisable not to expose the positive plate too freely to the darkroom safelight. The positive plate should be covered entirely for the first minute in the developer, then a quick inspection can be made. Too frequent exposure of the plate, to the darkroom light, during the developing, may produce a fog which will become doubly noticeable when the plate is projected on the screen. The safelight filter used for printing positive plates is the same as that for enlarging on bromide papers, although the chloro-bromide emulsion of the plates is slightly less light-sensitive. The treatment of the lantern slide plate in a shortstop bath and hypo is the same as that used when making enlargements on paper.

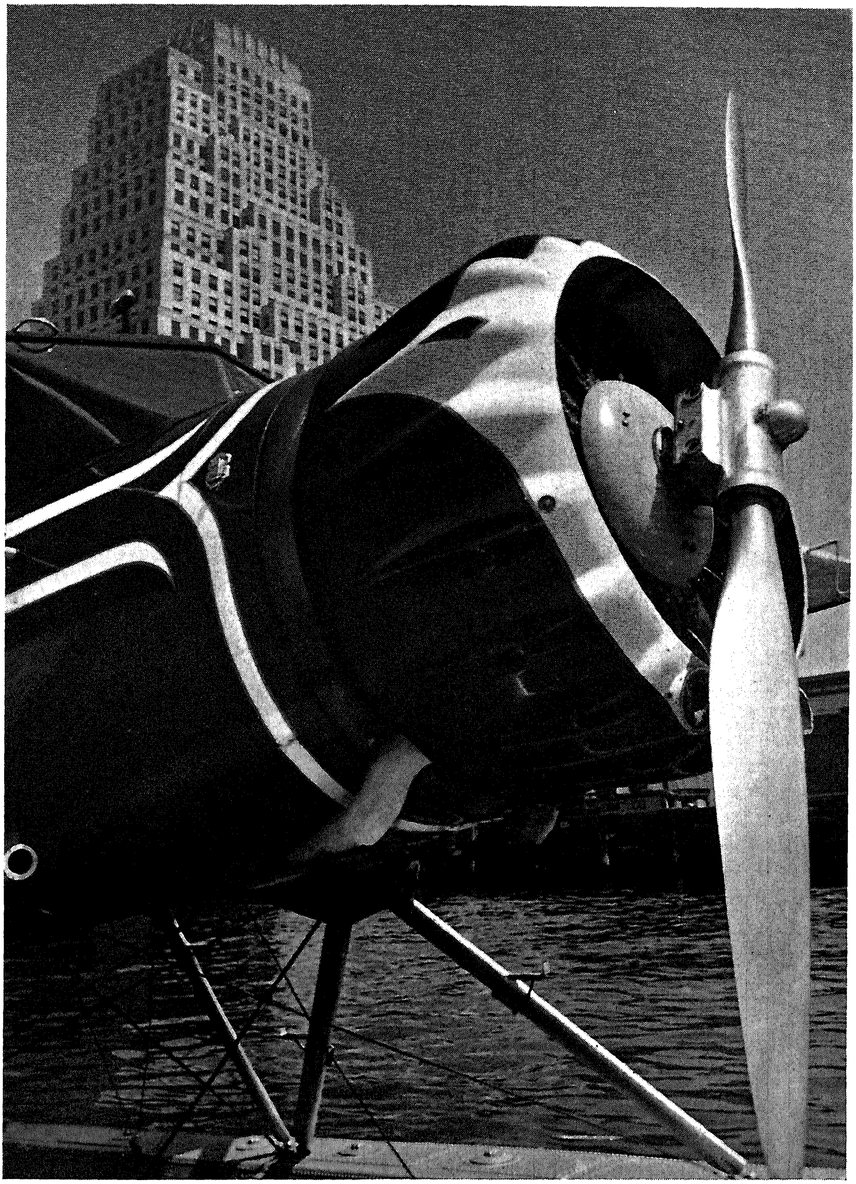
Contact printing. If the simple positive printers Eldia (for printing film strips), or Eldur (for printing glass plates) are used, a lamp is required to make the exposure unless we use the light unit of the enlarging apparatus. The intensity of the light source should be so weak that the exposure requires about six to eight seconds. If the light is too strong and the exposure is shortened correspondingly, the least variation in the time will cause the density of the positive to be influenced too much. The large printing apparatus is equipped with a built-in light source and a regulating resistance, and even has provisions for an exposure clock. This printer is also equipped with two lateral slots for the introduction of masks or other auxiliary devices which permit the dodging of portions of the negative.

Making Lantern Slides by Enlarging

The Leitz Works now make projectors which yield such intense light that the small Leica positive can be projected with good brilliance even when the screen distance exceeds ninety feet and the size of the projected image is approximately 9 x 13.5 feet. Under certain conditions it may be permissible to slightly enlarge the original Leica negative and by projection printing make a positive on a Leica lantern slide (2 x 2 in.) if the ratio of the enlargement is not much more than 1:1.5 or 1:2. This can be done if the original photograph was taken with an objective of too short a focal length and we want to increase the size of the more distant objects to create the impression that we used a lens of longer focal length. In this case, the danger of the image on the screen appearing too flat does not exist because we made a correction from exaggerated perspective to normal perspective. When making such slight enlargements, the Leica enlargers can be used by interposing intermediate rings between the lens mount and the lens employed. Personally I have hardly any use for this type of slightly enlarged positives because I always attempt to make use of the full area of the negative. In most cases I recommend to every photographer always to try to determine the desired composition within the frame of the picture **before** taking the photo rather than enlarging only a portion of the negative.

The Universal finder can be used to great advantage for this predetermination of the picture. View the subject through the finder, then increase or decrease the size of the rectangular frame and critically survey the appearance of the subject within the frame. When you have found the right framing, you can read on the ring of the finder what focal length lens is required to take the picture from that particular standpoint. But now approach the subject and gradually open the frame of the finder so that the area remains about the same but the relation in the sizes of the various objects at different distances changes; in other words, the perspective becomes more pronounced and the finder indicates that a shorter focal length is required. Thus, the Universal finder is helpful in studying the rules of composition and perspective, even if we own only one lens.

Making corrections. Although the safe-light of the darkroom permits a good inspection control of the positive during development, it is still possible that one or more positives may turn out to be too transparent or too dense. It is preferable to develop positives somewhat too long, even



Downtown Airport

Anton F. Baumann

Hektor 28mm, 1/60, f:9, No. 1 Filter, Panatomic Film though they may be somewhat dense. I shall briefly explain my reason for this advice.

When printing I expose and develop my positives rather fully. After they have been finished in the hypo solution and washed in water, I use a greatly diluted solution of Farmer's Reducer and in full daylight correct the density to the desired degree. Lantern slides which have been produced by this method show a particularly good brilliance.

Farmer's Reducer (Formula: R-4)

	Avoirdupois	Metric
Solution A		
Water	1 ounce	32.0 cc
Potassium Ferricyanide	15 grains	1.0 gram
Solution B		
Water	32 ounces	1.0 liter
Sodium Thiosulphate (Hypo)	1 ounce	30.0 grams

Add A to B and immediately pour over the negative to be reduced. The formula should be prepared immediately before using as it decomposes rapidly after mixing together the A and B solutions. When the negative has been reduced sufficiently, wash thoroughly before drying.

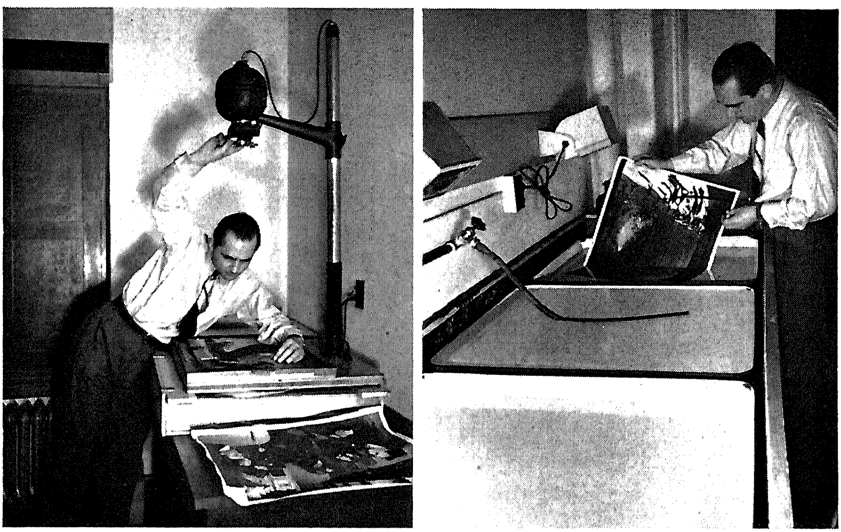
Of course, every photographer can tone his positives according to his own taste, but I should like to advise every Leica owner to restrict his activity to only a few varieties of tone. Directions and materials for the toning of lantern slides can be obtained in any photographic store.

Mounting lantern slides. Although a positive film strip is ready for use as soon as it has dried after printing, it has the disadvantage that, in spite of the most careful handling, it will eventually show scratches and dust spots because of the repeated rolling and unrolling of the film strip. It is possible to mount the film positives between glass plates, selecting either three consecutive frames for one mount or mounting the frames individually. This, incidentally, is the only satisfactory method for mounting Kodachrome films. However, wherever possible, this method should be avoided, and the individual Leica pictures printed directly on glass plates. The method of mounting by simply placing a cover glass over the lantern slide plate is extremely simple and it is much easier to avoid dust particles between the glass plates. As a binding material to hold the cover glass and lantern slide plate together, Scotch cellulose binding tape is recommended.

And finally, a few words about dust. In my previous article about the making of giant enlargements, I dwelt thoroughly upon the avoidance of of dust on the negative. It is almost still more important to avoid dust on the positive and this refers not only to printing but also to mounting; small dust particles which adhere to the surface of the negative or the positive plate during the process of printing will show as white spots on the screen, whereas, those particles which adhere to the surface during the mounting will show up as black spots. If, however, the slide is mounted in a relatively dust-free room and the photographer exercises a reasonable amount of care, neatness, and cleanliness, it is possible to avoid the appearance of dust almost completely. For cleaning purposes, I recommend either a piece of soft chamois leather which has been washed repeatedly or a fine badger-hair brush.

Black and White Enlargements from Kodachrome Positives

When the Kodachrome film became available for the Leica, everybody was highly enthusiastic about the beautiful projected pictures in natural and rich colors. Many photographers, including myself, were so favorably impressed by this form of presentation that they neglected black and white photography. These transparent positives in natural colors, however, can also be used for making black and white enlargements. I believe that the best way to proceed is, to make a slightly enlarged negative (2¼ x 3¼ in.) on Panchromatic process film and then to enlarge this negative in the regular way, see Chap. 15 for additional details. In making these intermediate negatives, we can apply color filters by following the same rules which govern the use of color filters when taking the original photo on Panchromatic film. These color filters have to be attached to the lens of the enlarger which is used to make the intermediate negative.



Franz Reichert

Fig. 46 Anton F. Baumann at Work in His Darkroom

The Wink Harold L. Harvey

Elmar 90mm, 1/60, f:6.3, Photofloods, Du Pont Superior Film

LEICA LENSES

H. W. ZIELER

CHAPTER 3

"What kind of a gadget is this? Is it a movie?"

"No, it's a little camera. Did you ever hear of the *Leica?*"

"Oh yes—so, this is a *Leica;* it certainly *is* a compact little thing! How large a picture can you take with it?"

"The pictures are not much larger than a postage stamp; but you can enlarge them to almost unbelievable sizes."

"Gee whiz—it must have a marvelous lens!"

Why does everybody think at once of the lens when he sees a miniature camera? Why must a small camera have a particularly good lens? What properties characterize a good lens? What does the lens have to accomplish and how well does it succeed? How can you use your lens equipment to best advantage and why may you want to have several lenses?

When miniature photography was in its infancy, there were many sceptics who pointed out that an enlargement can never be as sharp as a contact print; and since the small negative must always be enlarged considerably, the loss of detail, it seemed, ought to be so great that the enlargement would be of little value.

Practice soon gave ample proof to the contrary. But practice alone is often considered as insufficient proof because you may have to use all kinds of tricks which only the expert knows. To set our mind at ease about the possibilities of miniature cameras we may start our investigation about lenses by finding out how sharp the negatives of miniature cameras are. It is true that an enlargement must always be less sharp than the original negative because the same detail is stretched over a larger area. Still it is quite possible that we may not be able to detect any difference.

Suppose we have before us two pages covered with printed matter. Some clever printer may have been able to make the letters on one page as small as 1/500th of an inch. But the second page may have letters as small as 1/1000th of an inch. We hold these two pages as far away from the eye as we would hold a moderately sized photograph. Of course, we would not be able to read these pages.

We would not even be able to see from this distance which of the two pages has the smaller letters.

The capacity of the human eye to make detail distinguishable or, *the resolving power* of the human eye, is limited. If we compare two objects as, for instance, a contact print and an enlargement, the former having detail ten times smaller than the resolving power of the eye and the latter having detail which is only three times smaller than this limit, we may not be able to detect any difference in sharpness.

The limit of resolving power of the human eye has been determined by experiment and calculation. It is customary to express it by the magnitude of the smallest detail **in the object** which can still be *resolved.* This magnitude depends, of course, upon the distance from which we view this object. If we want to see finer detail, we move the object closer to the eye. But the *angle of vision* under which the finest resolvable detail appears, always remains the same. Thus it has been found that, allowing for slight variation of individual power of vision, the limit of resolving power of the human eye is about 2 to 3 minutes of arc. That means that in an object held about ten inches from the eye we cannot see detail if it is closer together than 1/100th part of an inch. If the object is 20 inches from the eye, the detail must be 2/100ths of an inch apart if we are to distinguish it.

Now we have to investigate how closely the detail can be crowded together in a negative from a miniature camera. This investigation is rather involved and it is to our advantage if we penetrate more deeply into the entire process of the formation of images by lenses.

Let us select the simplest object possible: one luminous point, Figure 48 below, shows a diagram of a simple experiment. A lentil-shaped piece of glass is placed at a certain distance from the luminous point P.

A sector of light of the angular aperture **a** passes through the glass and in doing so it changes its original direction. Each light ray is broken or, in scientific language: refracted. The more obliquely the rays meet the surface of the glass, the more pronounced is the change in direction. By skillfully shaping the piece of glass we may be able to guide each ray in such a manner that, after leaving the lens, the entire bundle of rays converges as a cone of the angular aperture **b** until the rays meet again in **one single point** $\mathbf{P}_1$, which is the image of the original point **P**.* This is the essential principle of

* If we hold a screen in the plane **I-I** we see on it one bright spot $\mathbf{P}_1$.

the formation of a *real* image. When photographing a complex object the lens collects diverging bundles of rays from each object point and must unite them in *image points* which must have such location in respect to each other that they reproduce the object in the image plane.

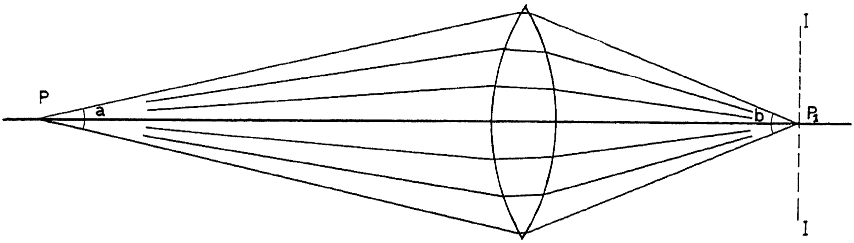


Fig. 48 Formation of a Real Image of a Luminous Point.

It is the job of the lens designer to *skillfully shape the lens.* In practice this job is so immensely difficult that we may say, it is impossible to succeed completely. In the first place it is next to impossible to grind and polish accurately enough any surfaces of unusual shape. In fact, in photographic lenses we only find lenses with spherical or plane surface. But even if we were not limited in this respect, we would meet with many other difficulties. These light rays are tricky individuals. One single ray of white light, for instance, upon entering the lens, begins to disintegrate into rays of various colors and finally a rainbow colored cone of light leaves the lens. This phenomenon is known as *chromatical aberration.* We also must contend with the fact that if we use spherical lenses, the outsiders, the rays which meet the lens with greatest obliquity, are *bent* too strongly and refuse to come to the same meeting point where the rays of the center of the cone unite. This is known as *spherical aberration.*

There are many more misbehaviors of light rays which give the lens designer a headache. If he wants to guide these rays to the same point he cannot restrict himself to the use of one single lens. He must combine several pieces of glass, selecting different materials and shapes and placing them at accurately determined distances from each other. Thus he creates a photographic objective of the type shown in figure 49 which is the famous Elmar lens of the Leica camera.

You will see the definite plan of construction: a single plano-convex lens is followed by a biconcave lens, placed at a definite distance from the first. Behind this second *element* there is a pair of lenses cemented together. Each lens has spherical or plane surfaces which in a diagram appear as parts of circles or straight lines. The centers of all these circles lie on one straight line, called *the optical axis.*

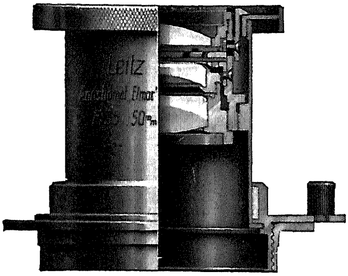


Fig. 49 Cross-section of the Elmar 50mm f:3.5 Lens

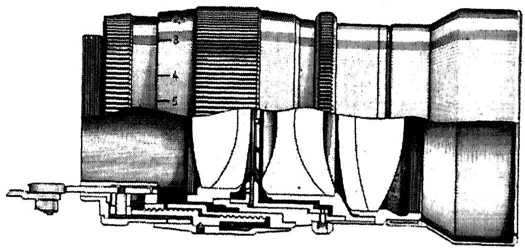


Fig. 50 Cross-section of the Hektor 73mm f:1.9 Lens

There are other types of objectives* such as the Hektor shown in figure 50, the Summar and many others. Each of them is built according to a different plan and represents an effort to make the rays *behave,* but no effort is completely successful. There is always a sacrifice in some respect, as we shall see later.

With one of these objectivevs we may perform a few interesting experiments. Of course, we cannot actually select as an object one single luminous point. But we may produce a disc of light of a definite and small diameter. Suppose a ground glass is placed before a bright lamp and again before the ground glass an iris diaphragm which can be contracted to very small diameters. This may produce a luminous disc of, say 1/10 of an inch. We place the lens at a certain distance from the light source and on the other side of it we place a screen so that on it the image of the luminous disc appears with maximum sharpness. The conditions may have been so selected

* "At this place, I wish to emphasize that I prefer the word 'objective' to the word 'lens', although the latter term is more popular. A lens is really one piece of glass whereas an objective is a compound unit and consists of several lenses."

that the image has a diameter of 1/200th of an inch. In other words, the image is twenty times smaller than the object. Now, we reduce the opening of the iris diaphragm to 1/30th of an inch and the image, again twenty times smaller, is 1/600th of an inch. But as we further reduce the diameter of the luminous disc (perhaps to 1/100th) we find that **the image retains the size of 1/600th inch.**

This is a very important discovery. Suppose we would have two luminous object points, each of them very small, for instance 1/1000th of an inch in diameter, but less than 1/30th of an inch apart. The lens, when forming the image at the same ratio of reduction as before, (20:1) reduces the distance between the images to less than 1/600th but at the same time each of the images occupies 1/600th. The two image discs overlap, melting so to speak into each other. We have now overstepped the limit of resolving power of the lens.

This experiment reveals a very important fact regarding the performance of optical instruments; the image of a theoretical object point is never a point but a light disc of definite, measurable diameter. But if we think that the actual magnitude of this disc can be made smaller and smaller as manufacturing methods and the art of lens designing improves, we are greatly mistaken. Unfortunately there are definite limits which cannot be overstepped and they have their cause in the very nature of light itself.

In a diagram we may indicate a light ray by one straight line, but in reality we find that as light progresses with infinite speed in the direction of this line, very minute vibrations take place with enormous frequency. Physicists have attempted to explain the many strange phenomena which light can produce, by assuming that it propagates like a wave motion. To help our imagination we may make a comparison. Suppose that you throw a stone into a lake. From the center, where the stone hits the surface of the water, we see a wave motion spreading with equal speed in every direction as circles of ever increasing diameter. From crest to crest of successive waves there is always the same distance, called the wave length. This wave length may be small or large. The motion of the waves probably spreads with a speed of several feet or yards a second. But as these waves move away from the center, the surface of the water only moves up and down so that if a piece of wood is swimming on the water, it is carried up and down but not away from the center of the disturbance.

If light proceeds from a luminous point, waves of unbelievably small wave length spread with equal speed in every direction. This speed, however, is very great, almost 200,000 miles per second. The vibrations take place at right angles to the direction of propagation. And, to come back to the formation of the image of a point, where the light is concentrated into the image point, we find an enormous confusion of vibrations from light waves of different lengths and directions. These waves partly interfer with and cancel each other but still they spread the light over a certain area. In fact, if we would study this area through a microscope, we would find a small disc of light surrounded by rings of light of very weak and rapidly diminishing intensity. This is called a *diffraction pattern.*

We need not penetrate further into these theoretical optical matters. We must only realize that even a theoretically perfect objective has a limited resolving power. This **theoretical** resolving power depends mainly upon the angle of convergence of the cone of light which the lens concentrates (in fig. 48 this cone is marked *b*). **The larger this angle, the smaller is the finest detail which a theoretically perfect objective could reveal.**

But here we can see the difference between theory and practice. It is unfortunate but true that, as we try to make objectives with great light concentrating power, the difficulties which we encounter increase beyond description. These misbehaviors of light: spherical and chromatical aberration and many others, can hardly be held in check. If we are content with a small cone of light, the situation can be controlled quite nicely. A small cone, of course, contains so to speak, only a small amount of light and when photographing we would have to give very long exposures. In this age of speed this would be a serious handicap. Therefore there is a constant race between the manufacturers to produce lenses of greater light concentrating power: but the task before them is very difficult indeed.

The Iris Diaphragm and the Resolving Power

As you know, photographic lenses are equipped with iris diaphragms with which the angular aperture of the cone of light, and therefore also the light intensity in the plane of the image, can be regulated. As we open or close this diaphragm the difference between theory and practice evidences itself as follows:

a. When the iris diaphragm is closed, the difference between theory and practice is least noticeable. At the same time the theoretical resolving power is at its *worst.*

b. As the iris diaphragm is gradually opened, the practical insufficiencies come more and more into the foreground. This does not mean that any practically produceable lens yields the sharpest images when the iris diaphragm is closed. In fact, in a good lens the sharpness will **increase** as we begin to open the iris. **Only, it will not increase as much as can be theoretically expected.**

c. If the iris diaphragm is opened considerably, the misbehaviors of light finally become so noticeable that even **the actual sharpness decreases.**

A good method to judge the quality of a lens is, therefore, to find out how much the iris can be opened with a beneficial effect upon the sharpness, the resolving power, of the lens.

Every photographer should realize the full significance of this fact and should not believe the wrong statement that any lens performs best when the iris is closed as far as possible.

But let us not forget our original question: How sharp is a miniature negative? The actual limit of the resolving power is not the only factor to consider. We must not forget that the image which the lens has formed is recorded on the film, which is coated with a light-sensitive emulsion. The emulsion is turbid and has a certain thickness. As the light penetrates into the emulsion, it is scattered and the record of the image of one single luminous point upon the film emulsion will necessarily occupy a larger area. Thus the film emulsion introduces a certain loss of sharpness. If we wish to find a quantitative measure for the sharpness of a miniature negative we must measure the diameter of the image disc on the emulsion when the object is so small that its image is equal to the limit of resolving power of the lens. This area is often referred to as the *circle of confusion,* because within this circle there is a great confusion of aberrations, diffractions, dispersions and many other misbehaviors of light.

Thus it has been found that the diameter of the *circle of confusion* of the better lenses, such as are used in miniature cameras, does not exceed 1/800th of an inch, even when the diaphragm is open and the practical discrepancies are most apparent. Upon closing the iris diaphragm, the sharpness improves, then retains this optimum value until finally, as the aperture assumes very small values, it decreases slightly.

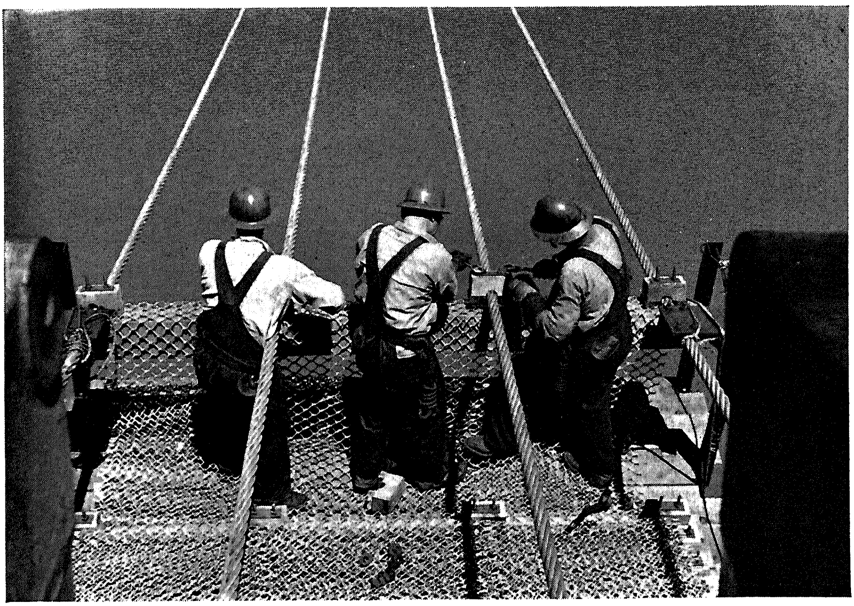


Fig. 51 Bridge Workers — Peter Stackpole
Elmar 35mm, 1/100, f:9, Du Pont Superior Film

We learned in the beginning that the smallest detail which the human eye can detect from a distance of 10 inches is about 1/100th of an inch. **If the detail in a miniature negative is crowded into as small a spot as 1/800th it is quite evident that this negative can be enlarged 8 times without noticeable loss of sharpness.**

If you really want to look at the **picture** you will never hold an enlargement of 8 x 10 inches closer than 10 inches from the eye. Only *grain fiends* have a habit of *smelling their pictures,* regardless of size. We, who want to enjoy the pictures which we have taken, have learned that an enlargement may appear as sharp as a contact print and thus we may confidently discard bulky equipment in favor of the small and compact Leica. Its existence is built upon a sound scientific basis and, as far as sharpness of the picture is concerned, we may safely say that for our purposes, it is sufficiently equivalent to the large camera.

The Miniature vs Larger Cameras

With this fact established we shall now proceed to find that in other respects the miniature camera is definitely and considerably superior to the large camera. Above all, it has reconciled two opposing factors which cannot be mastered with larger cameras: *speed* of the lens and depth of focus in the negative.

You will often have found in photographs that some parts of the picture were sharper than others. Either the objects close to the camera are sharp and those further away appear *fuzzy;* or the background is sharp and the foreground is *out of focus;* or there is a range-in-between which is imaged crisply, whereas the very near and very far objects lack in sharpness. The photograher can, at will, select the range of object distances within which everything is imaged with the best possible sharpness and, if he uses his camera correctly, he can always direct the attention of the spectator to the subject of interest. There is, then, a range within which everything is equally sharp and this range represents the *depth of focus.*

In photographs of general outdoor scenes and many other types of pictures it is highly desirable, if not essential, that the entire picture be in perfect focus. Only in portraits and group pictures it often is of special advantage to reproduce in sharpest focus only the subject of interest and to have foreground and background intentionally out of focus, in order not to distract the attention of the spectator.

If you compare Leica snapshots with those of a larger camera, you will notice at once the increased depth of focus in the Leica enlargement. I used the word *snapshots* for a special reason because as long as the big-camera owner is allowed to increase the time of exposure of his photos as much as he wants, he can also produce pictures of remarkable depth of focus. He must only close the iris diaphragm.

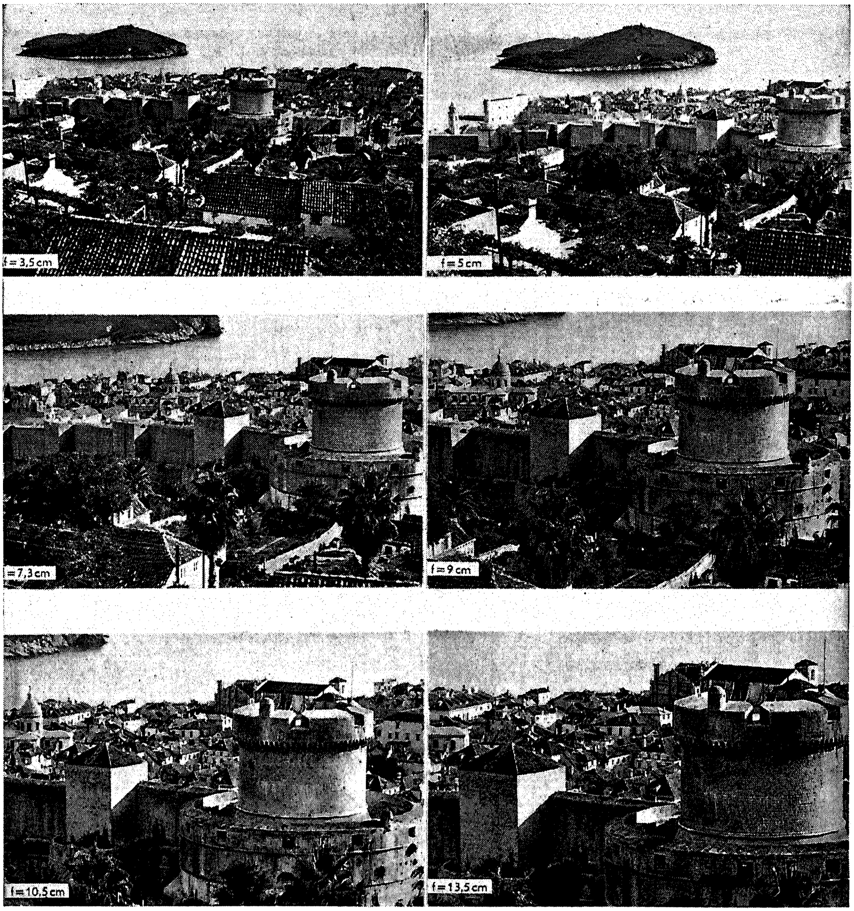


Fig. 52 Fields Covered by Six Different Leica Lenses. All Photographs Made From the Same Point.

On the mount of a photographic lens a whole series of numbers is engraved which, upon first sight, seem to have no sensible relation to each other. But if in a competition between large and small camera the iris diaphragm is in both cases set to the same figure, for instance f:4.5, and then the two pictures are compared in regard to depth of focus you will win the race by a wide margin if you were the one who used the miniature camera. And if you had inquired from your competitor about the time of exposure of his picture, you would have found out that it was the same as that which you gave, provided you both have the correct time.

In other words, the iris diaphragm affects not only the depth of focus but also the time of exposure. It seems important to study both functions. We begin, of course, with the effect upon the depth of focus. But even before we come to this, we must explain why the large camera, when the iris diaphragm was set to the same figure, yielded images of less depth of focus.

Depth of Focus and Relative Aperture

We resort again to experiments. We take a lens for a 5 x 7 inch camera and the Elmar 50mm lens. In both cases we set the iris to the figure f:4.5 although we do not know as yet what that means. We also need two screens, on which to project the images and a yardstick ruled in very fine units, with which we want to measure, not only the distance between screen and lens, but also the size of the images on the screens.

Since we want to explore various ranges of object distance, we select at first an object which is very very far away: the sun. We move the screens back and forth behind the lenses until the images are as sharp as possible. We see in both cases a very small and very brilliant spot. The screen for the large lens is about 10 inches behind the larger lens, whereas the other one is about two inches behind the Elmar lens.

This distance at which the image of an infinitely distance object is formed, is called *focal length of the lens.** If we have held the lenses so that their optical axes point directly into the sun, the images are formed in the *focal points.* The screens are in the *focal planes* of the respective lenses.

The **focal length** of a lense is a very important factor. It determines the location and size of the images which the lens forms of objects at different distances, the depth of focus, the perspective and many other things and is one of the main keys to the secret of the performance of the lens.

A comparison of the sizes of the images which in our experiment both lenses have formed of the sun reveals that, although both of them are very small, the one formed by the Elmar is still the smaller one.

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* Actually the focal length is the distance of the focal point from the so-called *principal plane.* Readers interested in optics may find further information in physics textbooks.

From the experiment we learn that the image of an infinitely far object is formed in the focal plane and that the lens with the smaller focal length forms the smaller image.

Now let us select another object which is nearer, for instance a telegraph pole which is about 30 feet high and 100 feet away. We discover that the screens must be moved farther away from the lens in order to be in the plane of the image. When the screens are properly focused the one of the 10 inch lens is 0.084th of an inch (or 2.12mm) behind the focal plane. Had we left it in the focal plane, the image would have been anything but sharp. The size of the image of the pole, incidentally, is about 3 inches high.

The screen of the Elmar lens, however, had to be moved only 0.0033th of an inch (or 0.085mm). This is not much more than the thickness of a sheet of paper. Therefore it is not surprising that even as long as this screen was left in the focal plane, the image was still remarkably sharp. As to the size of the image of the pole, which the Elmar has formed, it is only 5/8th of an inch high.

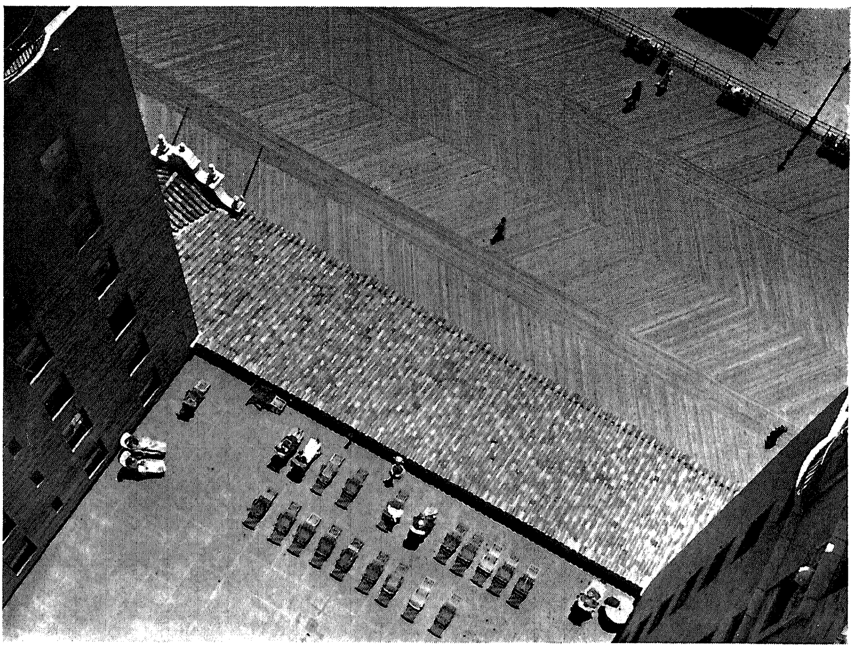


Fig. 53 Boardwalk, Coney Island — Richard Statile

Summar 50mm, 1/60, f:11, E. K. S. S. Pan Film

This experiment will convince you that the Elmar lens of the Leica camera forms images of greater depth of focus. The image of the sun (many millions of miles away) was practically in the same plane as that of the telegraph pole which was only 100 feet from the lens. But now remember figure 48 where the rays coming from one object point converge to a small spot and then diverge. As you move the screen farther away from the lens, the rays from this object point occupy a larger and larger area. At the same time the cone of rays from a nearer object point would still be in the process of converging. You must also remember that the image which a lens forms of a point even in the plane of maximum sharpness is never a true point but a small disc (circle of confusion). Thus we can illustrate the entire situation in a diagram shown in figure 54.

Point **P** is imaged at $\mathbf{P_3}$ where the image occupies a circle of confusion of the diameter **A—B**. Point $\mathbf{P_1}$, nearer to the lens, is imaged farther away so that in the plane **I—I** the rays are still as far apart as **A—B**. The geometrically correct plane of the image of point $\mathbf{P_1}$ is farther away, at $\mathbf{P_4}$.

On the other hand, point $\mathbf{P_2}$, farther away from the lens than **P** is imaged closer than $\mathbf{P_3}$ and in the plane **I—I** the rays have diverged so much that they occupy the area **A—B**. The total effect is that on the film held in the plane **I—I** the images of all three points are equally sharp and as sharp as the limit of resolving power of the lens.

If you have understood this relation, you will be able to answer the question: what happens when the iris diaphragm is closed further? The angular aperture of the image-forming cones of rays becomes smaller and the rays converge and diverge less rapidly. Thus the depth of focus increases. This is shown in the diagram of figure 55.

To summarize: Lenses of shorter focal length have greater depth of focus. The depth of focus of a lens of given focal length increases when you close the iris diaphragm.

Depth of Focus Scale

As mentioned before we find on the lens mount a scale with numbers, the meaning of which we have not yet explored. All we know is that these numbers refer to different apertures of the iris. But at the base of the lens mount, there is a beveled ring on which from one center index mark to both sides we find the same numbers as on the iris scale. These numbers, in connection with the distance scale on the lens ring enable you to read the depth of focus for each aperture of the iris.

You can close the iris to the mark f:4.5, focus the lens to an object which is 20 feet away and the depth-of-focus scale informs you that now even objects as close as 14½ and as far as 32 feet are in perfect focus.

If you make intelligent use of this depth-of-focus scale, you can greatly enhance the quality of your pictures. It is not always advisable to have the greatest depth of focus possible. In a portrait, for instance fine effects can be obtained by intentionally reducing the depth of focus, so that everything except the features of the subject is out of focus. Thus the attention of the spectator is at once directed to the subject of interest.

Even in other cases you can make good use of the scale. If on your honeymoon you want to take a picture of your bride at Niagara Falls you might be equally interested in showing the beauty of the falls. If you set the iris to f:9 and your bride is 15 feet from the camera which is correctly focused for this distance, everything from 9½ to 35 feet is in focus but the falls which are farther away, are not sharp. But if you consult the depth-of-focus scale you may learn that with the iris at the same stop, the same distance from the camera to the bride but the focusing mount set to a distance of 27 feet everything from 12½ feet **to infinity** is sharp. You have sacrificed the foreground for the benefit of the background. Many photographers do not realize the full significance of this possibility to correctly "place" the range of depth of focus.

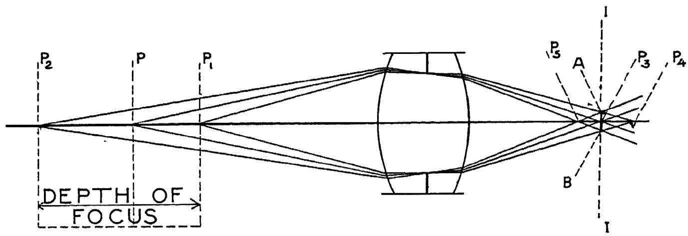


Fig. 54 Depth of Focus with Iris Diaphragm Open

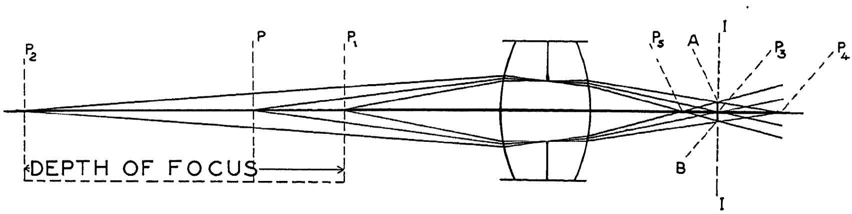


Fig. 55 Depth of Focus with Iris Diaphragm Closed

At this place it is advisable to draw attention to the fact that the depth-of-focus scale should not be taken too literally. You must realize that the smaller the circle of confusion,—or to express it differently, the sharper the image or the better the correction of the lens,—the smaller is the range of depth of focus for a given aperture. The scales are mostly based on an assumed size of this circle of confusion which is still small enough to permit enlargements to about 8 x 10 inches. It was mentioned before that upon closing the iris, the actual resolving power increases. Quite a number of other factors, such as the thickness of the emulsion on the film, etc., have to be considered. Therefore, the actual range of **maximum sharpness** (especially at smaller aperture of the iris) is **not identical** with the **depth of focus** indicated on the scale although even within this latter range, the sharpness is still satisfactory.

If on the other hand your best friend wants to *get your goat* by boasting that his lens of the same focal length and the same aperture has a greater depth of focus, don't be jealous, just pity him because either he lies or he admits with his boast that his lens is not as well corrected as yours.

Thus we conclude our investigation regarding the depth of focus and direct our atention to the other function of the iris diaphragm. The regulation of the amount of light which passes through the lens.

Exposure Variations

It is quite easy to comprehend that if we close the iris diaphragm, less light passes through the lens. But this knowledge alone is of little help to us. Suppose we had to close the iris to one-half of its original aperture in order to have enough depth of focus in the picture; how much do we have to increase the exposure? Rather than try until we hit by accident the right time of exposure, let us analyse the situation. Figure 56 helps us in our investigation.

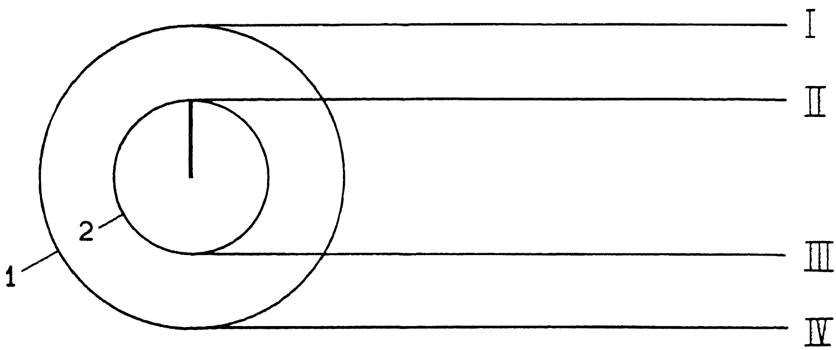


Fig. 56 Principle of "Relative Aperture"

Four rays, marked I to IV come from a distant point. If the iris diaphragm is fully open, the entire amount of light between the rays I and IV is collected by the objective. But the diagram shows only a cross section of the lens. Actually these rays would fill an area represented by the circle No. 1 at the left side of the diagram.

If we close the iris diaphragm to one-half of its original diameter only light within the cone of the rays II to III filling the area of the circle No. 2 would be able to pass through the lens. Although this circle has one-half the **diameter** of that of No. 1, you will remember that the **area** decreases with the square of this ratio. Thus only one-quarter of the original amount of light passes through the lens when the iris diaphragm is closed to one-half. Closing it further to 1/3rd of its original aperture would, of course, reduce the intensity to 1/9th, etc.

Realizing this we could make a scale which carries the number 1 when the iris is fully open, number 4 when the iris is closed one-half, number 9 when it is closed to 1/3rd, etc. These numbers would indicate the increase in exposure necessary when the iris is partly closed. But this would not fully solve our problem. Suppose you want to compare your Elmar with the lens of one of your friends who happens to own a 5 x 7 camera. His lens has a much larger diameter. Does it collect more light when the iris diaphragm is fully open? Comparative exposure data may show that even with the iris so far open that the actual diameter of the cone of light entering his lens is twice that of your lens, he requires longer exposures. What we need is an *absolute* system so that we can compare the light transmitting power of lenses of different focal lengths.

Do not forget that the lens of the 5 x 7 inch camera, having a focal length of 10 inches, also forms relatively larger images. If, for instance, a lens of different focal length has twice the diameter of your Elmar but objects at identical distances are imaged twice as large, the greater amount of light passing through the larger lens is also spread over a larger area (this area too increasing with the square of the size of the image) so that the actual intensity in each point of the image is the same as that in the image of your Elmar. Both lenses have the same light transmitting capacity.

In other words, the actual diameter of the lens is no usable measure for the amount of light collected by it. We must compare it with the focal length of the lens which, as you know, also determines the size of the images. The ratio: focal length divided by the effective diameter of the lens has therefore been introduced as the standard measure for the light collecting power of the lens. The increase in exposure when closing the iris diaphragm can always be found by comparing the squares of these ratios.

A practical example will illustrate how you must proceed: The lowest figure on the aperture scale of the Elmar lens is f:3.5. Since the focal length of this lens is 50mm, the actual effective diameter of the lens is 50:3.5 (or 14.3mm). How much longer do you have to make the exposure if you close the iris diaphragm to f:4.5? Divide the square of 4.5 (or 20.25) by the square of 3.5 (or 12.25) and you will find that with the smaller aperture you must expose 1.67 times as long. If in the first case (iris at f:3.5) you had to give an exposure of 1 second, you must expose 1.67 seconds with the iris at f:4.5 in order to obtain a negative of the same density.

But if you have once established the correct exposure for certain light conditions and a definite relative aperture of the lens (for instance f:4.5) you can give this exposure to any photo, regardless of the focal length of the lens. The Hektor 135mm at f:4.5, the Elmar 90mm at f:4.5, the Summar 50mm at f:4.5, the Elmar 35mm at f:4.5; all these lenses at these apertures require the same time of exposure. Stick to this rule, even if super-sensitive experts tell you that they have discovered minute variations in densities of negatives thus taken. The latitude of the film will protect you.

Also remember that the effective diameter of a lens, even when the iris diaphragm is full open, is not equivalent to the diameter of the first element in the lens but to the diameter of the cone of rays in an optical reference plane called **entrance pupil.** The size and shape of the first element depends entirely upon the plan of design of the lens and can vary even if the light transmitting power remains constant.

Perspective and the Various Leica Lenses

Before we discuss the merits of the various objectives for the Leica camera, a few words must be added in regard to the perspective in a photograph because the focal lengths of these lenses vary from 28mm to 200mm and sometimes you may be in doubt whether you should go close and use a short focus lens or take a lens of longer focal length and go farther away from the object until you see the same relation between image and frame size in the field of the view finder.

We have seen that the focal length of the objective determines the size of the image of any object at different distances. It is to our advantage if we become acquainted with the exact mathematical relation between the focal length, the object distance, the size of the object and that of the image. This relation can be expressed by the following equation:

$$\frac{O}{I} = \frac{D - f}{f}$$

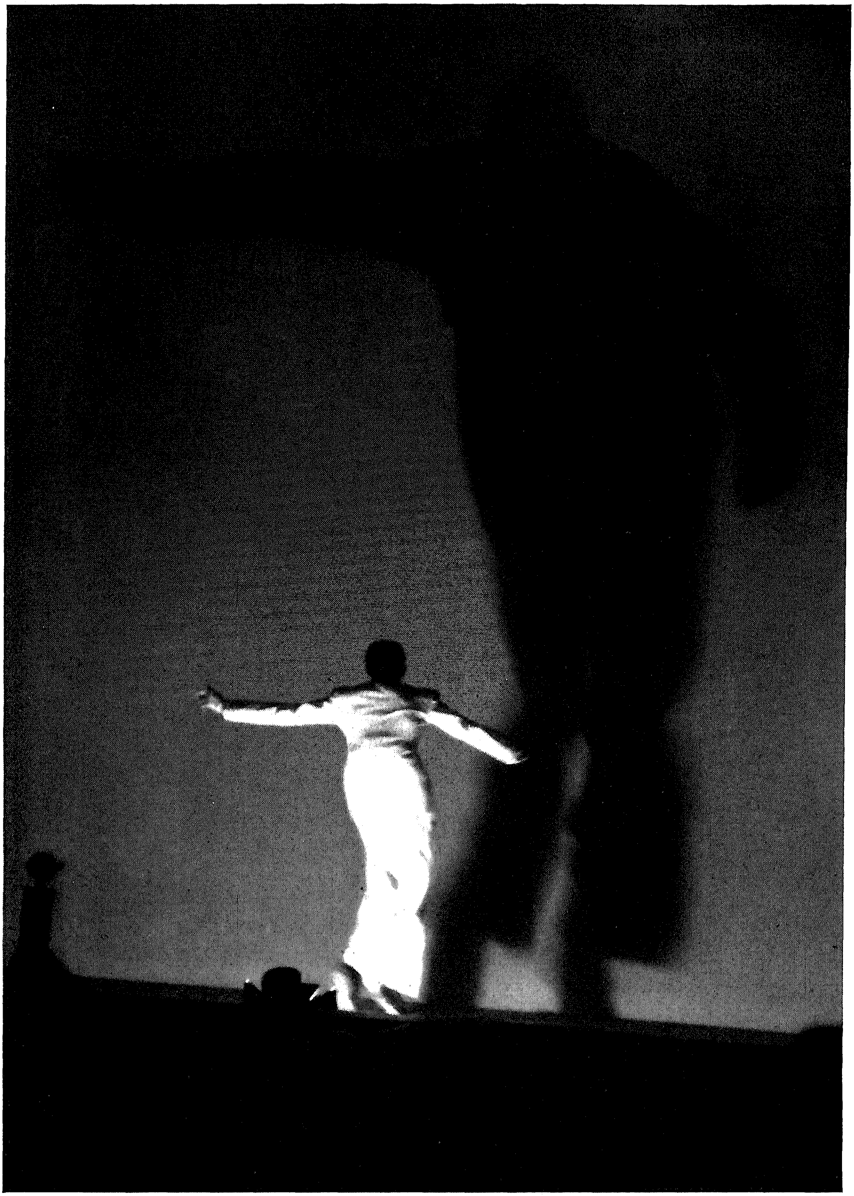
the symbols finding their interpretations as follows:

O = size of the object
I = size of the image
D = Distance of the object from the lens
f = focal length of the lens.

This fundamental equation should remain in the memory of every photographer because he can derive great benefit from it. The left side represents the ratio of reduction in the image. Here is how you can apply it:

Suppose you have obtained permission to photograph the animals in the zoo. There is a beautiful lion which you wish to photograph. The bars of the cage are about 15 feet from where the lion generally reposes. Which objective should you take along so that you can hold the camera between the bars of the cage and snap the picture without wasting space on the negative for the empty cage?

The lion is 6 feet long (72 inches) and the longer side of the negative is 1½ inch. The ratio of reduction must be 72 : 1½ or 48 : 1. The object distance is 15 feet (180 inches). The equation tells you that the objective which you should use must have a focal length of 3.6 inches or about 90mm.



Shadow Dance — Gilbert Morgan

Hektor 73mm lens, 1/40 second at f:1.9, Agfa Superpan film

But we can gain more valuable information from this equation. You know that objects which are far away appear small and those which are close appear large in the picture. This accounts for the perspective in the picture.

The ratio at which the image size decreases with increasing object distance likewise depends upon the focal length of the lens and can easily be determined with this equation.

Suppose you want to photograph the telegraph poles along the road side. They are about 20 feet high. The first pole is about 75 feet from where you stand and the distance between each following pole is 75 feet. At first you take a photograph with the 90mm lens. The equation tells us that the image of the first pole is 24mm high, that of the second pole is only 12mm high or one-half the size of the first one.

Now you change to the Elmar 50mm, but you **remain standing where you were.** On this negative the first pole appears as an image of only 13mm and the second one is about 6½mm. Although both images are smaller the second pole appears again at one-half the size of the first one. From this experiment we learn that: **lenses of different focal lengths, used for photographing from the same distance show identical perspective in the image but different ratios of reduction. The smaller the focal length the greater the ratio of reduction.**

But when you use the 50mm Elmar you can *go closer to* the first pole until its image is again 24mm high. You must now approach it until you are only 41.7 feet away. But now the image of the second pole is only 8.6mm high or only slightly more than **1/3rd of the size** of the first one. From this experiment we learn that: **lenses of different focal lengths used for photographing so that the ratio of reduction of the image of one given object remains the same, show different perspective. Lenses of shorter focal length yield images with more pronounced perspective.**

If you hold side by side the two photographs of the telegraph poles taken with the 90mm Elmar and the 50mm Elmar from different points of view so that the first pole in both cases is equally long in the pictures, you may want to know which of the two has more natural perspective. The general problem involved is somewhat complicated because various factors are involved. For instance, we must give consideration to the size of the enlargement and the distance from which we look at it. But in general we may assume that an enlargement of 5 x 7 inches is held about 10 to 12 inches from the eye and as the size of the enlargement increases we also increase the distance from which we view it.

Under these conditions **the most favorable focal length of a lens for the negative size of the Leica camera is 50mm.** A lens of this focal length will yield images of the most natural perspective. It is, therefore, not surprising that this is the focal length of the most popular Leica lenses.

Only if you want to photograph from a rather close distance, as in portrait photography, it is advisable to select a lens of slightly longer focal length. As we come too close to the subject, the size of the image increases so rapidly that there is a tendency for the image of the closest features to be unproportionally larger than that of the farther features. Then you obtain pictures where the nose is large and the ears are too small. Such portraits are not flattering. Some photographers are of the erroneous opinion that for portrait photography the miniature camera is altogether unusable. This assumption is wrong. In fact, the miniature camera can produce portraits with a perspective which is **identical** to that which we find in portraits taken with cameras of larger negative size. A lens of about 73 to 90mm will do the trick. If we select an objective of still longer focal length, the portrait will even lack in "plasticity" and the faces will appear too flat.

We have gradually acquired knowledge about some of the most fundamental principles of photographic lenses in general and can appreciate the special requirements of lenses suitable for miniature cameras. The family of Leica lenses has grown steadily and we may summarize our knowledge by discussing each of them.

Fig. 58 The Leica Camera Together with the Various Interchangeable Lenses

With the exception of the 28mm and 35mm lenses each of the Leica lenses bears a separate index mark (indicated by the letter R) for setting the lens when engaging in infra-red photography. The infra-red rays, to which certain special films are sensitive, do not unite with the visible rays in forming an image. When using infra-red films and filters the lens is first focused in the normal fashion and then the focusing mount is turned to bring the special R index mark at the point formerly occupied by the regular index mark.

The Hektor 28mm f:6.3

This lens has the shortest focal length of all available for the Leica camera; as such it yields pictures having the greatest depth of focus. Even with its diaphragm wide open at f:6.3 when fixed at infinity the range of sharpness of this lens will include everything from infinity to within as little as 12 feet from the camera. Incidentally, the short focal length of this lens accounts for the great reduction in size of the image of objects that are apparently near the camera. This power of reduction permits us to cover a much larger field and to crowd more things into a single frame of the Leica negative. The lens actually collects rays within an angle of 76° into the frame of the negative. It is distinctly a wide angle lens. The perspective which is quite accentuated offers attractive possibilities to the skillful photographer especially on account of its almost unlimited depth of focus. These two factors: rapidly receding perspective and depth of focus are very useful in the treatment of architectural subjects. The "super speed" photographer may consider this lens slow because its largest opening is only f:6.3. One should realize, however, that for a specifically wide angle lens having such extremely short focal length, yielding images so completely free from distortion—the aperture of f:6.3 may be considered an achievement of optical craftsmanship. The lens comes in a non-collapsible mount, its short focal length making this possible. A special view finder which renders a clear and brilliant image of the field is available for this lens.

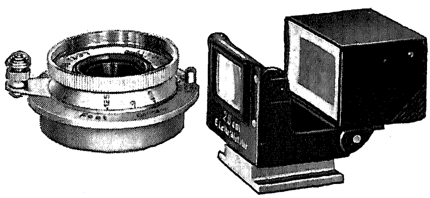
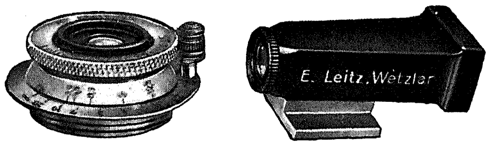


Fig. 59 The Hektor 28mm Wide-Angle Lens with its Special Brilliant View Finder.

The Elmar 35mm f:3.5

This is another member of the wide angle lens family which covers an angle of view of 65°. While the angle of vision is somewhat smaller than that of the Hektor 28mm, this is amply compensated by greater light collecting power of its comparatively large aperture of f:3.5. Pictures made with this lens have considerable depth of focus and their perspective is more nearly approaching that of normal vision. These two features of the Elmar 35mm lens make it an ideal medium for snapshooting. Set for infinity, with its diaphragm slightly stopped down, it requires almost no focusing. From the depth of focus scale we know that with the diaphragm set for f:6.3, when the lens is focused for 30 feet, the range of sharpness will extend from 10 feet to infinity. Thus focused, the camera can be kept in constant readiness in the pocket or in the Eveready case. Due to its short focal length the lens does not need a collapsible mount and protrudes only slightly beyond the body of the camera, rendering it very handy for quick work. Though its field of view is adequately covered by the Vidom Universal View Finder so many people find it more convenient and expedient to use in connection with this lens the special small view finder available for it. It fits snugly into the clip of the camera upon the range finder, combining maximum convenience with minimum of bulk. For general outdoor photography the speed of f:6.3 is quite adequate. If candid photographs have to be made in artificial light, when critical focusing may require more time than is available—the lens can be left wide open and set to an approximate focus. The aperture of f:3.5 is often sufficient to secure usable negatives even in artificial illumination if super-sensitive film is used.

Fig. 60 Elmar 35mm f:3.5 Lens with its Special View Finder which fits into the camera clip.



The 50mm Lenses

The Elmar 50mm f:3.5 This is the lens which made the Leica camera famous. The sharpness of the pictures taken with this lens was responsible for the immense success of the Leica. It may be remembered that more than 35,000 Leica cameras were sold before a model with interchangeable lenses was offered. The Elmar 50mm is still the best standard lens upon which you can build your equipment. This lens really set a new standard for the correction of the optical equipment of cameras and carries a great share of the credit for having *put across* the idea of miniature photography. The Elmar plan of design was later on used for three other Leica lenses of 35mm, 90mm and 105mm.

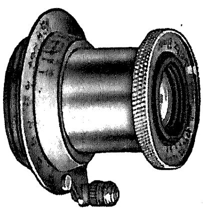


Fig. 61 Elmar 50mm f:3.5 Lens

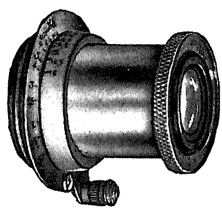


Fig 62 Hektor 50mm f:2.5 Lens

The maximum sharpness in the negative prevails when the objective is stopped down to about f:6.3 or f:9; and upon closing the iris further there is no *noticeable* decrease of sharpness in the negative.

The depth of focus of this Elmar 50mm is still remarkable, and it was with this lens that the surprising possibilities of miniature cameras in combining speed of the lens, depth of focus and sharpness of the negative were first demonstrated so successfully to the public, who became at once enthused about miniature photography. The perspective of its pictures is *natural.* The lens can even be used for portrait photography, although in cases where extreme close-ups are taken, it should not be used, unless you make use of a simple trick. Place the subject somewhat farther away and when you make the enlargement, use only 2/3rds of the center portion of the negative.

In summarizing the merits of this Elmar 50mm, one point should not be forgotten: the price question. Before the Leica appeared, an objective of an aperture of f:4.5 for a large camera was considered extremely fast, because faster lenses were hardly obtainable. Faster lenses were not made because their price would have been so prohibitive that there would have been no market for them. Only when the Leica with its objectives of *short focal length* made its debut, faster lenses became accessible for the amateur.

The Hektor 50mm f:2.5 This lens differs from the Elmar of the same focal length in two respects: in the first place, the name implies that it is built upon a different plan of design, and secondly it has a higher speed. It was the thirst of the amateur for *still more speed* which was to be satisfied with this new type lens, and this higher speed necessitated a new plan of construction. The difficulty before the lens designer was great indeed. The cry for more speed did not indicate whether the amateur knew how much more expensive a good lens of this type would have to be. The step from f:3.5 to f:2.5 means an increase of speed 100%. You may know that if the top speed of a car would have to be doubled, it would become necessary to design a new model which may be three to four times as expensive. Such margin was not available for the lens designer. The speed increase would have to be gained by making a sacrifice in some other respect. If we follow the historical course of events we must not forget that when the Hektor 50mm was created an enlargement of 5 x 7 inches was considered rather a satisfactory size. Strange, how quickly fashions change! From the short skirt to the long skirt was hardly more than a year. From the 5 x 7 enlargement to the monstrous size of 16 x 20 from a Leica negative was only a few years!

But the Hektor 50mm with 100% increase in speed and a slight decrease in sharpness at full aperture, was so designed that even if the iris was closed only to f:4.5 or f:6.3 the sharpness equalled if not surpassed that of the pictures of the Elmar 50mm. And furthermore, this lens has one other slight advantage over the Elmar. Its plan of design made a slightly higher color correction possible. Critical and impartial amateurs may have noticed slightly superior results with the Hektor 50mm over those of an Elmar 50mm when using panchromatic films.

In spite of these advantages and a moderate price the Hektor 50mm lost some of its popularity as soon as a faster lens became available, although at a still higher price.

THE SUMMAR 50mm f:2 This lens must be considered as a triumph of the science of optics. You will remember that the quality of a lens can be judged by finding how much the iris diaphragm can be opened with beneficial increase in sharpness of the picture. When we come to as high an aperture as f:2 we may be satisfied by seeing **how little the sharpness decreases.** The Summar 50mm at this high aperture yields images so sharp that even when enlarged to the size of 8 x 10 inches the smallest detail is still beyond the limit of resolving power of the human eye if the photo is held 10 inches from the eye.

With the iris diaphragm fully open the speed of the Summar 50mm is three times as high as that of the Elmar at its best. This speed is enough to enable the photographer to take photos even under extremely unfavorable light conditions. Thus it was with this fast lens that the Leica camera conquered another field: candid and stage photography.

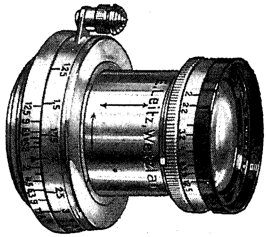


Fig. 63 Summar 50mm f:2 Lens in Collapsible Mount

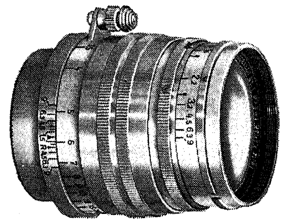


Fig. 64 The Xenon 50mm f:1.5 Superspeed Lens

The Xenon 50mm, f:1.5 On the point of an ultra-speed lens of 50mm focal length the Summar is now superseded by this new objective, which is about 75% faster than the Summar. However, it is larger and heavier than the Summar and is supplied only in a rigid mount, whereas the other 50mm lenses have collapsible mounts. The range of the diaphragm is from f:1.5 to f:9.

The lens is finished in beautiful and durable chromium and its mount is so designed that its rotation for critical focusing can be accomplished either by moving the regular locking thumb-knob or by grasping the outer knurled collar of its mount. Some people find that the latter method assures smoother operation. This lens should gratify the yearning for high-speed lenses of even the most radical speed fiends for some time to come.

The Hektor 73mm f:1.9

This lens has a slightly noticeable softness at full aperture. But this trace of lack of sharpness is very much less pronounced than that in its cousin of 50mm focal length. Such improvement could be accomplished because in the plan of design of the 73mm lens it was preferred to place perfection of correction before the necessity of a low price.

The lens is one of the best among those offered for the Leica for the purpose of portrait photography and here this minute effect of softness is rather a benefit. In portrait photography the smaller range of depth of focus which results from the longer focal length and higher speed is also an advantage because the subject of interest can thus stand out more distinctly against the blurred background.

With the diaphragm closed to f:4.5 or more, the sharpness of the pictures obtained with the Hektor 73mm also surpasses that of the pictures taken with the Elmar 50mm, especially when panchromatic film is used.

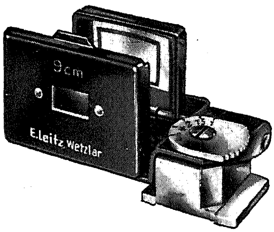


Fig. 65 Sport Finder for the 90mm Lens with Parallax Adjustment

Fig. 66 Hektor 73mm f:1.9 Lens

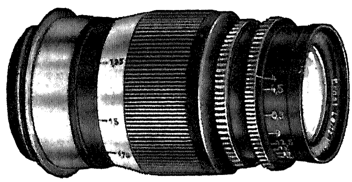


Fig. 67 Elmar 90mm f:4 Lens

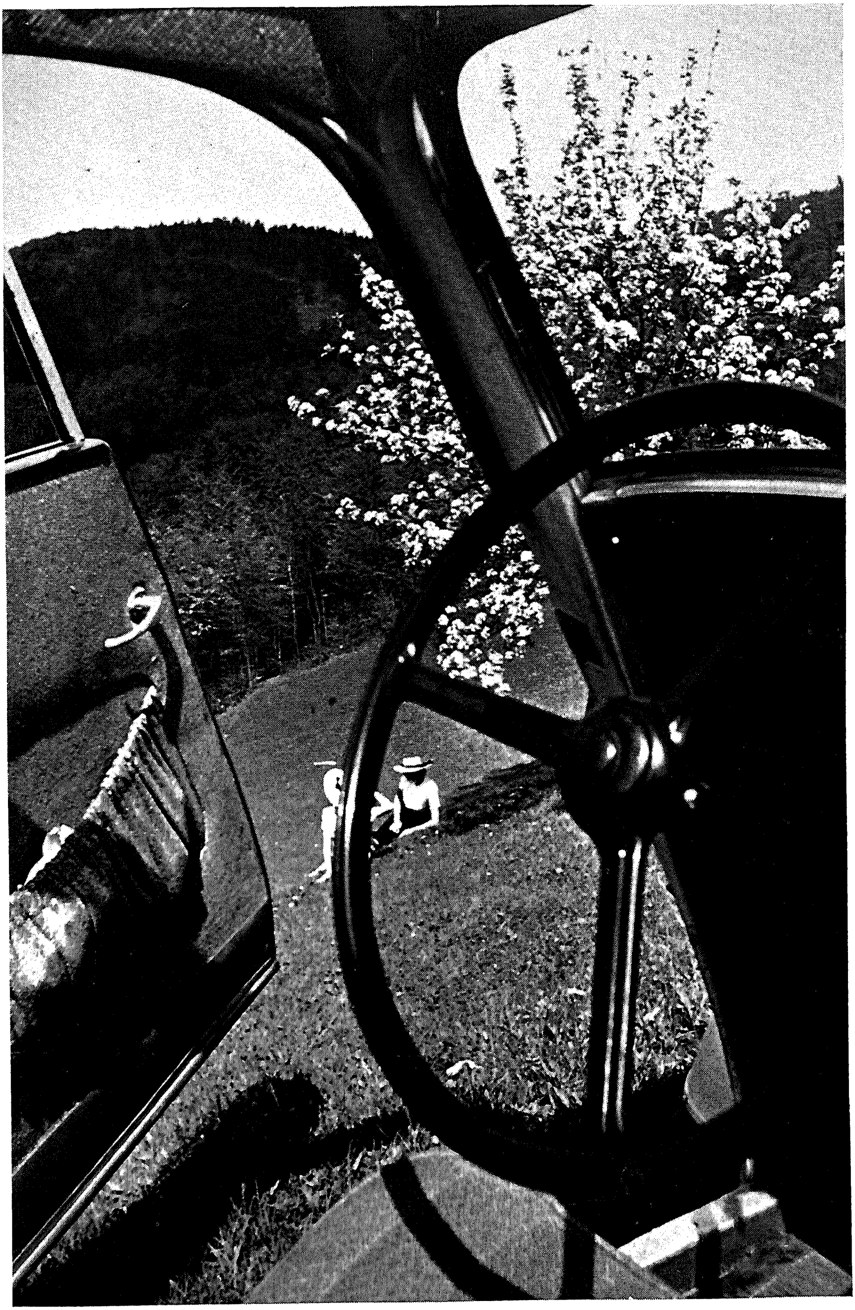
The Elmar 90mm f:4

The general characteristics of this lens need hardly be enumerated because they are evident from the preceding general remarks. In regard to sharpness it fulfills every expectation. The depth of focus is naturally smaller than that of the Elmar 50mm. But in outdoor photography the lens will mostly be used for longer distances and then the depth of focus is sufficient for all purposes. Its speed is high considering the rather long focal length. It is also an ideal objective for portrait work.

Due to its price, which is lower than that of the Hektor 73mm, the Elmar 90mm may also deserve preferred consideration in completing a lens equipment. With three lenses, of 35mm, 50mm, and 90mm focal length, almost any task can be fulfilled.

The Thambar 90mm f:2.2

Undoubtedly this lens will contribute considerably towards a successful invasion of the field of Portrait Photography with the Leica camera and will convince those who still have serious objections to portrait photography with this small camera. Its focal length is ideal for portrait photography and its extremely high speed offers three distinct advantages. In the first place, it permits a reduction of the depth of focus which is often necessary in portrait photography when we wish to have the subject stand out against a soft or unsharp background. Secondly, this high speed of the lens permits shorter exposures or less light, so that even under unfavorable light conditions it may be possible to take snapshots. This is an important point if we



Country Drive
Elmar 35mm, 1/60, f:9, S. S. Pan Film

Paul Wolff

aim for natural and unposed expressions of the subject and wish to avoid the somewhat self-conscious and lifeless artificial effects which are so often found in posed portraits.

Finally, the high relative aperture and the very peculiar and entirely novel plan of design of this lens make it possible to obtain a soft focus effect which can be varied within wide limits. The means which are available for this purpose are somewhat unusual and quite ingenious. Since aside from the well known means of increasing the sharpness of soft focus lenses by closing the iris diaphragm (thus reducing the amount of spherical aberration which the marginal rays cause, and which produce the soft focus effect) there is also the possibility of eliminating the rays in the center by introducing a so-called "center spot."

Fig. 69 The Thambar 90mm f:2.2 lens with its "Center Spot" Disc in a Screw-In Mount

This "Center Spot" is introduced over the front of the lens by means of a disc of optically flat thin glass in a screw-in mount which has a small semi-opaque spot in its center, which "closes" the center of the lens to all light. This method of obtaining a soft focus creates very pleasing effects in portrait photography as well as general photography with back light. The "Center Spot" cannot be used beyond diaphragm opening f:9 since then an image of the "Center Spot" will be reproduced on the film.

When this lens is "stopped down" further, the image will be really crisp and sharp so that the Thambar can also be used for regular landscape photography and other purposes. These features and the agreeable fact that the Thambar is relatively low priced (considering its very high relative aperture) make it a useful and versatile Leica lens.

The Elmar 105mm f:6.3

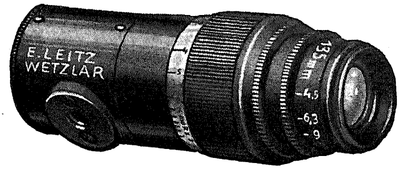
In many ways similar to the 90mm lens, this Elmar may be preferred by the tourist who wishes to economize in weight of equipment and needs the longer focal length for photography at long distance. The lower speed is not directly objectionable because when you take a picture from the peak of a mountain to the next you usually have ample light at your disposal. (The production of this lens has been discontinued.)

The Hektor 135mm f:4.5

This is decidedly a lens for long distance photography. Although still usable for portrait work, the critical judge may notice a certain flatness (lack of third dimension) in portraits taken with the Hektor 135mm.

These lenses of long focal length are sometimes called *Teleobjectives.* The expression is misleading, to say the least. The term actually refers to a type of long focus objectives with a very definite plan of design, consisting of a combination of a convex lens system. As you will remember, the Hektor type has improved color correction, and at apertures not exceeding f:4.5 it yields images of perfect sharpness. Those who use panchromatic or infra-red sensitive film with red or infra-red filters may find the Hektor 135mm the best lens for long distance photography.

Fig. 70 Hektor 135mm f:4.5 Lens



The Telyt 200mm (8 inch) f:4.5

This new lens is a Tele-Objective in the full sense of the term (a true TELEPHOTO lens). It is so designed that the distance between the film plane and the lens is shorter than the focal length, a feature which is characteristic of the Tele System on which this lens is based. This is obtained by introducing a negative lens element back of the positive lens element. Thus, while the focal length of the Telyt is 65mm longer than that of the 135mm lens its barrel is only 3.3mm longer. It will be remembered that the Hektor 135mm lens is not built on the principle of the Tele System but is a regular anastigmat of long focus. The Telyt is the first Tele System objective in the series of Leica lenses. Its correction is excellent so that it produces images entirely free from distortion. Particular attention was given to chromatic correction which makes the lens available for long distance photography with panchromatic and Infra-Red film in connection with red and Infra-Red filters. Excellent results may be expected in this type of work. It should be remembered, however, that for long distance photography clear atmospheric conditions are quite essential. While aerial haze can be overcome with the aid of haze-cutting filters, it is almost hopeless to attempt to photograph across so-called "heat-waves" or heat currents caused by rapidly rising layers of air heated by sunrays or by heat reflected from the ground. Such conditions cause local variations of the refracting power of the air, resulting not only in decreased sharpness of the photographic image but frequently in its complete distortion.

The long focal length of this lens made it possible (and necessary) to equip it with a special mirror reflex focusing device contained in a small and compact dice-like box which is attached directly to the camera. For this particular lens such a method of focusing was preferred to the direct coupling to the automatic range-finder. It combines the advantages of extremely accurate focusing with the convenience of viewing the entire picture on the ground glass of the mirror reflex box through a 5x or a 30x magnifier.

Best results can be obtained with the Telyt only if a good tripod is used or if the camera and lens are otherwise rigidly supported.

The Telyt, as compared with the standard 50mm lens, yields a magnification of 4x. Its view angle is approximately 12°. Its focusing mount permits direct focusing by scale from infinity to 9 feet. At 9 feet it covers an area of approximately 12 x 18 inches. Special extension tubes are available for this lens permitting close-ups down to a working distance of 4 feet from the camera, at which distance the lens will cover an area of 4 x 6 inches, yielding a magnification on the negative of approximately 4½ x.

The basic principle of interchangeability of Leica lenses has been maintained in the Telyt. The mirror reflex housing can also be used with other Leica lenses, particularly with the Hektor 135mm, which can be supplied in a special shortened mount (without the automatic coupling), which is simply screwed into the reflex housing in place of the Telyt. When thus used the lens is acting as a normal 135mm objective and can be used up to infinity.

Fig. 71 Intermediate Extension Collar for Taking Close-up Pictures with the Telyt 200mm Lens

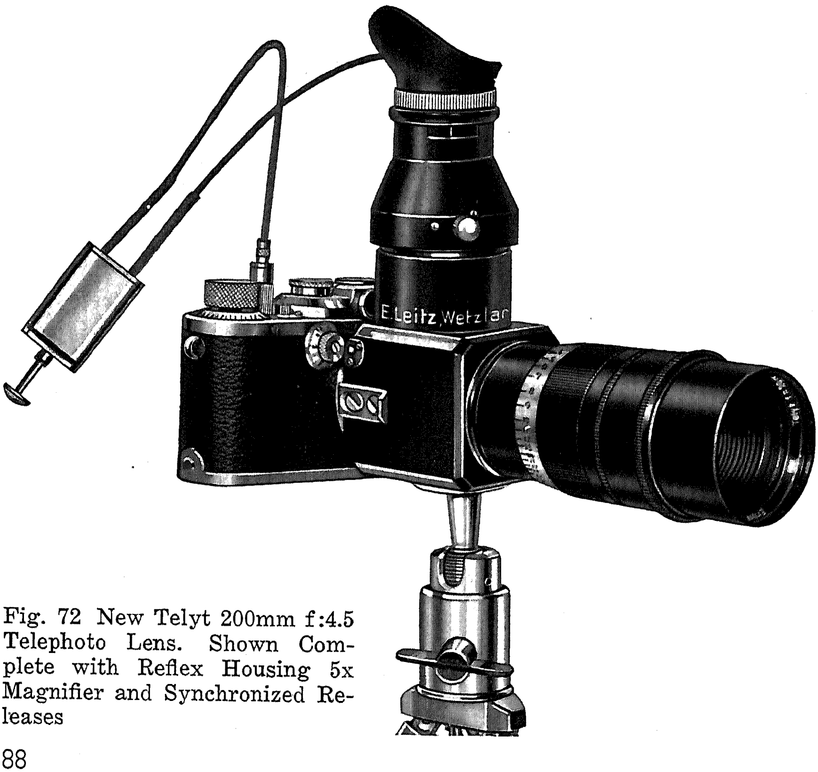


Fig. 72 New Telyt 200mm f:4.5 Telephoto Lens. Shown Complete with Reflex Housing 5x Magnifier and Synchronized Releases

Two Photographs Taken From the Same Position with the 28mm Wide Angle and the Telyt Lenses

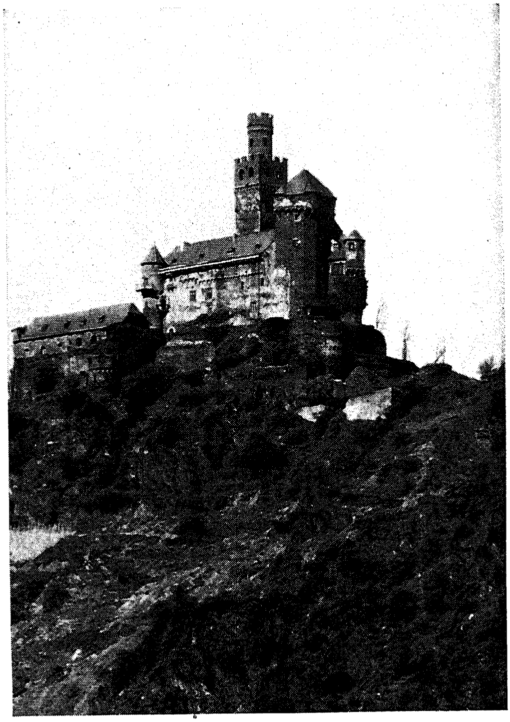


Fig. 73 Photograph Made with the 200mm Telyt lens

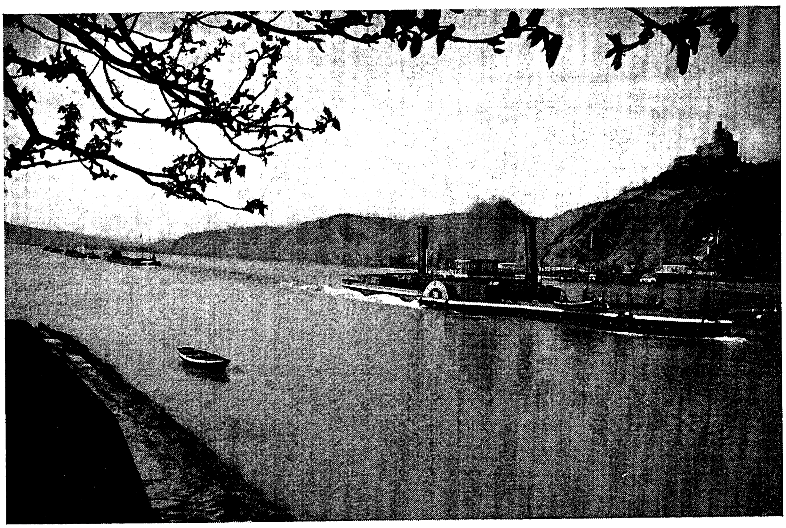


Fig. 74 General Wide Angle View Obtained with the Hektor 28mm Lens

Using the Mirror Reflex with Other Leica Lenses

Other Leica lenses of shorter focal lengths are limited to close-ups when used in connection with the reflex housing. If the focusing mount of the respective lenses is set for infinity the resulting ratio of reduction or magnification respectively (on the film) is as follows:

Lens:	Focal Length	Ratio of reduction (on film) *(lens set for infinity)*
Hektor	135mm	1:2.2
Elmar	105mm	1:1.7
Elmar / Thambar	90mm	1:1.5
Hektor	73mm	1:1.2
		Ratio of magnification (on film) *(lens set for infinity)*
Elmar / Hektor / Summar / Xenon	50mm	1.2:1
Elmar	35mm	1.8:1
Hektor	28mm	2.2:1

For estimating correct exposure with these lenses, whose focal lengths are reduced by their use in connection with the reflex housing, formulas offered in the chapter on copying and close-up photography should be consulted. The length of the reflex housing (considered as an extension tube) is 63mm.

Front Lenses and Close Distance Photography

The problem of photographing objects at close range can be solved in two different ways: either we can introduce intermediate extension tubes to increase the distance from the lens to the plane of the negative, or we can reduce the focal length of the lens system by placing front lenses before the regular objective.

The use of extension tubes directly on the camera together with table of working distances, ratio of magnification etc. is described on page 230.

As we see from the Front Lens tables, these auxiliary optical systems permit the photographing of objects with the Leica camera from 3½ feet to 10 11/16 inches from the camera back. The smallest object which can thus be photographed to fill the negative frame measures 3⅜x5 inches. If we wish to compare the optical principle of photography with Front Lenses and with intermediate rings, we must again recall a few optical principles. It will be evident that if in figure 75 the object point would have been infinitely far away, a practically parallel bundle of rays would have entered the lens. We have neglected so far to mention that if the lens is so designed that it will converge with the highest perfection any *parallel* bundle of rays, it is by no means to be understood that this same lens system will converge with the same perfection (although in another plane) a *divergent* bundle of rays from an object point which is nearer to the lens. In other words, a lens which will yield the sharpest image without spherical aberration when the object is far away will not yield as crisp an image when the object is close to the lens. As the object moves from infinity to minimum distance of 3½ feet the amount of divergence of the bundles of rays entering the lens is quite negligible, but if the object comes considerably closer the spherical aberration would become so noticeable that the images would suffer considerably in quality.

If we add a Front Lens to the Leica objective, we reduce the focal length of the entire lens system in a peculiar way and we learn from the tables that for instance through the addition of Front Lens No. 1 to the Elmar 50mm we can set the focusing mount to infinity when the object is only 39½ inches away. The Front Lens converts the slightly divergent rays into a parallel bundle so that through this addition the Elmar, in order to photograph an object at 39½ inches, yields an image of the same quality as one photographed at infinity without the Front Lens. This same principle is consistently applied so that with the Leica focused to 3½ feet, we can photograph objects at an actual distance of 22 9/16 inches when we add Front Lens No. 1. The front lens tables give further details.

What we have to cope with particularly when photographing at short distance is the misbehavior of light which is called "spherical aberration." We will recall that the marginal rays have a tendency to converge closer to the lens than the rays passing through the center of the objective. The marginal rays can always be eliminated by closing the iris diaphragm. Since in close-up photography, every optimum of detail rendition is absolutely essential, we cannot afford to leave the diaphragm wide open but have to close it to such an extent that through compromise of the small remaining defects in a lens system which have been described before, the actual sharpness of the image is most favorable. The front lens tables contain definite information how much the Leica lenses have to be stopped down for the Front Lenses and various distances.

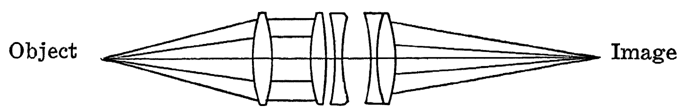


Fig. 75 Path of Rays in the Elmar Lens with Supplementary Front Lens

Another interesting fact relates to the f values of the regular Leica lenses. As long as we use Front Lenses for close-up photography, original f values retain their value because the actual light intensity gathered by the objective and expressed by the so-called f value is represented by the figures: distance from lens to image divided by the diameter of the lens. Since the use of a front lens enables us to use the same focusing mount at close distance we find that for photography of an object at 39½ inches with front lens No. 1 the distance from the lens to the film is the sace as if we would photograph an object at infinity without the front lens. It is therefore possible to measure the actual intensity of the object with a standard exposure meter and compute the value for the respective aperture of the lens at which we take the photograph.

These hints may be valuable for those who use the Front Lenses and it may be added that these auxiliary optical devices are particularly advantageous if we wish to obtain the crispest sharpness and best detail rendition in flat objects within the range of distances indicated in the Front Lens tables. The question of photography at still closer distances is covered in Chapters 11, 20, 21, 22, and 23.

Proper Care of Lenses

It seems advisable to conclude with some suggestions relative to the care of the miniature camera lenses. All lenses are made with an accuracy which can hardly be found in any other piece of manufactured goods. The lens surfaces must be so smooth and so accurately spherical that even a deviation of 1/100,000th of an inch would affect their performance. It is quite evident that such a delicate and accurate piece of equipment requires special care and can easily be ruined by careless handling.

The first rule for the care of lenses is therefore: keep the lens surfaces free from dust and other impurities. When the lens is attached to the camera and not in use, see to it that it is covered with the lens cap. When the objective is removed from the camera, use the dust cap to close the other side so that the lens surfaces are not exposed and no dust can collect on them.

Should the surfaces show deposits of dust or other impurities, do not try to remove it by rubbing the surface with your fingers. You may wipe the surfaces with a piece of silk cloth or with a piece of lens paper. You may also use a fine camel-hair brush. In any case it is imperative that the surface be wiped very gently. The dust in the air is full of little abrasive particles which could scratch the surface of the lens. The smallest scratch is in comparison to the length of a light wave like a deep and wide trench, since a light wave is as small as 1/50,000th inch. You may secure a small bottle of xylol and a package of lens paper and always moisten the paper in the xylol when cleaning the lens surfaces. In wiping the lens, have the paper make a circular motion.

If a lens surface is once scratched, it is not possible to simply repolish this surface because such action would make the entire lens thinner and would affect the optical performance. Only a replacement of this lens can fully repair the damage.

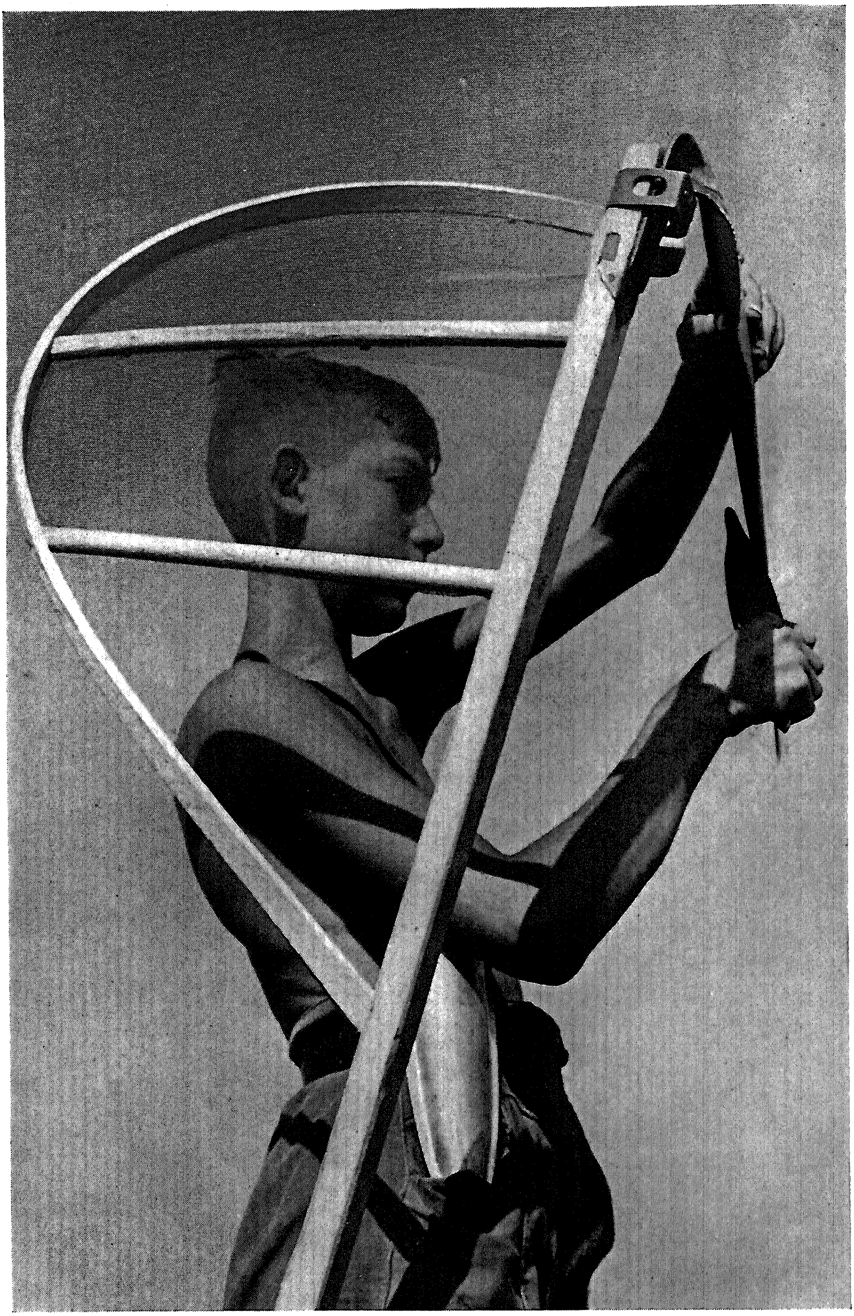
Under no circumstances should the photographer try to take the lens apart. Such warning may seem unnecessary to many miniature camera owners, yet it is given in view of experiences which have repeated themselves only too frequently. A photographer may try to insert a color filter betwen the lens elements, may try to clean the inside surface or find another excuse for satisfying his curiosity and take the lens apart. He will be sadly disappointed when he finds out how hard it is to reassemble the lens so that no dust remains inside. The lenses are assembled by the manufacturer in rooms which are absolutely free from dust and special instruments are used to keep dust from the insides of the lens.

Sometimes lenses show a few very minute bubbles in the glass. These are not objectionable. The area of one bubble in comparison to that of the entire lens surface, is very small and whatever small amount of light is thrown off its course by this bubble is by far too minute to cause any photographically recordable light impression. A long scratch over the lens surface is much more serious.

Altogether the photographer in trying to repair a lens should restrict his activitiy to a minimum. As long as the objective is kept closed by lens and dust cap no danger of serious trouble will ever arise. If something irregular comes into evidence, the objective should rather be sent to the manufacturer.

Fig. 76 Off the Record — Arthur A. Gleason

Summar 50mm, 1/500, f:4.5. S. S. Pan Film



Harvest Time Paul Wolff

COLOR FILTERS

HENRY M. LESTER

CHAPTER 4

A filter is a medium which allows light rays of a certain kind to pass through, while it is more or less impervious to others. From its very definition, it appears that its function is purely subtractive: it adds nothing in the way of illumination; it merely eliminates from light certain qualities which may be undesirable. This is the reason for the increase of exposure generally required when filters are used. Thus a filter should be looked upon as just another means of controlling light and illumination in addition to the others at our disposal. These are the shutter . . . for control of the length of time during which the light is permitted to reach the film; the lens diaphragm . . . for control of quantity and optical quality; the filter . . . for control of color quality or intensity. Additional means of light control are available in the form of reflectors and diffusers.

Photographic color filters are usually made of glass. The coloring which renders it capable of absorbing certain colors of light, while allowing others to pass freely, is imparted to it by several methods. Certain dyes are mixed with the glass in its molten state, thus rendering it colored before polishing and shaping. This provides the most satisfactory type of filter for use directly on the camera lens, it being thin, uniform, color-stable, and unaffected by changes of temperature and climatic conditions. Only breakage or scratches on the surface will impair its usefulness.

Color filters are also prepared by coating gelatin containing a given quantity of an organic dye upon optically flat and otherwise prepared glass, and after drying, stripping this film from the glass. The film is then cut to any size or shape and mounted between two pieces of optically flat glass by means of a special cement (Canada balsam) under heat and pressure. This type of filter requires greater care in handling than the solid glass type. Improper handling, contact with water, alcohol or high temperatures will render it useless. Humidity or exposure to direct action of sunlight also causes deterioration. This type of filter should never be selected for use in the tropics or for sea travel. However, for use in a temperate climate, with careful handling, it will prove entirely satisfactory. Gelatin filters are available in a far greater number of colors than solid glass filters, and being less expensive, are to be recommended for special purposes and experimental work.

Still another type of filter is obtainable in the form of a so-called water cell, which consists of a glass container having two parallel sides filled with distilled water into which the dye required is dissolved. This type of filter is used especially in scientific work, such as photomicrography, where it acts not only as a color filter, but also as a heat absorption filter. It is placed, not between the lens and the photographed subject, but between the latter and the light source.

For the purpose of general Leica photography, we are concerned only with the first two types of filters, either of which may readily be slipped on and off the lens of the camera. Of these two, the solid glass type filter is much the better for the Leica camera on account of portability. Gelatin filters have a definite place in the kit of the experimentally-minded worker, or one whose specialized work calls for an endless variety of filters for tests and for other specific purposes.

Solid glass filters are to be preferred not only because of greater stability and permanence, but also because of simplicity. Any medium transmitting light affects its course to a greater or lesser degree,

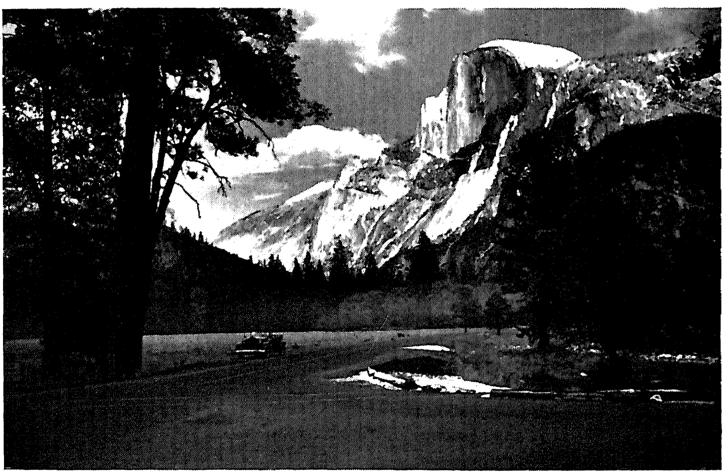


Fig. 78 Mountain Scene Ernst Schwarz

Elmar 35mm, 1/30, f:5, medium yellow filter, Agfa Superpan depending upon whether it is optically flat. If it is, the disturbance is negligible. The greater the number of media the light has to traverse, the greater the disturbance of its course. Thus, when light penetrates thin solid glass, it is affected only by the process of entering it on one side, traversing its dyed mass and emerging on the other side. Pure gelatin filters used without mounting between glass would be just as effective were it possible to handle them in such form. But a gelatin filter, cemented between two pieces of glass, requires the light to pass through glass, Canada balsam, gelatin, Canada balsam and glass again. Obviously it is simpler to produce a filter with two plano-parallel (optically flat) surfaces than one possessing ten surfaces meeting this requirement. Of course, this is merely a theoretical, rather than a practical, objection, but it is frequently confirmed in practice resulting in pictures of lesser sharpness and poorer definition.

As a matter of fact, it should be known that filters actually affect the sharpness of the picture, the type of the filter merely accounting

Fig. 79 Summer Solitude John L. Davenport

Elmar 50mm, 1/100 sec., f:4.5, Filter: 23A, Du Pont Superior Film for the degree of unsharpness. Theoretically speaking, the shorter the wave-length of light, the sharper the image. Violet and blue light, having the shorter wavelengths, are capable of producing sharper images. If a dense filter is used which holds back the entire amount of blue light, it permits only that light which has the longer wave length to reach the film, with the resulting decrease in sharpness of the image. Moreover, some lenses are not so well corrected for light of the longer wave length so that they cannot yield relatively as sharp an image as that obtainable in the presence of blue rays. In other words, the use of filters results in pictures of lesser sharpness because the very element which contributes mostly to sharp images has been eliminated or weakened.

What has been said about filters and their effect upon sharpness of images should not be taken too literally. For practical purposes, the effect of a good filter upon the sharpness of the image is, as a matter of fact, quite negligible. Most of the objections are of a theoretical nature based upon careful and painstaking comparisons made under the microscope. The purpose of these objections is not so much to discourage the use of filters as to produce a more intelligent and judicious attitude towards their application in Leica photography. Our nearest photographic relatives, the cameramen of Hollywood, using almost the same negative material, employ filters extensively. But their results tend only to confirm what has been said: their knowledge of emulsions, plus their knowledge of filters, yield results of rare excellence and quality.

It may not be amiss to qualify filters as the "necessary evil" of miniature photography. They are something to be used if absolutely necessary, but it would be better, whenever possible, to do without them.

Undoubtedly, this very feeling prevailing among photographers causes manufacturers of film to strive for those characteristics in their products which gradually make the use of filters less essential.

When Filters Should Be Used

Filters can and should be used if their choice and application are made judiciously and not indiscriminately. They are intended to establish and correct contrasts between various degrees of *brightness* in the picture. The human eye has the ability to distinguish, not only between light and dark, but also between colors. Colors produce the sensation of various degrees of brightness. Since color cannot be rendered through black and white photography, we make it reproduce our sensations of the varying degrees of brightness in

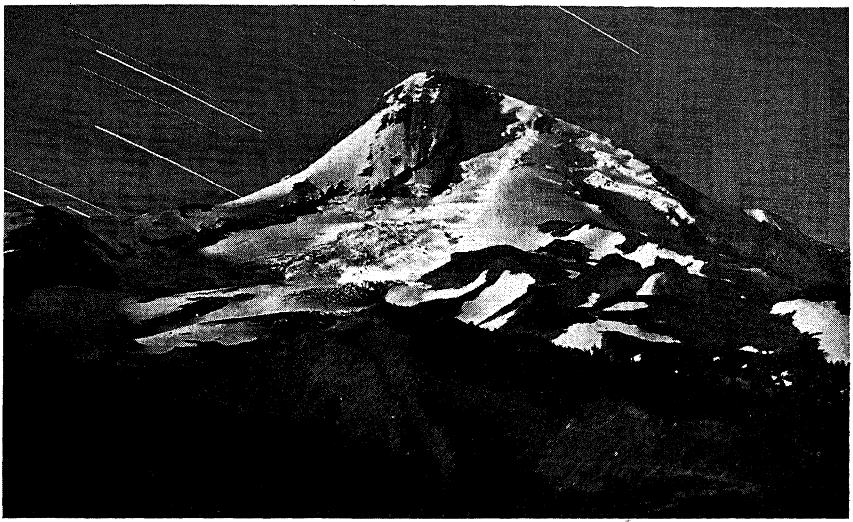


Fig. 80 Mt. Hood by Moonlight — E. D. Jorgensen
Elmar 50mm, ½ Hour Exposure, f:3.5, S. S. Pan
Note Movement of Stars During Exposure

terms of black, white and intermediate shades of gray. To compensate for the inability of the film to interpret things in terms of degrees of brightness as does the eye, we use filters. It is important to realize that ordinarily we would need no filters if the film reproduced colors at the same scale of tonal values as the eye sees them. This is important because film manufacturers strive to approach this *millenium,* and modern film materials require the use of filters to a much lesser degree than the older types of film.

Basically, color filters, as used in photography, can serve a twofold purpose: to establish the balance of color values, or to upset that balance. When the contrast between the various degrees of brightness in the pictures approximates that perceived by the eye— the balance is considered established. Depending upon the emulsion used, it is then **normal** or **corrected.** When the contrast between the various degrees of brightness is rendered differently from the visual perception . . . it is said that the color values, interpreted in terms of shades of gray, are **undercorrected** or **overcorrected.** A black sky or a dark gray sky with white clouds in a midsummer landscape is an example of overcorrection, while a white sky with light gray clouds in a similar picture would indicate undercorrection. An intentional upsetting of the balance of color values may lead to attractive effects. But the practice should not become a mania.

To be able to use filters correctly, to make them fill a definite need and perform a definite task, the photographer must know the film he uses, know its sensitivity to colors, know which colors react more strongly on its emulsion and which should be suppressed and retarded so that other colors may become equally effective. This, in effect, is nothing less than handicapping one or more of the more actinically active colors in favor of those which are "slow in getting there." Thus, if the film records blue too freely, some of it should be held back. A yellow filter is used for this purpose.

A panchromatic film is, generally speaking, more evenly balanced in its response to colors, but its sensitivity to green is slightly lower than to other colors. To effect balance, all other colors must be

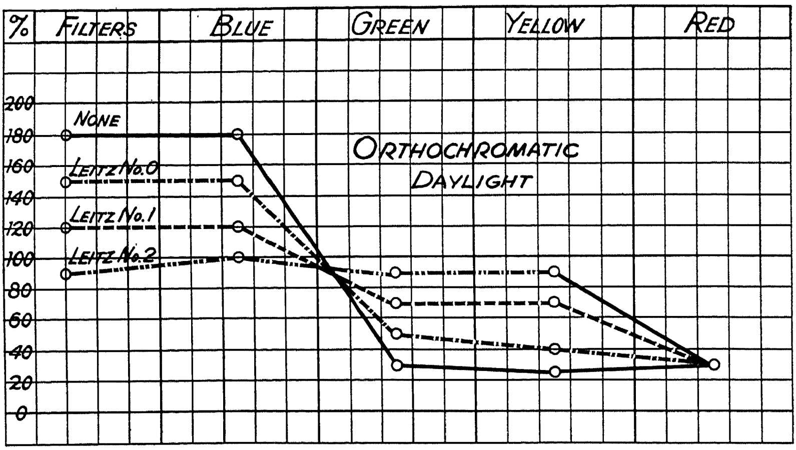


Fig. 81 Effect of Filters upon Relative Color Sensitivity of Film: A Typical Orthochromatic Emulsion (in Daylight)

suppressed or retarded slightly in order to give the green color an opportunity to impress itself on the film. A certain greenish colored filter is used for this.

The effect which filters have upon certain emulsions may be clearly understood from the diagrams shown. These are not mathematically accurate, but they will help to understand the sensitivity of different film emulsions to various colors, when a filter is placed before a lens.

Nearly every film manufacturer publishes spectrographs of his respective emulsions, which if properly read, indicate their relative sensitivity to color. Some manufacturers have this information avail-

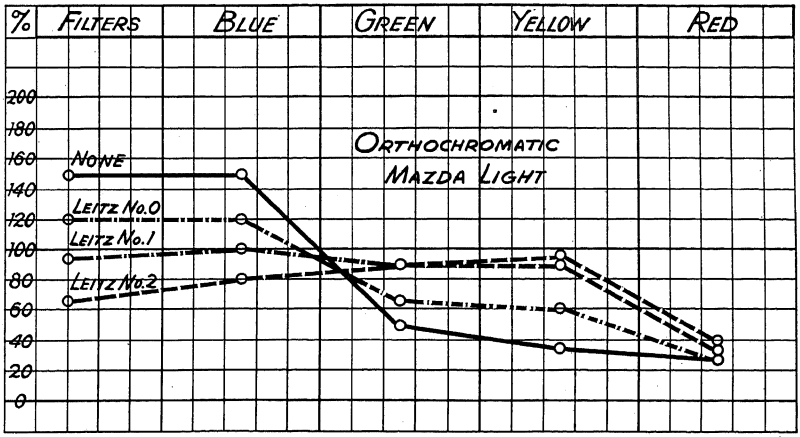


Fig. 82 Effect of Filters upon Relative Color Sensitivity of Film: A Typical Orthochromatic Emulsion (in Mazda Light)

able in the form of numerical tables showing the relative sensitivity in terms of per cent, 100 standing for ''normal'' color rendering.

In considering the use of filters, it is most important to realize that even films of the same type but of various makes have different characteristics regarding their degree of sensitivity to different colors. Thus, an **orthochromatic** film of one make will respond to certain colors to a different degree than an orthochromatic film of another make. The same applies to various makes of panchromatic films.

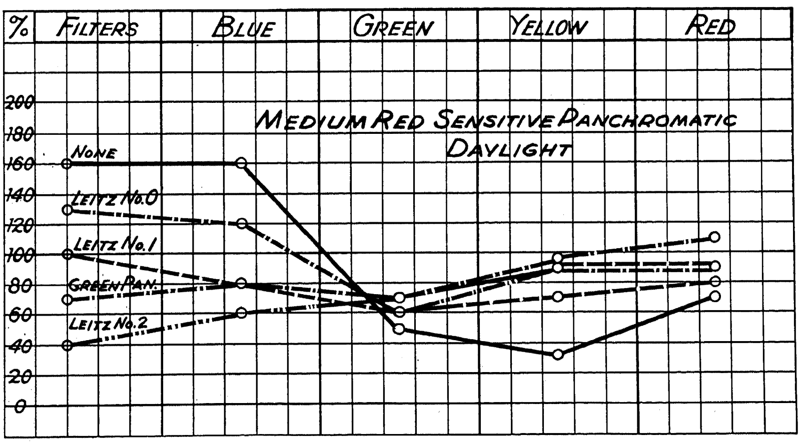


Fig. 83 Effect of Filters upon Relative Color Sensitivity of Film: Typical Panchromatic Emulsion of Medium Sensitivity to Red (in Daylight)

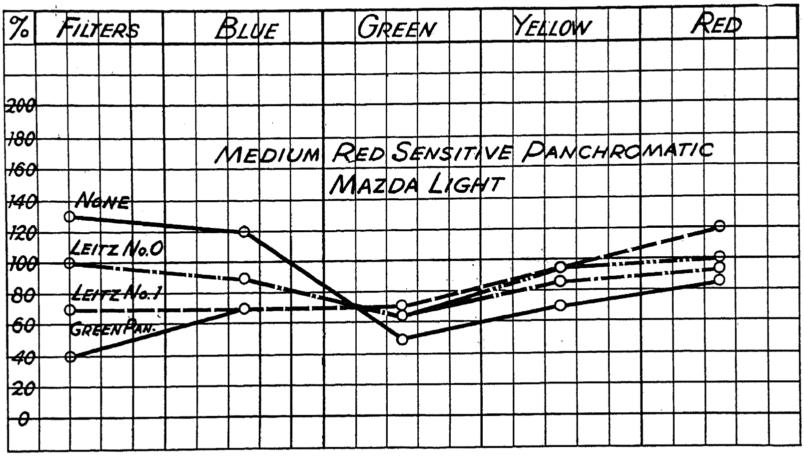


Fig. 84 Typical Panchromatic Emulsion of Medium Sensitivity to Red (in Mazda Light)

Some manufacturers of filters supply spectrophotometric absorption curves of filters which show graphically colors which are transmitted and absorbed by a given filter. A combined study of such data will yield accurate information as to what results may be expected from the use of certain filters in connection with certain films. This information, however, is not essential for the use of filters except in work of a very exacting nature. For general use, working familiarity with a film and filter may be gained by more practical methods.

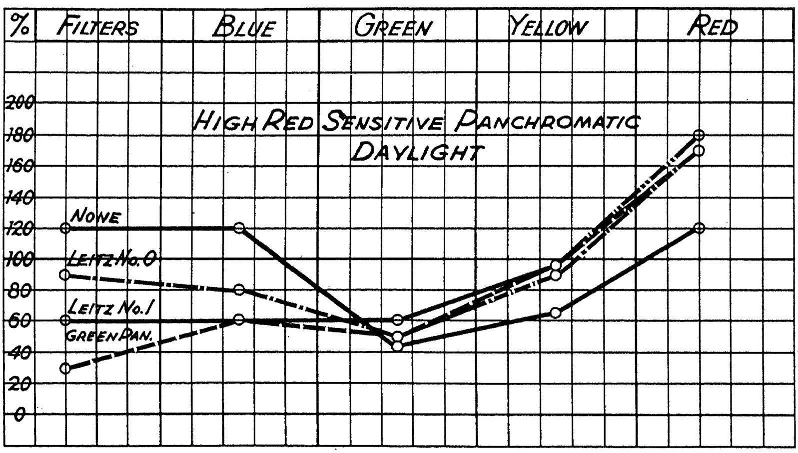


Fig. 85 Effect of Filters upon Relative Color Sensitivity of Film: A Typical Panchromatic Emulsion of High Sensitivity to Red (in Daylight)

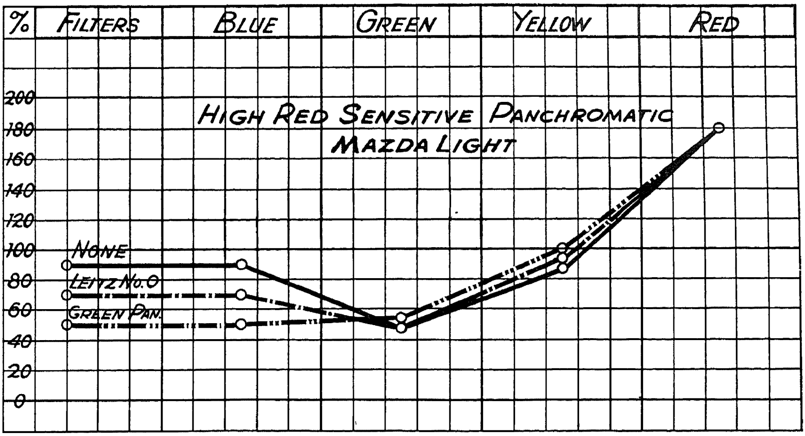


Fig. 86 Effect of Filters upon Relative Color Sensitivity of Film: A Typical Panchromatic Emulsion of High Sensitivity to Red (in Mazda Light)

Making Your Own Filter Tests

If a working knowledge of the properties of a film or filter is desired, a series of exposures on the film with and without the filter is the best means of getting it. Such exposures should be made with great care and a record of conditions kept. The first exposure should be made without the filter and should be based upon a careful reading of a reliable exposure meter. The series of exposures should be carried out according to a definite plan:

Film: ....**Rated Speed:** ....

Subject: ....

Exp. No.	Light	Filter	Meter Reading	Lens Aperture	Shutter Speed
1	Daylight	None	1 sec.	f:6.3	1 second
2	“	“		“	2 seconds
3	“	“		“	4 seconds
4 Blank Exposure					
5	“	“		“	½ second
6	“	“		“	¼ second
7 Blank Exposure					
8	“	No. 2	1 sec.	“	2 seconds
9	“	“		“	4 seconds
10	“	“		“	8 seconds
11 Blank Exposure					
12	“	“		“	1 second
13	“	“		“	½ second

Similar procedure may be employed for testing one or two other filters. The exposed film should be developed in the developer customarily used. The final proof of the test is in the finished print. The best print obtainable should be made from the negative resulting from Exposure No. 1. Prints from all other negatives should be made in exactly the same way, the same paper used, the same degree of enlargement, the same exposure given, the same developer and time of development. When these prints are finished and dry, they should be compared and studied for color correction, contrasts and detail rendering.

Such study will frequently yield surprising results. It may be found, for instance, that best results may be obtained without the filter. Or that the most desirable effect was produced when the filter was used without increase of exposure. And then again, it may be that the picture was most interesting when no filter was used, but the exposure halved.

Thus, for instance, it will be found by actual experience that if a filter, primarily intended to suppress blue rays for which a given film is too sensitive, is being used effectively in daylight, the same filter will be found unnecessary for work in artificial light because of its more abundant yellow and red rays. Obviously, there is no need to filter blue rays from a light which is in itself deficient in that color. The same would hold true of work in the late afternoon when daylight becomes more profuse in yellow light. There would, ordinarily, be no need for a yellow filter. It must be remembered, however, that although a filter is used to establish a definite **balance** of color rendering, the use of the filter is superfluous where that balance is present either in the light source or the subject. Thus, if the sky is dark blue, even a light yellow filter will create a correct color balance on a panchromatic film, and if it be a panchromatic emulsion of **high red sensitivity**, no filter will be required to produce such balance. If the sky, however, be pale blue or grayish blue, a more dense filter would be required.

Filter Factors

To identify filters by means of their respective factors would be meaningless, since no filter requires the same increase of exposure for every film and for every light condition. For this reason, modern filters are no longer designated by the symbol "x" following a number, like 2x, 3x, 4x, etc. These designations were intended to represent the increase of exposure by two times, three and four times, respectively. Modern filters are designated by their manufacturers either by a letter, number or both, and each represents a medium of definitely known power of absorption or transmission of certain rays of light. Consequently, filter factor tables should not be taken too literally, for the best of them are merely intended to give their relative power of absorption or transmission regarding a definite emulsion. These tables should be used as guides only. A definite familiarity with the properties of a film can be gained only through practical application very much in the same measure as is the case with emulsions, developers, papers, lenses, etc.

While color filters properly used offer a very flexible and definite control of contrasts and tones, it should be realized that there are other means with which certain effects may be produced. The making of prints by enlarging rather than by contact offers an opportunity for holding

Fig. 87 Popocatepetl From Sacro Monte — Charles R. Frazier
Elmar 50mm, 1/60, f:6.3, Sky Filter, Panatomic Film

back the light from certain areas of the print while permitting it to print through on other areas. This *dodging* or *shading* by means of a moving hand, finger, piece of black paper, or cardboard enables the skilled worker to produce quite remarkable effects on the finished print. Thus, for instance, if one has a negative of a landscape on which a filter has not been used, a negative possessing all detail and gradation in the foreground but a corresponding over exposure and whiteness of the sky, the latter may be successfully *printed in* or darkened to any degree desired by first exposing the paper for a length of time sufficient to bring out the detail of the foreground and then interposing a piece of cardboard between the lens of the enlarger and the portion of the paper containing foreground, letting the sky print through. The exact technique of *dodging* and *shading* is described elsewhere. This point is mentioned here to assist any who may have neglected to use a filter and who wish to improve a picture which would otherwise appear *bare* and uninteresting from lack of an appropriate sky background.

Choice of Film and Filter

Those who lack experience in selecting a film and a filter to go with it to produce certain effects will be well served with **Viewing Filters.** These are strictly, as their name implies, visual filters and should never be used for actual photography. They consist of discs or squares of colored glass or gelatin mounted between glass. Colors, when viewed through them, are considerably dulled and impress the eye in terms of their relative brightness and contrast of tone, approximating the interpretation of the film. These visual filters are available in the form of *monocles,* or regular spectacles. By looking through them, the photographer is in a position to anticipate the effect upon the film before exposure. For work on orthochromatic emulsions deep blue filters are used, while panchromatic emulsions require either a muddy yellow or greenish visual filter. By far the most practical and economical visual filter guide for the purpose can be had in the form of an inexpensive Filter Test Chart, furnished by the Eastman Kodak Company. This chart contains eight transparent samples of the most popular contrast filters and four test filters (blue, green, yellow and red) through which subjects may be viewed.

If the subject, as seen through the monochromatic filter, appears to the eye so that one can distinguish the different degrees of brightness of the various colors, the film and filter indicated under that viewing filter should be used to secure such rendering. If one cannot distinguish the various colors, the subject should be viewed through another filter, and so on. One of these will be found to give the desired color correction. Considerable knowledge of rendering color contrasts may be gained from frequent application of this simple device.

What Filters to Use

It is a good policy to follow the suggestions of manufacturers of photographic equipment as to the type of accessories. They can very well bear the responsibility for such use as it is to their interest to help obtain the best results possible. Choice of the type and make of filters used should be based upon the negative material employed. If a variety of films is used, one will be best served by the comprehensive line of solid glass filters offered by the makers of the Leica camera. These filters are of excellent quality, thin, uniform and well mounted. The filter mounts are important, particularly when the camera is to be used in connection with the various accessories and attachments for which these mounts are designed. For special purposes, and for specific work with Eastman Kodak emulsions, the Wratten Light Filters (gelatin mounted between glass) should be used, they being also of excellent quality and easily available in unmounted circles fitting the Leica Filter mounts. The Wratten Light Filters are especially designed for Eastman emulsions and the most comprehensive information is available on their effect on these emulsions.

One would be well served with a complete line of Leica filters to which special Wratten Light Filters may be added as required. However, an impressive array of filters is not needed to turn out excellent pictures. One or two should be sufficient for all general work with modern film emulsions. The writer knows of several workers who boast of many an excellent picture but of only one filter.

Those who prefer orthochromatic films will be able to go through life with but one or two filters without missing anything. Leitz No. 1 would be the best choice, while No. 2 might be added to complete the outfit. The addition of a Graduated Sky Filter might be included sometimes in preference to the No. 1. The equivalent of these are the Wratten K1 and Wratten K2.

Users of Panchromatic Films may use more filters, but only if the scope of their work is greater. Besides the two filters mentioned above, together with possibly the Sky Filter, the Green Panchromatic Filter should be used. If Eastman panchromatic emulsions are employed, instead of the Leitz Panchromatic Filter, the Wratten XI (for daylight) or the Wratten X2 (for artificial light) should be used.

Fig. 88 Before the Take-Off Anton F. Baumann
Elmar 50mm, 1/60, f:9, No. 1 Filter, E. K. Panatomic

The Leitz Infra Red Filter is a special filter which should be used in connection with the Infra Red Films for special effects. It is one of those filters which for special reasons emphatically upsets the color balance. The Wratten line offers a complete assortment of red filters, ranging from very pale red to such densities as do not transmit visible light. The choice of the density should be governed by the purpose for which it is intended.

A special filter is made by the Leitz Company for elimination of invisible ultra violet rays adjoining the visible range of the spectrum. These filters are intended for use only in the high altitudes where these rays are abundant. At sea-level invisible ultra violet rays are not sufficient to be detrimental. In small amounts they are not effective, being actually filtered out by the glass of the lens itself. Never use a filter unless one is required to eliminate something that is not wanted in the pictures. With particular reference to the Ultra Violet Filter, commonly known as the U. V. Filter, it should be remembered that if the filter holds back only certain rays, the effect of which we want to suppress in the pictures, whereas it freely transmits all other rays, the exposure need not be increased to compensate for that filter, since those colors that will result in underexposure are being deliberately so treated by the very use of the filter. The same may apply to some other filters, particularly those pale yellow, pale green and pale blue filters which are used for very slight color correction. While actually even clear glass filters require a theoretical increase of exposure (about 8%), this may easily be disregarded because of the available latitude of the film and the improbability of getting a 100% correct exposure at all times.

Some of the red filters, like the Wratten A or F may be used for many purposes. Although they are not strictly infra-red filters, since they do transmit a good portion of the visible part of the spectrum, they will produce effects quite similar to those obtainable with the regular infra-red filters when used in connection with Infra-Red films. It will be simply a matter of degree, but the exposure will be substantially shorter. These red filters are frequently known as *effect filters* because they are used to produce most striking effects of night scenes, moonlight scenes in broad daylight. In addition, these filters are also known as *haze-filters* because they have the rare property of eliminating aerial haze in distance photography, and in aerial photography. It should be remembered, however, that while these filters are very effective in eliminating aerial haze, they will not cut through air filled with smoke, dust, fog or steam.

While speaking of effect filters, the so-called *fog-filters* should be mentioned. These fog filters, unlike the haze-filters, are not used to eliminate fog from pictures, but, on the contrary, to put it into the picture! Fog-filters are decidedly misnamed. They are not filters but merely diffusion screens, which are available in a number of degrees of *softness* or *fog*. In skilled hands, these fog-filters produce truly remarkable results. But, as a matter of general practice, their use is not to be recommended. The small Leica negative should remain as sharp as possible. If softness is desired, it should be produced by means of illumination or by using an appropriate lens at the proper opening. All kinds of fog, and all degrees of softness and diffusion may be produced on the finished print by skillful

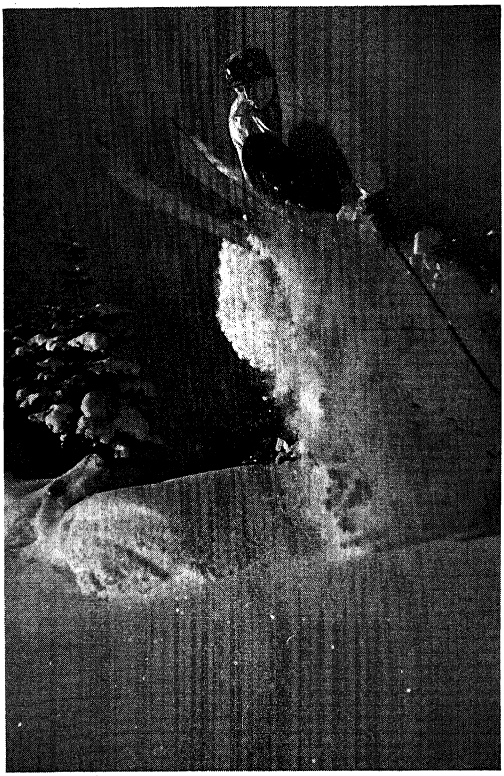


Fig. 89 Gelandesprung
Photo by A. N. Carscallen,
Calgary, Alberta, Canada

Elmar 50mm, 1/500, f:3.5, U. V. Filter, Altitude 7500 feet, 10:30 A. M., Panatomic Film

manipulation of the enlarger, and the reader is cautioned against placing too much faith in such *filters* as are entirely satisfactory for, say, motion picture work, but barely desirable in Leica photography.

Just when to use a filter is often something of a mystery to a beginner. Obviously, it is a matter of that great combination of knowledge, experience and judgment. In order to assist the beginner, the following list is offered:

Yellow Filters: May be used with either ortho or pan films. Everything else being equal, a denser yellow filter should be used with the ortho than with the pan film. These filters are almost exclusively for cloud effects upon light blue skies. The lighter the sky the darker should be the filter.

Sky Filters: For use with all films. This filter has a lower half of clear glass, which from the center gradually changes into a yellow upper half. The purpose of this filter is to hold back the blue rays emanating from the sky only, without affecting the lower half of the image in any way. It requires no increase of exposure. One should be careful in using this filter that the center of the picture coincides with the line of the horizon. A most useful filter for landscapes and seascapes.

Green Panchromatic Filters: A filter specifically designed to enhance the comparatively low sensitivity to the green of panchromatic films. Its effect upon a panchromatic emulsion is similar to that of a yellow filter upon an orthochromatic emulsion. It holds back not only the blue, but also the red, to which this type of film is very sensitive. It is, therefore, useful in the same way for cloud effects, etc. Whenever Eastman panchromatic films are used, Wratten green panchromatic filters are recommended for best results. (X1 for daylight work and X2 for artificial light.)

U. V. Filter: To be used only in high altitudes, mountains, etc. Not for work from an airplane when photographing the earth! The layer of air acts as an efficient U. V. Filter. This filter does in the mountains what a denser (yellow) filter does at sea level.

Red Filters: For extreme contrasts and effects, where **overcorrection** is intentionally aimed for in order to produce dramatic effects. Brilliant white clouds against a black sky. Moonlight effects with the sun substituting for the moon. Dramatic sunsets. To be used with panchromatic films only. The darker red filters are designed and intended specifically for infra red photography with Infra Red film.

Special Purpose Filters: For work with Kodachrome Films three special filters are available: For the Regular Kodachrome Film (K-135) the so-called Photoflood Filter (Wratten No. 80) must be used when the film is employed in connection with photoflood illumination. This filter has an exposure factor of 4x. For the same film a Kodachrome Haze Filter (Wratten No. 1.) is recommended for long distance work, or for portraiture in the shade. This filter does not require increased exposure as it is only an Ultra Violet absorbing filter. Finally the Kodachrome Type A Daylight Filter must be used when the Kodachrome Type A Film (K-135-A) is used in daylight. No increase of exposure is necessary when this filter is used in connection with the K-135-A film.

Editor's Note.

Our readers will be interested to know that filters having transmission characteristics and factors similar to those of the Wratten type, are now available in many of the popular colors in solid glass form. These filters are made of optically flat glass not affected by temperature or climatic conditions. They are distributed in this country by the Chess-United Co., 160 Fifth Avenue, New York City, through their agents and dealers.

Filter Factor Table

The following table of filter factors is offered in the hope that it be used with a grain of salt. It is deliberately placed at the end of the chapter, trusting that the reader will not use it literally, but merely refer to it for general guidance and information. The factors are bound to change with varying light conditions. They should not be followed blindly, but when used intelligently may be helpful in getting the desired results.

FILTER FACTORS: DAYLIGHT 2/ MAZDA LIGHT /2 NOT RECOMMENDED –/– NOT AVAILABLE (blank)

FILM	LEITZ FILTERS 0	1	2	3	GREEN	RED I	RED II	RED III	U.V.	WRATTEN FILTERS K1	K2	G	AERO 1	AERO 2	3N5	5N5	23A	A	F	70	B	C5	X1	X2
AGFA PLENACHROME	2/1.5	3/2	6/2.5	8/3	6/3	–/–	–/–	–/–	2	2/2	5/3	7/6	2/3	4/4			–/–	–/–	–/–	–/–			7/–	10/–
" FINOPAN	1.4/1.4	1.6/1.5	2/1.8	2/2	3/2.5	16/10	–/–	–/–	1.3	1.4/1.2	2/1.5	3/2	1.4/1.2	2/1.5	4/3.5	7/5	4.5/2.5	6/3	12/6		10/6	4/8	4/3	6/5
" SUPERPAN	1.4/1.4	1.6/1.5	2/1.8	2/2	3/2.5	16/10	–/–	–/–	1.3	1.4/1.2	2/1.5	3/2	1.4/1.2	2/1.5	4/3.5	7/5	4.5/2.5	6/3	12/6		10/6	4/8	4/3	6/5
" " REVERSIBLE	1.5/1.2	1.8/1.3	2.2/1.5	2.8/1.8	5/6	–/–	–/–	–/–	1.2	1.8/1.5	2/1.8		1.8/1.5	2/1.8	4/3.5	7/5	3.5/2	4/2.5	8/4		15/12	10/20	4/3	20/15
" INFRA RED						{1/20 SEC. AT F:3.5 BRIGHT SUNSHINE}																		
DUPONT MICROPAN	1.5/1.3	1.7/1.5	2.5/1.7	3/2.5	3/2				1.5	2/1.3	3/1.4	4/1.6	2/–	3/–	5/–	7/–	6/3	9/4	16/–	–/–	6/6	6/8	–/–	–/–
" SUPERIOR " F.G. PARPAN	1.5/1.3	1.7/1.5	2/1.8	3/2	4/3				1.5	1.7/1.5	2/1.7	2.5/2	1.5/–	2/–	3.5/–	5.5/–	4.5/2.5	6/3	16/6.6	–/–	5.6/6	6/8	–/–	–/–
" INFRA D				8/		16/	16/	64/										16/	16/	25/				
E. KODAK PANATOMIC	1.5/1.5	1.5/1.5	2/1.5	2/1.5	2.5/2	7/3	40/20	–/–	1.5	1.5/1.5	2/1.5	2.5/2	1.2/–	1.5/–	4/–	5/–	3/	4.5/3	10/5		8/8	6/12	4/–	–/5
" SUPER SENSITIVE	1.5/1.5	1.5/1.5	2/1.5	2/1.5	2.5/2	7/3	40/20	–/–	1.5	1.5/1.5	2/1.5	2.5/2	1.2/–	1.5/–	4/–	5/–	3/	4.5/3	10/5		8/8	6/12	3/–	–/5
" SUPER X	1.5/1.5	1.5/1.5	2/1.5	2/1.5	2.5/2	7/3	40/20	–/–	1.5	1.5/1.5	2/1.5	2.5/2	1.2/–	1.5/–	4/–	5/–	3/	4.5/3	10/5		8/8	6/12	4/–	–/5
" PAN K. INFRA-RED (SENSIT.)						20/2	20/2	30/3																
GEVAERT EXPRESS SUPERCHROME	2.1/1.8	3.3/2.1	6.5/3.5	8.5/4	–/–				1.8	3/	5/													
" PANCHROMOSA	2/1.3	2/1.6	2.9/1.8	3.2/2.7	2.9/1.8				2	2.5/	3/												3.5/–	
MIMOSA EXTREMA	1.7/1.7	3.4/2.1	4.7/2.9	6/3	–/–				1.8	3/	5/													
" PANCHROMA	1.5/1.4	2.1/1.8	3.1/2.5	3.5/2.7	2.8/2.3				2	2.5/	3/												3.5/–	
PERUTZ NEO-PERSENSO	1.9/1.5	2.7/2.1	4.1/2.3	5.5/3	–/–				2	3/	4/													
" PERPANTIC	1.8/1.5	2.8/1.6	3/1.7	4/2.5	3.2/2.4				2	2.5/	4/												3.5/–	
" PEROMNIA	1.8/1.5	2.2/1.7	2.5/1.8	3.5/2.8	3.2/2.4				2.2	2.5/	3/												4/–	

LEICA MANUAL

Fig. 90

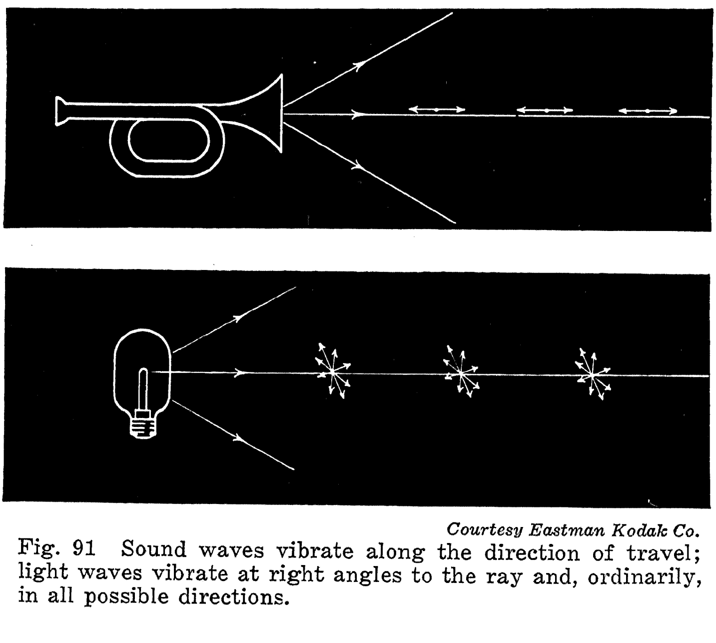
Polarized Light Photography

Photography is dependent upon the reflection of light. Reflections which aid in the true reproduction of a subject are desirable, those which cause distortion of tone values and become accentuated in the final print are undesirable. These undesirable reflections can be removed by photographing with polarized light.

Photography with polarized light is not new. The photo-microscopist has employed the use of polarized light for years in photography through the microscope. Recently an entirely new method of polarizing light has been devised, whereby the use of a screen, or what appears to be a gelatin coated filter (the Pola-Screen) over the camera lens we can cause light from certain angles to become polarized.

The first undesirable reflections which come to the photographer's mind are those from eye-glasses. The lamps used in photography reflect strong highlights in the eye-glasses. These can be eliminated by careful lighting of a subject or by retouching the negative afterwards, but with the pola-screen hours spent in careful lighting or retouching can be saved.

Reflections from glass windows in stores or houses can be completely eliminated. Reflections of the sky in water can be eliminated. Many times such reflections are desirable for artistic reasons. But when photographing a school of fish in shallow water or some types of fungus growth in clear water sky reflections are very undesirable.



Courtesy Eastman Kodak Co.

Fig. 91 Sound waves vibrate along the direction of travel; light waves vibrate at right angles to the ray and, ordinarily, in all possible directions.

The reflections of light can be removed from glassware, silverware, highly polished furniture or oil paintings, or when copying glossy or rough surfaced photographic prints. Any object giving spotty specular reflections can be properly photographed with the Eastman Pola-Screen.

We are familiar with two qualities of light which are significant in photography: the intensity which determines the exposure required and the color which we have learned to control through the use of filters.

There is a third quality not generally well known but which can be used to correct unwanted reflections, such as are most commonly incurred when photographing polished wood floors or furniture. This quality is known as vibration of light. It is known that rays of light vibrate at right angles to the ray and in all possible directions. In this they differ from sound waves which vibrate only in the direction of the ray. (See Fig. 91.)

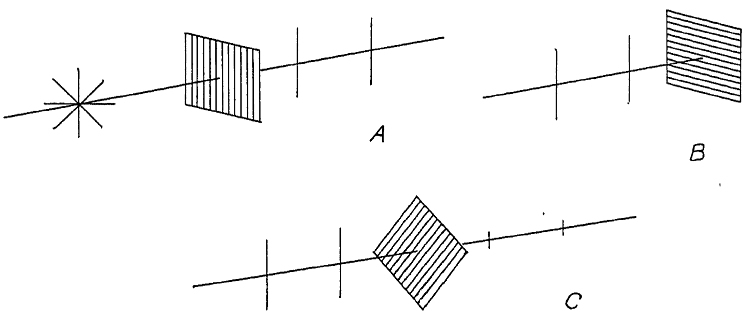


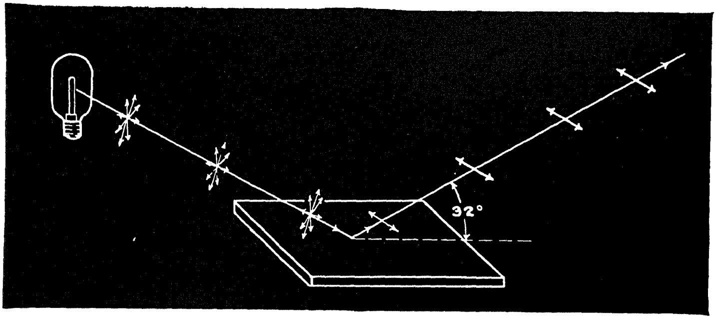
Fig. 92 Light waves after passing through a polarizing medium (shown diagramatically in the form of parallel slits).

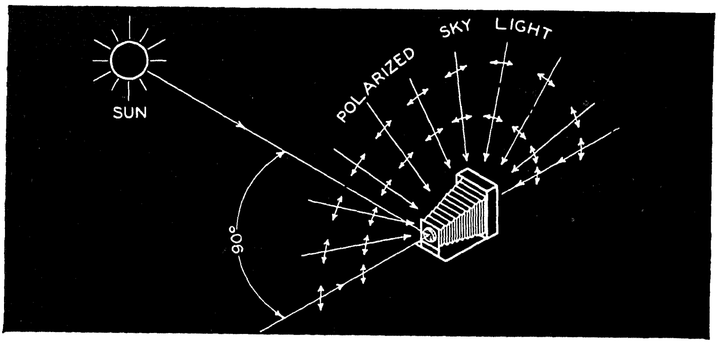
This may be compared to a violin string which when plucked vibrates in all directions. Now if this string were passed through a vertical slit in a card and plucked, it would be possible for it to vibrate vertically only, that is to say only in the direction of the slit. In similar manner a light wave passing through a screen made up of countless minute rod-like crystals which are parallel to each other as shown in figure 92-A will be stopped with the exception of the vibrations which are parallel to the slits in the screen. The result is said to be polarized light, that is light vibrating in only one direction.

In like manner a ray of light polarized to vibrate in, say a horizontal plane, will be stopped completely by a screen the slits of which are perpendicular to the vibration as in figure 92-B, or partially diminished in strength if the slits are set at an angle to the vibration as in figure 92-C.

Light rays may be polarized in another manner. When a ray of light strikes a reflecting surface at an angle of from 32° to 37° it is strongly polarized by the act of reflection, the vibrations parallel to the surface being

Fig. 93 Ray plane polarized by reflection. A ray of ordinary, unpolarized light is almost completely polarized when specularly reflected at about 32° to any non-metallic surface, such as glass. This permits subduing oblique reflections from glass and water by a single Pola-screen over the lens





Courtesy Eastman Kodak Co.

Fig. 94 Clear blue skylight, arriving at right angles to the sun's rays, is polarized. The sky may be darkened by the Pola-screen without affecting the monochrome rendering of foreground objects. The strongest effect is attained with the camera axis roughly at right angles to the sun's rays

the ones most strongly reflected. (See fig. 93.) Another source of polarized light is the sky itself. Light coming from a clear blue sky at right angles to the sun's rays is polarized so as to vibrate at a right angle to the sun's rays.

Pola Screens for Black and White Photography

Supposing we are confronted with reflections in the polished surface of a car as in the accompanying picture. Here the snow and even the girl on skiis is clearly reflected in the car. The picture would be much improved if this could be eliminated. From the discussion above we know that by moving to the front of the car taking the picture at about 35° with the side of the car as we have done, the light rays reflected in its side are polarized parallel to the side of the car, that is to say vertically. Now if we hold a Pola-Screen so that the handle is parallel to the ground and look through it we will see that the reflections have been almost entirely eliminated. The lower photograph on the opposite page was taken with the Pola-Screen in that position but held over the lens.

Many other applications will be found similar to this—particularly in photographing interiors where we wish to preserve the grain of the wood

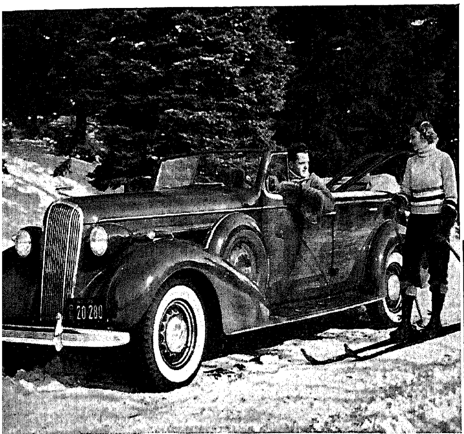


Fig. 95 No Pola-Screen. Note objectionable reflections on side of car

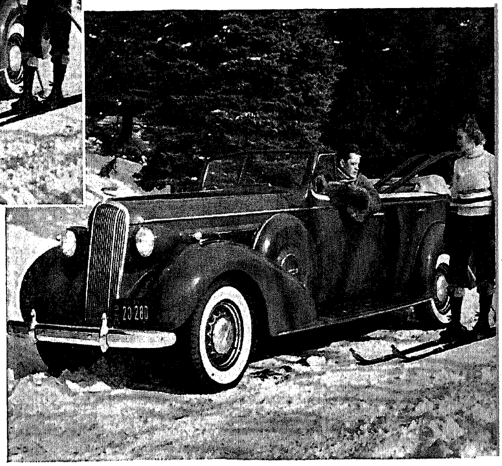


Fig. 96 Pola-screen over lens alone. The oblique reflections are subdued.

Courtesy Eastman Kodak Co.

in polished floors and furniture, silverware, objects behind glass or under water, wet specimens, particularly clinical specimens, copying paintings, and photographs or printed matter where ink or paper or both are shiny.

Dark Sky Effects

As mentioned above the light from a clear blue sky coming at right angles to the sun's rays is polarized. A Pola-Screen turned so that the slits are parallel to the sun's rays will cut down the light from the sky giving a very dark sky in the picture. If used in conjunction with a red filter a black sky is obtained giving the effect of bright moonlight as in the accompanying pictures.

Used in Color Photography

Aside from the use of Pola-Screens for removing unwanted reflection in polished surfaces Pola-Screens are very valuable in color photography for increasing the intensity of the color.

We know for instance, what green trees, or yellow flowers, or a bright red scarf will look like when photographed on color blind film. The result is not true to the original but the film has been noticeably affected. This is due to a blue surface reflection from the shiny leaves, etc.

The Pola-Screen when turned so that the slits point to the sun will reduce this reflected blue light thereby permitting the true colors to show through thereby greatly enhancing the color quality.

Another use for the Pola-Screen in color work is to darken the sky without otherwise affecting the color rendition. With a clear blue sky the Pola-Screen acts as a variable density filter for that part of the sky at right angles to the sun. Any effect from normal to a quite dark blue sky may be obtained by rotating the filter in front of the eye and then placing it over the lens at the same angle. For color work Pola-Screen type IA only should be used as type I will over-correct.

The Eastman Pola-Screens absorb the ultra violet and freely transmit the infra red rays without polarization so the exposures must be increased slightly more with orthochromatic than with panchromatic materials and still more with non-color sensitive materials (positive film). In general when using Pola-Screen, type IA an increase of one diaphragm setting larger than normal will give correct exposure. This amounts to approximately double normal exposure. With the type I screen an increase of four times in exposure is required—when using the Type II screen over the light source and a Pola Screen over the lens no exposure factors can be given since each subject will require different treatment exposures ranging from 16 to 100 times normal.

Adjusting the Screen

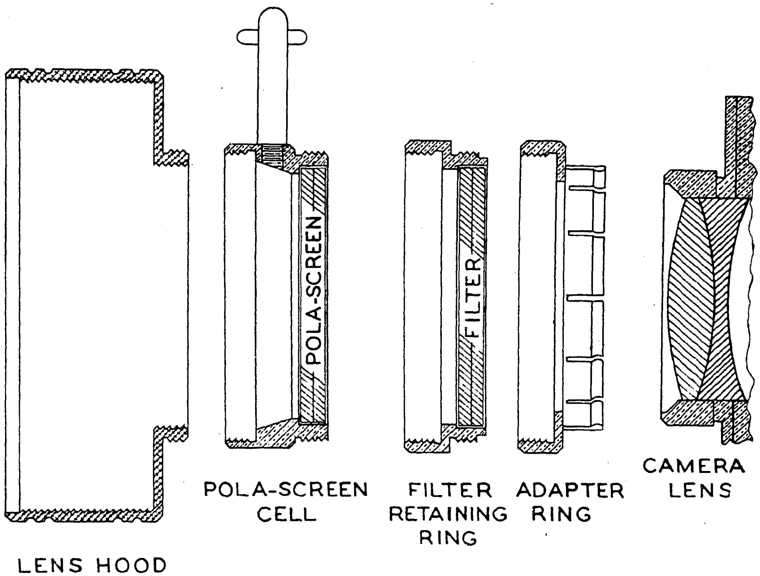
In the Eastman Pola-Screens the mounting is made with a handle which is in line with the slits in the screen so that you can tell their position by the handle. When the handle is vertical only vertically polarized light is permitted to pass and when horizontal only horizontally polarized light passes.

To photograph a subject like an automobile the unwanted reflections being in the side of the car we turn the handle horizontally to remove the reflections. On the other hand, to remove reflections from a floor, table top, or the surface of water, turn the handle upward.

In using the screen to darken the sky the greatest effect is obtained with the handle pointing directly at the sun. The shadow of a small pin in the end of the handle indicates this point when it falls along the center of the indicator handle. To set the screen for intermediate points observe the subject through the screen and maintaining the same angle place it over the lens.

Equipment

Recently the Eastman Kodak Company made available a comprehensively designed line of Pola-Screen Accessories providing any desired combination of Pola-Screens, Filters, and Lens Hoods for practically any lens. Figure 97 indicates the way in which the various parts shown fit together. These various parts are so designed that special adapters for other lenses can be made easily by a local optician or machinist.



Courtesy Eastman Kodak Co.

Fig. 97 Pola-Screen Accessories

For fitting a large range of lens sizes, there are four accessory sizes with a number of adapters for each size. These accessory sizes are referred to as "Series." Series V is the smallest, Series VIII the largest. Series V attachments, described later, may be applied to lenses ¾ inch to 1 3/16 inch, by 12 different adapters. Among these adapters are several special ones, to fit such lenses as the Leitz Elmar f:3.5.

Accessories now available in these four sizes are:

1. The Kodak Pola-Screen Type IA. "Type IA" refers, not to size, but to the kind of polarizing material used. Type IA differs from Type I in that Type IA is suitable for both Kodachrome and black and white. Type IA is more neutral and has a lower exposure factor, at the expense of some polarizing power. Two Type IA's should be used together to control severe oblique reflections.
2. The Wratten Filter Retaining Ring. This ring makes possible the use of circular Wratten filters, cemented in B glass but unmounted. Since

the filter is placed temporarily in the retaining ring for use, any one of a number of such filters can be used in the same ring. Two or more filters can be used simultaneously by using an equal number of retaining rings. Required filter sizes are listed below.

3. Lens hoods. These are hoods of fixed size, of turned aluminum. They are intended for lenses of usual angle of view, the hoods should not be used with wide-angle lenses.

None of these three accessories is complete in itself; an adapter ring is required to fit the accessory to the lens. But one adapter ring is sufficient for any combination of these accessories.

Procedure in Fitting a Lens

If measurement of the lens shows that no Adapter Ring fits exactly, choose one slightly larger than the lens. Then to adjust the ring to the lens, bend in slightly three equally spaced sections of the flange until they fit the lens barrel snugly. If the range of the Adapter Ring interferes with screws or lugs in the lens mount or if it covers an index line for the diaphragm or focusing scale, one or more of the sections of the flange should be removed entirely by bending it back and forth a few times until it breaks.

For those unusual lenses which cannot be fitted by any of the Adapter Rings regularly supplied, a suitable adapter can be made locally.

The items required for using the Pola Screen on the f:3.5 Elmar lens on the Leica are

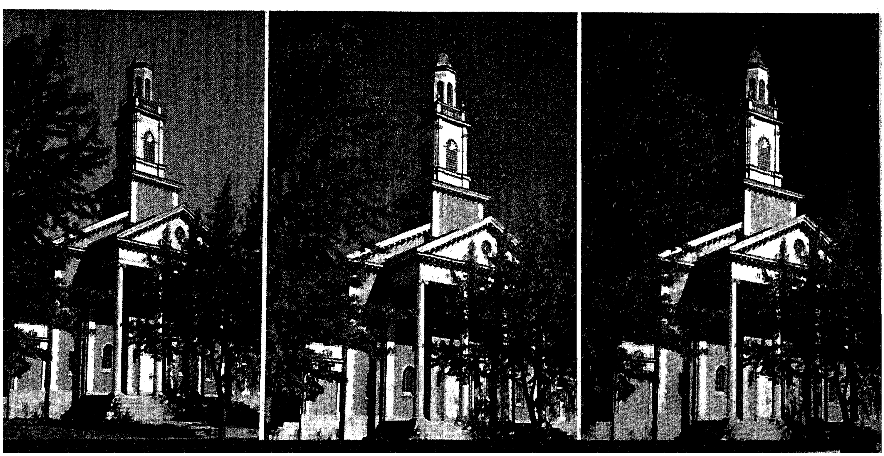
Adapter Ring number 18
Series V Kodak Pola-Screen Type 1-A
Kodak Lens Hood Series V

A series V filter ring can also be used with this equipment giving added flexibility by the use of filters with pola-screen such as for instance the Red filter number 25.

Fig. 98

No Pola-screen, no filter — Pola-screen set for darkest sky — Pola-screen and red filter together

Courtesy Eastman Kodak Co.



THE 35 MM FILM
SELECTION, EXPOSURE, DEVELOPMENT

HENRY M. LESTER **CHAPTER 5**

The 35mm film used in standard motion picture cameras establishes for the Leica a valuable relationship. Because of the vast quantities of film which the motion picture industry consumes, the manufacturers of 35mm film go to no end of trouble to produce the greatest variety and finest quality of film. This in turn makes available to the Leica user an unlimited choice of negative material which the user of larger cameras does not enjoy. While this is a decided advantage to an experienced Leica worker, it is frequently confusing to the beginner.

It may be said, almost without reservation, that the modern 35mm film produced by large manufacturers is of excellent uniform quality throughout, regardless of its type. However, not all films are adapted to every kind of work. If they were, there would probably be no need for some fifty different types of 35mm film now available. Some film emulsions will fill a wide range of application and may be considered more or less **universal**. The word **universal** is obviously a generality and as such is only measurably true. Other films are designed to fill a specific need in the more specialized fields of photography.

Those Leica workers who do not concentrate upon the more specialized phases of photography, like photomicrography, aerial photography, clinical work, etc., but who want to obtain excellent photographs within the scope accessible to all photographic workers will find that almost any good film of a standard make will answer their requirements—**provided they will get to know it through constant use and will understand its characteristics and its response to exposure and development.** On the other hand, those who are doing specialized work should select a film to answer that specific purpose. In either case, for consistently good results, once a film emulsion is decided upon, whether it be for portraiture, pictorial work or copying X-rays, **that film should be used always for that purpose,** to the exclusion of all others.

Success in photography, as in all other crafts, is based upon the ability of the worker to produce definite results. To produce them consistently the worker must know his equipment and materials thoroughly to make them do what he wants. Therefore: **know your film, learn what it can do and make it fit your purpose.**

Part I — Film Selection

The 35mm films should be considered from the following viewpoints as the first step in making the selection:

1. **Sensitivity to Color** . . . From this viewpoint the films are considered depending upon their response to various colors.

   Those that respond or are sensitive to all colors including red are known as *Panchromatic.*

   Those that are sensitive to all colors except the spectral red are known as *Orthochromatic.*

   > The relative sensitivity of an emulsion to the various colors can be controlled by means of filters.

   Films that are not sensitized to distinguish between colors, except between black and white, are known as *Color-Blind.*

   Then there are the *Special Emulsions* required for color photography, infra-red photography, or direct positives.

2. **Speed of Emulsion** . . . From this angle the films are considered depending upon the relative amount of light required to form an image on the emulsion. This classification results in terming films as **fast, medium** or **slow.**

   > The speed of a given emulsion can be controlled within certain limits by development.

3. **Graininess** . . . From this point of view the films are considered depending upon the size of the grain of the emulsion. The smaller the size of the grain, the more desirable the emulsion for Leica work.

   > Although the size of the grain is inherent in each emulsion, being a definite part of its structure, its final size in the negative can be controlled by means of suitable development.

4. **Contrast** . . . From this viewpoint, we consider the emulsions as to their ability to render comparative degrees of brightness of the image. If the film is capable of rendering many shades or gradations of grays between black and white, it is known as **a low contrast** or **long scale** film. If the range of gradations of

gray between black and white is not great, the emulsion is known as one of **high contrast** or **short scale.** Generally, the finer the grain the greater the contrast and the shorter the scale.

Although contrast is substantially built into the emulsion, it can be effectively controlled by exposure and development skilfully made to depend upon each other.

5. **Latitude** . . . Here we consider the film by its ability to react to various quantities of light admitted to it. It would be just too bad if every exposure would have to be "on the button", so to speak, to produce a usable negative. We therefore look to the emulsion for its ability to yield usable negatives with a certain amount of under or overexposure. Latitude is important to us not only because of the ever present danger of over or under exposure, but also because it offers a means of producing definite effects by intentional over or underexposure. Generally, the finer the grain of an emulsion, the less its latitude.

   The latitude of the film is one of its inherent characteristics which cannot be readily controlled.

Selection to Fit the Purpose

An important factor of successful Leica photography which is not generally appreciated and understood is the necessity to choose a film to fit a definite purpose.

The general level of quality of Leica work could be raised considerably if the worker, instead of asking the dealer for the best and most expensive film, would consider these questions:

What is the film going to be used for?

In what developer will the film be processed?

What size enlargements will be required?

What type of paper will the enlargements be printed on (glossy, mat, rough)?

The size of the grain, as is generally known, increases with the speed of the emulsion. There is a vast field of photography where extreme speed of the film is not as essential as fineness of grain. The selection of the emulsion should therefore be made with a preference for fine grain rather than speed. This is made quite feasible by the growing availability and popularity of extremely fast and sharp lenses. However, where sufficient light is not available, or quick action must be recorded, fast films must be used and one must be willing to sacrifice the size of the grain and be satisfied with a smaller enlargement for the sake of getting the picture, which would be impossible without the fast film.

Types of Film

With a view to simplification of the multitude of emulsions available on the market, a classification into five groups is offered. It should be remembered that while each of these grouped emulsions has its own distinctive characteristics, they have a good deal in common, and the grouping is offered for simplicity. Also as a means of expediency, not all the emulsions are being listed, but only those whose popularity makes them readily available in either bulk or daylight loading packages.

Group No. 1 Panchromatic Emulsions (Fast)

Agfa Superpan and the New Ultra-Speed
DuPont Superior and the New DuPont XL Pan
Eastman Kodak Super-X
Eastman Kodak Super-Sensitive
Gevaert Panchromosa
Perutz Peromnia, etc.

The films of this group are fully **panchromatic**, being sensitive to all colors, including red. These emulsions are not alike in their **relative** response to the various colors of the spectrum. For extremely critical color corrections spectrographs of each emulsion should be consulted. (These spectrographs are readily obtainable from the respective manufacturers.)

The most distinguishing feature of the emulsions of this group is their **speed**: their all-over great sensitivity to light, both daylight and Mazda. Their speed rating is 24-50 Weston (23° to 26° Scheiner) to daylight or 16-32 Weston (21° to 23° Scheiner) to Mazda light. The emulsions of this group are of the **low contrast—long scale—soft gradation type.** The degree of contrast of these films can successfully be controlled in development. They possess excellent latitude and will yield usable negatives resulting from several times under or overexposure. Their graininess is consistent with their high speed.

Group No. 2 Panchromatic Emulsions (Medium Fast)

Agfa Finopan
*DuPont Micropan
DuPont Fine Grain Parpan
Eastman Kodak Panatomic
*Eastman Kodak Micro-File
Perutz Perpantic

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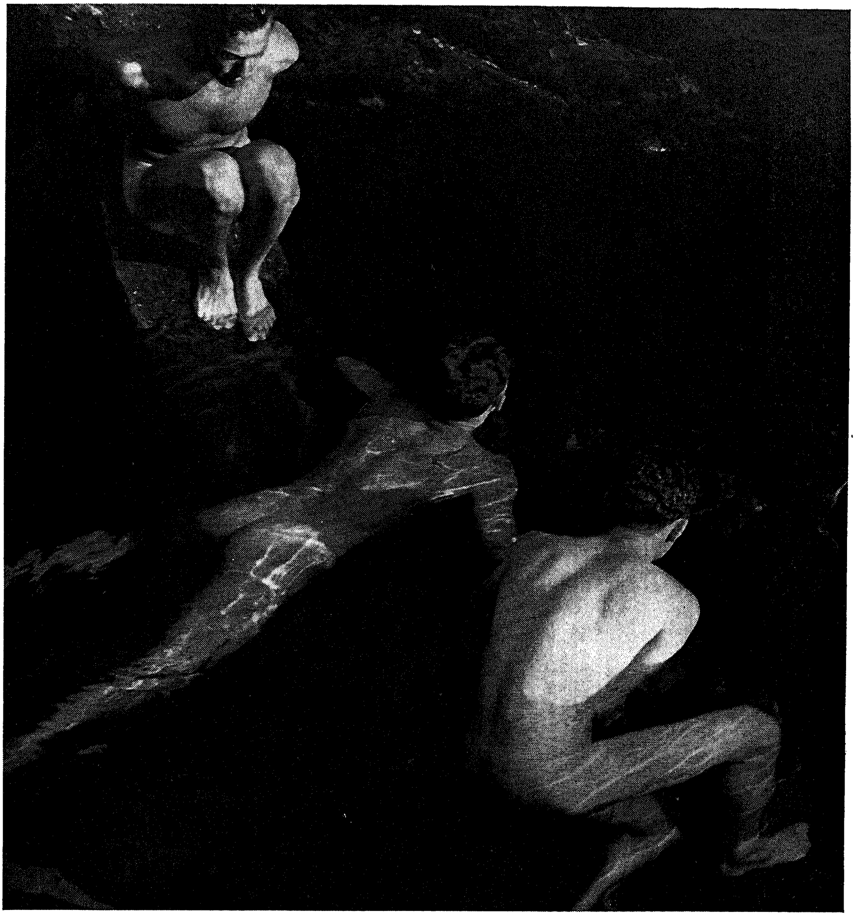
* DuPont Micropan and E. K. Micro-File actually belong in a group of their own, because they are slower, more contrasty and finer grained films than other emulsions in this group. Also they require a shorter development and do not need a very fine grain developer to yield the optimum in grain size.



The Old Swimming Hole
Elmar 35mm, 1/200, f:3.5, Panatomic Film

Augustus Wolfman

The films of this group are fully **panchromatic,** the same as those in Group No. 1, being sensitized to all colors. The particular distinction of these emulsions is the exceptional fineness of grain combined with good all-over sensitivity, which places them in the **medium fast** class. Their speed ratings range from 12 to 16 Weston to daylight (20°-21° Scheiner) and from 8 to 10 Weston to Mazda light (18°-19° Scheiner).

The latitude of the films of this group is not as great as that of Group No. 1 but still considerable, and can be controlled in development. Generally, films of this group are of the "brilliant" type, yielding negatives of high contrast and consequently of a shorter scale.

Group No. 3 Orthochromatic Emulsions

Agfa Plenachrome
Gevaert Express
Mimosa Extrema
Perutz Neo-Persenso, etc.

The emulsions of this group are fine representatives of the popular **orthochromatic** type. They are sensitive to all colors, except the spectral red, with a high sensitivity to green. These films combine extreme fineness of grain with extreme speed to daylight. Their definition is excellent and the gradation quite complete. They belong to the "brilliant" type characterized by **high contrast** and a medium long scale. Their speed rating in daylight ranges from 20 to 24 Weston (22° to 23° Scheiner).

Group No. 4 Color-Blind Emulsions

This group includes only **positive film,** which is produced by every manufacturer of negative film. Positive film is sensitive only to the blue and violet colors of the spectrum. The distinguishing features of positive film are its extremely fine grain, high resolving power, excellent definition and extremely high contrast. The length of its scale of gradation is rather short, but this depends greatly upon exposure and developing procedure. The speed rating for positive film to daylight is about 1 or 2 Weston (8° or 11° Scheiner), while only 0.15 or 0.3 Weston (1° or 3° Scheiner) to Mazda light, depending upon the blue light contents of the light source.

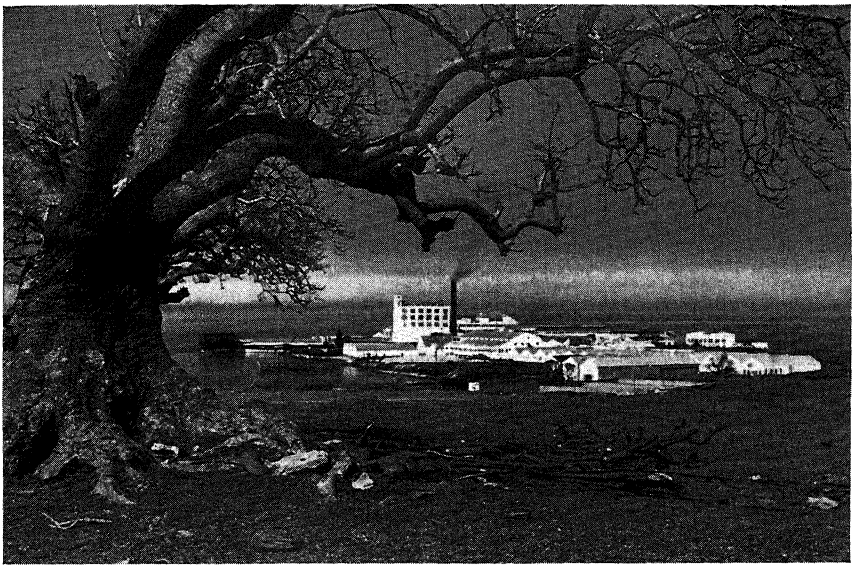


Fig. 100 Montevideo, Uruguay Burton Holmes

Group No. 5 Special Emulsions

A. Films for Color Photography

Agfacolor
Dufaycolor
DuPont Bi-Pack
Eastman Kodak Zulcras Bi-Pack
Eastman Kodak Kodachrome
Lumiere Film Color, etc.

Each of these films represents a definite system in itself, and complete information pertaining to their characteristics is beyond the scope of this chapter. Specific and detailed information on KODACHROME FILM is contained in Chapter 15.

B. Infra-Red Films

Agfa Infra-Red
DuPont Infra-D
Eastman Kodak K (I-R)

These films are neither panchromatic nor orthochromatic as they are not sensitive to all colors, being blind to a portion of the spectrum in the green region. Their sensitivity extends beyond the visible portion of the spectrum (which ends at the wave length of approximately 700 millimicrons) covering light waves of wave lengths from 700 to 1000 millimicrons and beyond. Infra-red emulsions should be used exclusively with special filters available for Infra-red photography in order to be effective as such. Numerical speed ratings of Infra-red films in terms usable for exposure meters are not offered here, for the obvious reason that exposure meters are sensitive only to the visible portion of the spectrum, while Infra-red films are rendered "blind" to all colors but red and Infra-red by the use of special filters. Modern Infra-red films have a high sensitivity which permits exposures of approximately 1/20th of a second at f:3.5 in bright sunlight with any red, orange or deep yellow filters. See chapter 24 for additional data on photography with Infra-red film.

C. Agfa Reversible Superpan

This is an interesting new emulsion intended for direct positives secured by reversal. This film cannot be developed to a negative. It was designed for direct production of positives to be viewed by projection or by transmitted light. Another interesting application of this film material is for production of paper negatives or enlarged negatives by direct projection.

The speed rating of Agfa Reversible Superpan to daylight is 20 Weston (22° Scheiner), and 12 Weston (20° Scheiner) to Mazda light. See page 157 for complete processing information.

Emulsion Speed Values

Definite speed ratings for each emulsion are not given here. Speed ratings of emulsions are merely relative values. They are useful only in connection with given exposure meters, and then only in connection with definite developers, such as are recommended by the manufacturers of the film. Every good exposure meter is accompanied by a complete list of speed rating of almost every film known. One should refer to these lists for such specific information and apply it judiciously, bearing in mind the fact that an effective speed of a given emulsion depends upon the type and character of developer used for processing of that film. Fine grain developers tend as a general rule to decrease the effective emulsion speed by requiring "increased", "full", and otherwise greater exposures than required with developers designed by film manufacturers for bringing out the full emulsion speed of a given film.

That different developers have a definite influence upon the effective emulsion speed value of the film, every serious worker should prove to himself. This effect may be noticed by variations in density. It is suggested that this experiment be done in the following manner. Expose a full roll of, say panatomic film, remove it from the camera in a darkroom and cut it in two. Develop one-half in a fine grain developer, such as Eastman Kodak Ultra-Fine Grain Developer and develop the other half in a Metol Hydroquinone Developer like D-76, see page 141. If both portions have been developed according to the time and temperature recommended, a difference in their respective densities will be apparent on inspection.

Such tests will conclusively prove that it is necessary to know the developer in which a film will be processed in order to know the emulsion speed of that particular film. Unless the emulsion speed values are considered in this light, one will frequently be misled.

The various emulsion speed values now used cannot, in general, be compared directly with each other, except possibly H & D and the Weston speed values, for the reason that they are based on entirely different principles.

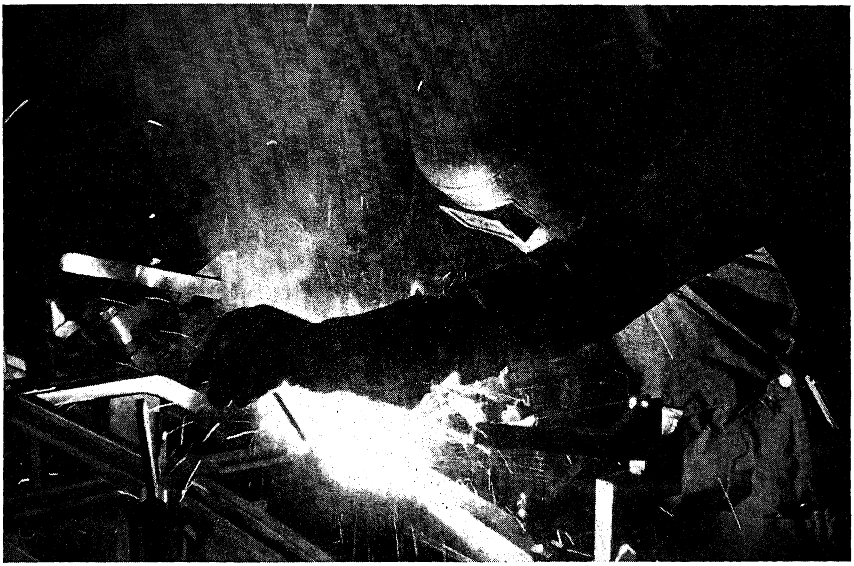


Fig. 101 The Welder — Ed. Schaefer

The Scheiner and Din speed numbers have no definite relation to each other nor to the other speed values except for emulsions having the same characteristics which, however, are quite different for the various kinds of commercial films or plates.

To give a rough idea of the relation of the various speed values a comparison is given below for a type of film having the same characteristic as an ordinary commonly used film, but as stated above, the relative values do not hold for other types of emulsions and must, therefore, be used with due caution.

For example, a report of an actual test shows that 26° Scheiner may be equivalent in Din degrees to any value from 12/10° to 17/10° Din, which corresponds to a ratio of over 3 to 1 in sensitivity. Further, 18/10° Din may be equivalent in some emulsions to 65 Weston and in others to 24 Weston.

Comparative Table of Speed Ratings of Various Systems

CAUTION—Do not use this table without reading above.

Relative Value	Weston	Scheiner	DIN	H & D
18.3	3	14	7/10	159
23.4	4	15	8/10	200
29.8	5	16	9/10	252
37.9	6	17	10/10	318
48.3	8	18	11/10	400
61.6	10	19	12/10	504
78.5	12	20	13/10	635
100	16	21	14/10	800
127	20	22	15/10	1000
162	24	23	16/10	1270
207	32	24	17/10	1600
264	40	25	18/10	2020
336	50	26	19/10	2540
426	64	27	20/10	3200

Fitting the Film to the Job

Following are suggestions of the type of film to be used for best results in different kinds of work. The recommendations refer to groups of similar emulsions (see above); the choice of any one film is left to the worker:

		Group of Film Suggested
Aerial	Depending on light conditions, density and color of filters employed	1 or 2
Action and Sport	In daylight	3
	In artificial light	1
Architectural	Exteriors only	3 or 2
	Both exteriors and interiors	1 or 2
Candid	Including child and pet photography	1

Copying	Blue-prints (with red filter).....	2
	Black and white drawings, charts, line work, documents and other printed matter in black and white where good contrast is required..	4
	Coins, stamps, paintings, fabrics or any other small or large objects containing color or requiring use of filters for better contrast.....	2
	Photographs in good condition..	3
	Photographs, old or faded where use of red filter is required......	2
	Transparencies, black and white, finger prints, X-rays, etc.........	3
	Transparencies containing color..	2
Entomology (insects etc.)	....	1 or 2
Flowers, Plants, Gardens	....	1 or 2
Geology (minerals)	....	2 or 3
Landscape and Pictorial	If true color correction is required	1 or 2
	If great enlargements and fine grain are preferred............	3
Medical	For general use, and for adverse light conditions	1
	If adequate illumination is available	2
	Dental work	1
	Dermatology	3
	Ophthalmology	1
Night and Stage	....	1
Photomicrography	If color filters are required......	2
	If no color filters are required...	3
	For living organisms...........	1
Portraiture	If adequate illumination is available	2
	For adverse light conditions.....	1

General Use	For beginners	3
	If outdoor in daylight	3 or 2
	If entirely or partly indoor, or entirely or partly under artificial light	2 or 1
Natural Color		5 A
Infra-Red		5 B
Reversal Transparencies		5 C

Films for the Leica

All films mentioned here and many others are available for the Leica camera in the following forms:

1. **Bulk film:** in rolls containing 25, 50, 100, 200 or 400 feet. Bulk film has many advantages, including that of considerably lower cost. When purchased in original manufacturer's packages it is more likely to be free from scratches and abrasion marks than film obtained in daylight loading units. Those who need and appreciate uniformity of film will find that bulk film offers it, since a roll of say 100 feet is the same throughout, and once its characteristics become known to the user, they can be depended upon as long as this supply is used. Bulk film also offers the advantage that it can be cut to any desired length, enough for forty exposures or perhaps only five. It is recommended to buy bulk film in so-called "automatic camera" packages consisting of solid metal spools, which provide a most satisfactory method for storing and handling film, protecting the emulsion and edges against excessive contact with fingers. BULK FILM SHOULD BE HANDLED WITH EXTREME CARE and its use should not be attempted by workers lacking the necessary experience.

2. **Daylight loading** spools or magazines containing 30 to 36 exposures. Recently Eastman Kodak introduced an 18 exposure magazine, which should prove popular with many people who like short lengths of films. For convenience and ready availability daylight loading magazines are most desirable.

3. **Semi-bulk film.** Recently bulk film is put up by at least two manufacturers in the United States in the form of notched and tongued length of 35mm film ready for loading into camera magazines of five or ten lengths of 36 exposures each, edge marked with frame numbers. For those who use large quantities of film this is a very practical package as one can load the Leica film magazines in a darkroom without knife or scissors for trimming the film. This sort of packing is offered for the time being in this country by the Agfa Ansco and DuPont companies.

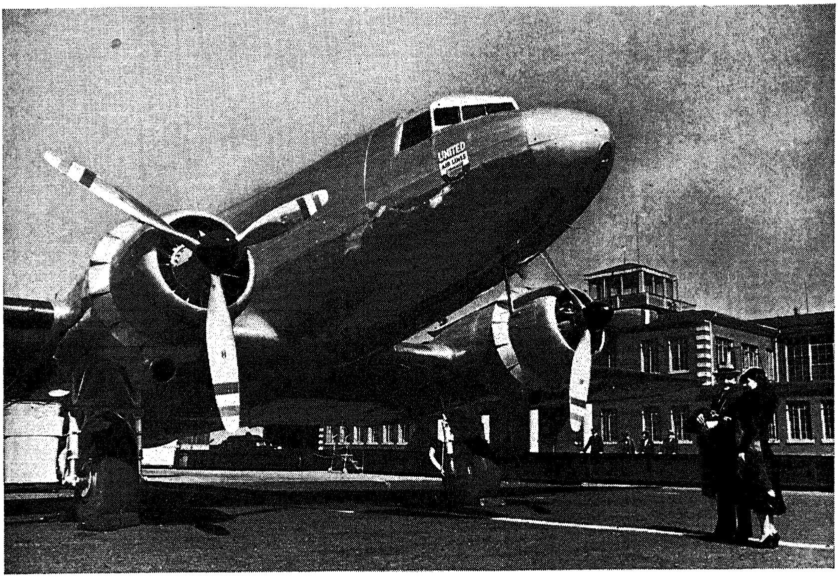


Fig. 102 United Air Liner — Anton F. Baumann
Elmar 35mm 1/60, f:6.3, No. 1 Filter, Panatomic

Part II — Film Exposure

The last decade has witnessed an interesting trend in the field of photography. Both the professional and amateur workers had gradually become exposure conscious. They began to realize that every important characteristic of the finished photograph takes its root at the time the exposure is made, and that the desired result depends upon their ability to coordinate judicious exposure with skilful development of the negative.

The Leica camera is in a great measure responsible for this realization. Leica photography has established a definite system based on the successful application of a number of principles. One of these principles is a certain uniformity of exposures, since as many as thirty-six negatives are usually developed at the same time, and individual negatives cannot be controlled in the development.

This requirement of Leica photography brought about the interest in **normal exposure.** Normal exposure is that which places the range of brightness somewhere in the middle of the limits of the latitude of the emulsion. In terms of every day work normal exposure strikes a compromise between the light and dark portions of the subject so that the bright portions are not overexposed while details in the shadows are recorded too.

From this point, within the limits of the latitude of a given emulsion, a range of exposures favoring either the shadow details or the highlights is available, depending upon whether the predominant part of the photograph is to bring out the dark or light portion of the subject. Which brings us to the matter of **correct exposure.**

That exposure is correct which puts on film exactly what is wanted in the picture.

A great variety of exposure meters and tables is available to assist us in obtaining normal exposures. But normal exposures do not necessarily mean correct exposures. While normal exposures are within reach of every owner of a reliable exposure meter, correct exposures require judgment and skill on the part of the photographer—the knowledge of when and how to use over or underexposure to get what is wanted in the picture. This knowledge comes with practice and experience.

Exposure Meters

Exposure meters are essentially of three types:

1. **Exposure tables and calculators** are helpful guides to normal exposures based on compiled actual experiences. Some of these are available in the form of direct tables which suggest approximately normal exposures for different emulsions and for various subjects, taking into consideration time of day, location, season, weather, etc. Others are put up in the form of slides or discs made of cardboard, celluloid, etc. Then there are some in the form of booklets containing in addition to suggestions concerning exposures a variety of information, references, etc. The chief merit of all of these lies in their providing **some basis** for arriving at a more or less normal exposure.

2. **Visual exposure meters** which are freqquently known as the "extinction type" require sighting the subject through a ground or tinted glass screen while the amount of light admitted is gradually reduced to a minimum. When that minimum is reached a scale indicates the desired data. The greatest disadvantage of this type of meter is the impossibility to assume a standard sensitivity of the eye to light. Its chief advantage is its ability to give readings in extremely unfavorable light conditions of interiors and night photography. Any one of these instruments, if used consistently and with judgment, will provide usable information as to normal exposure.

3. **Photoelectric exposure meters** are the latest and to date most accurate and dependable means for ascertaining normal exposures. They are usually made as instruments of great accuracy and precision, and should be handled as such. The instruments are built around a photoelectric cell which converts light energy into electrical energy, which in turn activates extremely sensitive miliammeters calibrated in terms of light values. Such a popular photoelectric instrument as the Weston, though comparatively expensive, belongs actually to those self-liquidating investments which earn their price through constant economies of film, elimination of uncertainty and securing consistently good results.

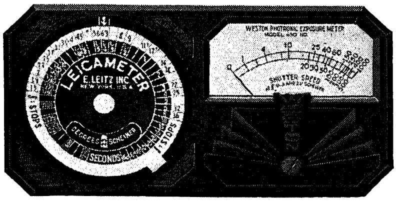


Fig. 103 Weston Photoelectric Leicameter, New Model No. 650

Any photoelectric exposure meter when used strictly in accordance with manufacturer's instructions will yield results of surprising accuracy. Each has its own advantage and a careful comparison of them should be made before deciding which one will answer individual requirements. It is difficult to make specific recommendations because of the vastness of the field which Leica photography covers today.

There are no factotums in photography. The more one knows about photography the more difficult it becomes to point specifically to any one film, exposure meter, lens, developer, paper and attach the term "universal" to it. Only a careful examination of the product and scrutiny from the viewpoint of what it is expected to perform will determine its usefulness.

No matter what the relative merit of any of these meters may be, it is safe to state that the consistent use of any one of them will yield results far superior to those obtained by guesswork.

How to Use an Exposure Meter

An exposure meter, very much like a lens, has a very definite field coverage, varying with the make. The manufacturer supplies this information with every instrument. The area covered should be thought of as the base of a cone whose apex is in the center of its light sensitive surface. The angle of this apex varies anywhere from 50° to 70°.

It should be remembered that a meter has no power of selectivity. For instance, if a reading is taken of a dark object back of which is a light surface, the meter will give a reading proportionate to the

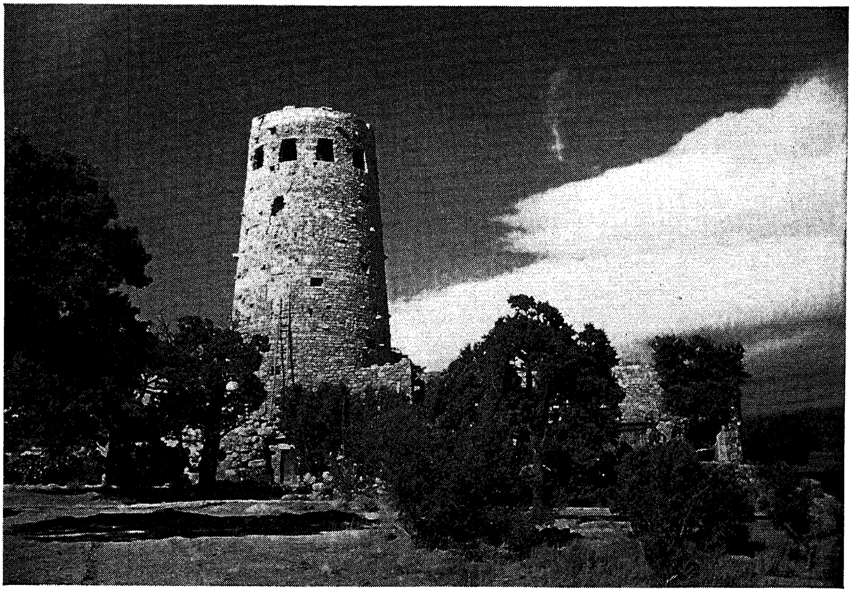


Fig. 104 The Tower Ernst Schwarz
Elmar 35mm lens, f:9, 1/60, dark yellow filter, Agfa Superpan.

relative amount of light and dark portions of the entire area which it "sees". One should endeavor, therefore, to take a reading by holding the meter as close as possible to the object for whose detail the exposure is to be made. It is a good practice to hold the meter at a distance from the object approximately equal to the smallest dimension of the object. The meter should be held so as to prevent its shadow being cast on the area under observation.

When taking the reading of small objects occupying only a small portion of their background, the proper way to secure a correct reading is by the method of substitution. A sheet of paper or fabric of a color and brightness approximating that of the small object should be placed over the object and its background and a reading secured from that. For instance, if teeth are photographed and the meter directed on the face or mouth, considerable overexposure of the teeth would result, because the skin and lips are darker than the teeth. However, if a piece of ivory tinted paper is placed over the face and the meter directed on that, a correct exposure of the teeth will result, while the lips and skin will be somewhat underexposed. This example is quoted merely in the hope that it will assist in the judicious use of exposure meters. Here again, the *purpose* of the picture must be borne in mind.

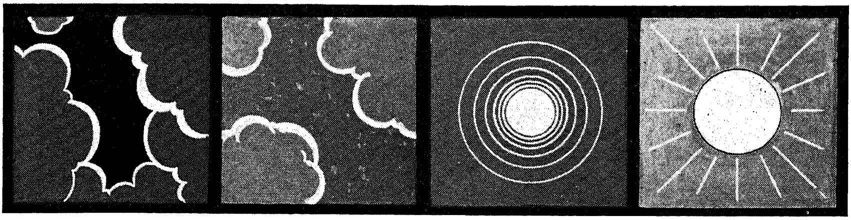
How to Make Exposures Without an Exposure Meter

Approximately correct exposures for outdoor photography can be determined easily without an exposure meter if one were not readily available or if there is no time to consult one. This method can be easily memorized if the simple principles are grasped and practiced a few times.

Exposure Guide for Outdoor Photography

Four Types of SKY CONDITION Most Frequently Encountered

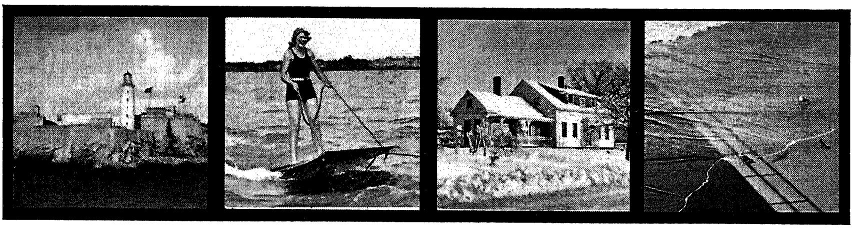
Fig. 105 **SKY FACTORS**



No. 1.	No. 2.	No. 3.	No. 4.
Very Dull Overcast Sky With Heavy Clouds	Dull, Cloudy No Direct Sunlight; No Shadows Cast	Bright Sun Shining Through Thin Clouds or Haze. Shadows Indistinct	Brilliant, Bright Sun in Clear Sky; Heavy, Distinct Shadows Cast

Four Types of SUBJECTS Most Frequently Encountered

Fig. 106 **SUBJECT FACTORS**



No. 1.	No. 2	No. 3.	No. 4
Portraits under Trees; on porches Nearby Shaded scenes	Street scenes City Buildings Nearby Landscapes showing little or no sky	Open Landscapes with sky; white buildings, outdoor sports and activities	Marine and Beach Scenes, Distant Landscapes, Snow and large masses strongly reflecting white light.

Multiply number of SKY FACTOR by number of SUBJECT FACTOR which correspond to existing conditions; the product of multiplication will give you nearest f value to which lens should be set.

Example: Street Scene on a bright, but hazy day in July:

3 (SKY FACTOR) × 2 (SUBJECT FACTOR) = 6.

Set lens opening at f:6.3

Set your SHUTTER SPEEDS as follows:

Summer ....1/100 second
Spring and Fall...........1/60 second
Winter ....1/30 second

The above method is based on the use of FILMS OF GROUP NO. 1. (see page 122.) If FILMS of GROUPS 2 or 3 (See pages 122, 123) are used either the next larger lens stop should be used, or the shutter should be adjusted to the next slower speed. This exposure guide for outdoor photography has more than proven itself because of its simplicity and ease with which it can be remembered. Satisfactory exposures will be secured almost invariably, since the latitude of the film will take care of possible slight under or overexposures.

Exposures for Photoflash

Average Distance Covered by One General Electric Mazda Photoflash Lamp in a Reflector

Diaphragm Opening	*Size of Photoflash Lamp*	*Approx. Distance of Lamp to Subject* Group No. 2 or 3 Film	Group No. 1 Film
f:18	No. 10	5 ft.	7 ft.
	No. 20	7	10
f:12.5	No. 10	7	10
	No. 20	10	15
f:9	No. 10	10	15
	No. 20	15	20
f:6.3	No. 10	15	20
	No. 20	20	30
f:4.5	No. 10	20	25
	No. 20	25	35
f:3.5	No. 10	25	30
	No. 20	30	35

These figures are based on a room with medium colored walls and ceiling. Where pictures are made outdoors or under adverse conditions at the greater distances, use the next larger diaphragm opening or reduce distance from lamp to subject to about 70 per cent of that shown.

Part III — Film Development

Development with Relation to Exposure

Leica negatives will produce excellent enlargements if they meet two requirements:

1. Fineness of grain.
2. A comparatively low degree of contrast.

Both of these conditions can be met by carefully selecting the negative material and **by coordinating the exposure with the development.**

Leica negatives must be processed with low energy developers which act gently and slowly. Development is carried out on the time-and-temperature principle.

Most fine grain developers adopted for Leica work are carefully and scientifically compounded to act uniformly and to produce predetermined results. It is not necessary to delve into details of sensitometry to obtain such predetermined results. To provide a means of comparison of densities and contrasts, scientists have evolved a definite system. The unit in which the functional dependence of density, contrast and exposure is expressed is the term **gamma** (γ) which is defined as a numerical expression for the contrast of the negative obtained from a range of given exposures carried out in a given developer in a given time.

Depending upon the size of the finished enlargement, the gamma of Leica negatives should vary between .6 to .8. The lower value, which stands for lower density and contrast, should be aimed at for greater enlargements; while the higher value for smaller enlargements. Gamma of approximately .7 will be found excellent for all-around purposes, and it is the gamma value of .7 on which the time-and-temperature units should be based for the various fine grain developers.

Density and contrast of a negative corresponding to gamma value .7 are based upon **normal exposure.** Consequently, underexposures with the same development will result in higher contrast and less detail in the shadows; while overexposure under the same developing conditions will result in lower contrast and more detail in the shadows.

The time-and-temperature factors for a given developer to produce gamma .7 stand for minimum development. This minimum is necessary to assure fineness of grain and low contrast. If development is carried beyond that minimum, it is likely to increase both graininess and contrast. In order that development be held to this minimum and still bring out as much detail in the negative as possible LEICA NEGATIVES MUST BE FULLY EXPOSED. Briefly: OVEREXPOSE—UNDERDEVELOP! . . . within reason of course. To put this in terms of practical application, the films speed ratings usually published should be considered as somewhat over-rated, and for best results the films should be used at ratings slightly below the "official" ratings.

Developing Equipment

The equipment for developing Leica film is extremely simple, easy to handle and with proper care will last a lifetime.

For convenient development of Leica film there are two tanks, the Correx and the Reelo. There is also a glass developing drum. Instructions for handling accompany each one. The tanks should be used preferably in all cases, except for reversal where the development drum alone or in connection with one of these tanks is recommended. The greatest advantage of developing Leica films in one of these tanks is the fact that no dark room is needed for the processing. Once the film is transferred into the tank (this can be accomplished in a changing bag), the development and subsequent handling do not require darkness.

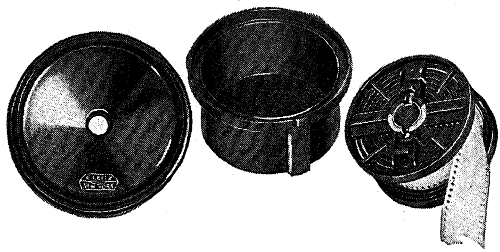


Fig. 107 The Reelo—All Bakelite Developing Tank

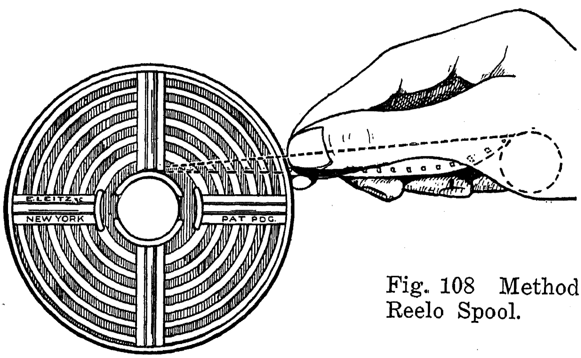


Fig. 108 Method of Winding Film upon Reelo Spool.

These two tanks differ from one another by the method in which separation of the film layers is accomplished. In the Correx tank the film is separated by means of a celluloid apron with studded edges, while in the Reelo tank it is separated by the grooved spool. The tanks are equally effective and selection between them is a matter of personal preference.

The capacity of the Correx tank is about 500.0 cc, or 16 ounces; and that of the Reelo about 400.0 cc, or 12 ounces.

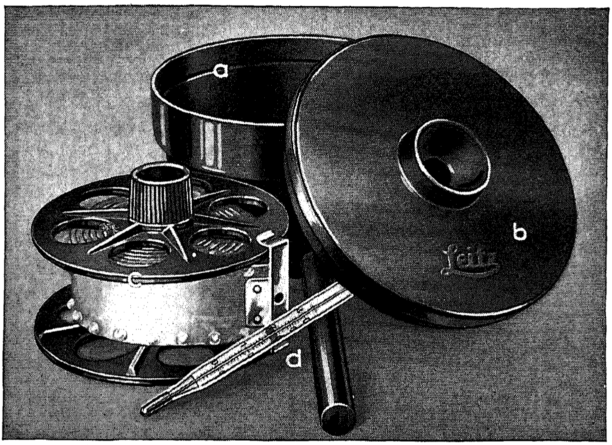


Fig. 109 The Correx — All Bakelite Developing Tank with celluloid Studded edge Apron and Thermometer

Developers

Those who wish to process their films themselves may use any one of the prepared ready-to-use developers on the market, which are available either in powder form or in concentrated liquid form. These preparations will give excellent results if used strictly in accordance with manufacturer's directions.

The number of prepared Fine Grain Developers is so great that it was always felt unnecessary to mention them specifically. Available in powders, ready-to-use liquids, concentrated solutions, the great majority of them give satisfactory results, varying only as to temperature and time recommended. The Editors of this volume had the opportunity to watch for the past few years experiments carried out by Mr. Harold L. Harvey, a talented photographer and equally talented photographic chemist. As this edition goes to press Mr. Harvey is almost ready to place his product on the market.

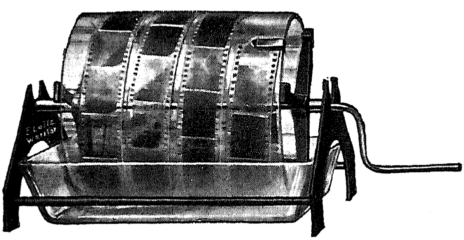


Fig. 110 Glass Developing Drum and Tray

Because of its exceptional merits and many unique features of extreme importance to Leica workers, the Editors feel that it is important to call this new developer to their attention.

The New Developer will be sold under the trademarked name of Harold Harvey's "PANTHERMIC 777" in a package sufficient to make one liter (1 quart), enough to develop 18 rolls of Leica Film. Put up in powder form, ready to be dissolved in water, the Panthermic Developer, as the name implies, may be used at all temperatures, without any fear of reticulation or effect on graininess. It never requires chilling before use. Formula 777 has a top limit of 90° F. (32° C.) which covers most dark-room temperatures found in the tropics. In very cold dark-rooms it is better to heat the developer to about 84° F. (28° C.) in order to shorten developing time. The short-stop and hypo baths may be used at the same temperature or lower. The developer exerts a sufficient desensitizing effect to permit inspection by bright green safelight (the normal pan light with larger light bulb).

Its keeping qualities are excellent both in solution and powder form. Solutions on test have been found not to alter their energy or alkalinity in twelve months.

Average development time on DuPont Superior is 10 min. at 82° F. (27° C.)

A procedure is now being worked out whereby the user may use two developer bottles, one for use, the other for stock. As each film is developed, one replaces a definite quantity of used developer with fresh solution from the stock bottle. By this method, the "working" solution is kept at its point of lowest graininess and constant energy . . . at any temperature, the specified development time remains the same, when using the replenishing method, whether one or forty films have been processed.

The structure and fineness of grain secured by the Panthermic 777 developer is such that it will be found eminently satisfactory for most pictorial and commercial work. The shadow detail and gradation leave little to be desired. The developer does not require increased exposure and produces brilliant negatives which received normal exposure, or even somewhat less than normal.

The Editors suggest that inquiries for this product be addressed to the office of MORGAN & LESTER, 100 East 42nd Street, New York, N. Y., where additional information will be available on this developer as soon as its retail distribution will get under way.

Preparing Your Own Developer

A more economical and possibly more practical way to produce excellent negatives is to prepare one's own developer as well as other solutions required for processing Leica negatives. A few simple chemicals, a scale and a few graduates, are all that is necessary.

The number of formulas offered for fine grain development is enormous. A careful study of them reveals the important fact that in addition to some processes which have purely experimental merits, there are only two classical basic formulas available. Others are merely modifications of these two:

1. **The Metol Hydroquinone Borax type.**
2. **The Paraphenylene Diamine type.**

The first type represents a developer which, as far as miniature camera work goes, can be termed the **maximum energy developer.** It will bring out details in shadows and underexposed portions of the negative to a remarkable degree, while it will produce granularity of sufficient fineness to yield excellent enlargements up to 8x10 inches.

The second type is a **low energy,** extremely fine grain developer which requires a fuller exposure than the first type, but in return will yield negatives of such fine grain, excellent definition, and low contrast that enlargements of 16x20 inches can easily be obtained.

Reference to fine grain performance of these two developers is made specifically in connection with films of Group 1, which due to their speed have an inherently coarser grain structure.

Developing Formulas

The Metol-Hydroquinone-Borax type of fine grain developer is represented by the classical formula known as Eastman Kodak D-76, or its derivative the Modified E.K.D-76, also known as Buffered Borax.

E.K. Formula D-76

	Avoirdupois		Metric
Water (about 125°F. or 52° C.)	**24**	**ounces**	**750.0 cc**
Metol	**29**	**grains**	**2.0 grams**
Sodium Sulphite, desiccated	**3 1/3**	**ounces**	**100.0 grams**
Hydroquinone	**73**	**grains**	**5.0 grams**
Borax (the 20-Mule Team variety)	**29**	**grains**	**2.0 grams**
Cold water to make	**32**	**ounces**	**1.0 liter**

Dissolve chemicals in the order given. Use without dilution. This formula can be re-used and the quantity is sufficient to develop from 8 to 10 Leica film lengths.

Develop at 65° F. or 18° C.—

Ultra-Speed Films	20 to 28 minutes
Films of Group 1 or 3	16 to 22 "
Films of Group 2	12 to 18 "
Films of Group 5B	20 to 25 "

Modified E.K. Formula D-76 (Buffered Borax Negative Developer)

	Avoirdupois		Metric
Water (about 125°F. or 52° C.)	24	ounces	750.0 cc
Metol	29	grains	2.0 grams
Sodium Sulphite, desiccated	3 1/3	ounces	100.0 grams
Hydroquinone	73	grains	5.0 grams
Borax (the 20-Mule Team variety)	29	grains	2.0 grams
Boric Acid, crystals	203	grains	14.0 grams
Cold water to make	32	ounces	1.0 liter

Dissolve chemicals in the order given. Use without dilution. This formula can be re-used and the quantity is sufficient to develop from 8 to 10 Leica film lengths.

Develop at 65° F. or 18° C.—

Ultra-Speed Films	25 to 28 minutes
Films of Group 1 or 3	20 to 22 "
Films of Group 2	16 to 18 "
Films of Group 5B	24 to 27 "

The two developers given above should be used for films of Group 1 in all cases where it is known that the film has received the minimum possible exposure due to adverse light conditions (such as encountered in stage, night, candid and action photography).

They are excellent standard developers for all films of Group 2 and 3.

Dr. Sease Fine Grain Developers

The Paraphenylene Diamine type of developer is capable of yielding the finest grain yet obtained among the so-called "chemical" developers. It is based upon the mild "reducing" action of Paraphenylene Diamine (base; not the Paraphenylene Diamine Hydrochloride) in a mildly alkaline solution. The presence of Glycin as a second reducing agent with Paraphenylene Diamine increases the effective working speed of the developer, while retaining for it the fine grain characteristics in resulting images.

A comprehensive group of four developing formulas was evolved by Dr. Sease of the DuPont Film Laboratories. These formulas are remarkable for their delicately balanced proportions of the same three ingredients: Sodium Sulphite, Paraphenylene Diamine (base) and Glycin, with the latter gradually increasing from 0 in formula No. 1 to 12 grams per liter in formula No. 4.

Of these four formulas of Dr. Sease Fine Grain Developers:

Formula No. 3 should be considered STANDARD.

Formula No. 1, which yields the finest obtainable grain, requires from three to four times the NORMAL EXPOSURE for the DuPont Superior Film (or the films of Groups 1, 2 or 3) and for the Infra D. Film (or films

Dr. SEASE FINE GRAIN DEVELOPERS

	No. 1 Avoir.	No. 1 Metric	No. 2 Avoir.	No. 2 Metric	No. 3 Avoir.	No. 3 Metric	No. 4 Avoir.	No. 4 Metric	ND-3 Avoir.	ND-3 Metric
Water (ab. 135° F. or 57° C.)	24 oz.	750.0 cc	24 oz.	750.0 cc	24 oz.	750.0 cc	24 oz.	750.0 cc	31 oz.	975.0 cc
Sodium Sulphite, des.	3 oz.	90.0 grams	3 oz.	90.0 grams	3 oz.	90.0 grams	3 oz.	90.0 grams	3 oz.	90.0 grams
Paraphenylene Diamine	146 grains	10.0 "	146 grains	10.0 "	146 grains	10.0 "	146 grains	10.0 "	146 grains	10.0 "
Glycin	—	—	15 grains	1.0 "	88 grains	6.0 "	175 grains	12.0 "	29 grains	2.0 "
Cold water to make.	32 oz.	1.0 liter	32 oz.	1.0 liter	32 oz.	1.0 liter	32 oz.	1.0 liter	32 oz.	1.0 liter

Dissolve all chemicals in the order given. Use without dilution at 68° F. or 20° C.

Time to reach gamma .7 Stagnant development at 68° F. or 20° C. (*occasional agitation*)

Emulsion	No. 1 Minutes	No. 2 Minutes	No. 3 Minutes	No. 4 Minutes	ND-3 Minutes
Superior (Group 1 or 3)	50	42	24	22	25
Parpan (Group 2)	28	20	15	14	16
Micropan	12	10	7	7	8
Infra D (Group 5B).	—	65	42	42	60

Gamma for time and formulas indicated for emulsions listed on left. Stagnant development at 68° F. or 20° C.

Emulsion	Minutes	No. 1 γ	No. 2 γ	No. 3 γ	No. 4 γ	ND-3 γ
Superior	14′	.38	.46	.54	.54	.53
(Group 1 or 3).	28′	.56	.64	.76	.78	.74
	42′	.60	.70	.86	.94	.84
Parpan	14′	.42 *.74*	.60 *.91*	.68 *1.15*	.70 *1.16*	.66 *1.00*
(Group 2)	28′	.70 *1.00*	.90 *1.18*	1.00 *1.43*	1.13 *1.40*	1.00 *1.28*
Micropan	42′	.80 *1.26*	.98 *1.34*	1.20 *1.60*	1.24 *1.58*	1.10 *1.46*
(*read italics*)						
Infra D	14′	.44	.36	.42	.46	.43
(Group 5B).	28′	.62	.46	.62	.61	.54
	42′	.70	.53	.69	.70	.63

These five formulas can be re-used and each 32 oz. or 1 liter is sufficient to develop from 8 to 10 Leica film lengths.

NOTE: Above information is the latest available at time of printing and supersedes any other data appearing in this volume at variance with it.

of Group 5B), but requires little or no increase of exposure for the DuPont Micropan Film.

Formulas No. 2, 3 and 4 which yield extremely fine grain (the contents of Glycin in a formula is inversely proportional to the fineness of grain), require about **two times** NORMAL exposures for the DuPont Superior Film (or films of Groups 1, 2 or 3) and for the Infra D Film (or films of Group 5B), but require little or no increase of exposure for the DuPont Micropan Film.

Above requirements for overexposure should be considered as merely approximate and as referring actually to **minimum exposures**, which are so prevalent under inadequate lighting conditions. One may interpret the latent image formed on the emulsion as the result of exposure as having a certain amount of "inertia" to the reducing action of the developer, that inertia being greater the lower the energy of given developer. Thus, the greater the so-called threshold value of the light that is permitted to affect the emulsion the easier it is for these low energy developers to "pull up" the image. Consequently when exposures are made in full, brilliant light, the requirements for overexposures stated above are not as great as those under adverse light conditions.

Modified Dr. Sease Fine Grain Developer

A marked improvement in contrast with almost identical fineness of grain has been achieved by lowering the Glycin content of Dr. Sease No. 3 Formula to 1/3 of its original quantity. The resulting Formula is known as the:

ND-3—Fine Grain Negative Developer

	Avoirdupois	Metric
Water (at 125° F. or 52° C.)	31 ounces	975.0 cc
Sodium Sulphite desiccated	3 ounces	90.0 grams
Paraphenylene Diamine (base)	146 grains	10.0 grams
Glycin	29 grains	2.0 grams
This makes final volume of	32 ounces	1000.0 cc

Dissolve chemicals in the order given. Use without dilution.

When using this formula the negative should receive 50% to 100% more than NORMAL EXPOSURE to avoid loss of detail.

To reach gamma .7: develop with occasional agitation at 68°F. (20°C.)

Ultra-Speed Films	30 minutes
Films of Group 1 or 3	25 "
Films of Group 2	16 "
Films of Group 5B	60 "

Time and Temperature Control of Fine Grain Developers

The activity of all developers is affected by temperature. Close temperature control is required for uniformity of results. There are times, however, when developers have to be used at temperatures others than recommended as standard. Experience has shown that over a *small range* of temperature variation compensatory changes of developing time may be introduced to keep results approximately uniform. For such conditions the following table is offered as a guide for changing time of development. It is based on the experimental fact that, for the developers given here, the percentage change in time to compensate for change in temperature is approximately the same for all. The table is given for the two main temperatures recommended: 65°F (18°C) and 68°F (20°C), and is expressed in terms of percent of standard developing time, which is taken as 100%.

At temperature of:		If recommended Temperature of Developer is:	
		65° F. (18° C.)	68° F. (20° C.)
°F.	°C.	Change recommended Time of Development to:	
62°	16.5°	120%	140%
65°	18°	100%	120%
68°	20°	85%	100%
71°	22°	80%	85%

EXAMPLE: Standard Developing Time being, say 18 minutes at 68° F. (20° C.) it should be: at 62° F. (16.5° C.) 140% of 18, or abt. 25 minutes
at 71° F. (22° C.) 85% of 18, or abt. 15½ minutes

Compromise Developers

Neither of the two types of developers described above is entirely satisfactory for certain kinds of work where photographs taken under extremely poor light conditions must be considerably enlarged. Such a situation is frequently encountered in stage, action and candid photography. For such purposes "compromise" formulas were evolved which produce excellent shadow detail, gradation and contrast, combined with exceptionally fine grain—in cases where only minimum exposures were possible.

Two such formulas are offered, either of which is a modification of Dr. Sease No. 3 formula:

PYRO Fine Grain Formula for Not Fully Exposed Negatives

	Avoirdupois	Metric
Water (about 135° F. or 57°C.)	24 ounces	750.0 cc
Sodium Sulphite, desiccated	3 ounces	90.0 grams
Paraphenylene Diamine	146 grains	10.0 grams
Boric Acid	14½ grains	1.0 gram
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.
Directly before using add to every 500cc (16 ounces) of the above solution:

Pyro Crystals	43½ grains	3.0 grams,

Filter and cool to 65° F. or 18° C.

Ultra-Speed Films	38 minutes
Films of Group 1 or 3	30 "
Films of Group 2	25 "
Films of Group 5B	34 "

This developer cannot be re-used after addition of Pyro. Store it without Pyro.

The other compromise formula is based on the well known property of Metol to bring out shadow detail and gradation.

METOL Fine Grain Formula for Normal and Not Fully Exposed Negatives

	Avoirdupois	Metric
Water (about 125° F. or 50° C.)	24 ounces	750.0 cc
Paraphenylene Diamine	146 grains	10.0 grams
Glycin	73 grains	5.0 grams
Metol	88 grains	6.0 grams
Sodium Sulphite desiccated	3 ounces	90.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given. Use without dilution. This formula can be re-used and the quantity is sufficient to develop from 8 to 10 Leica film lengths. It definitely improves with age and use.

Develop at 65° or 18° C.

Ultra-Speed Films	23 minutes
Films of Group 1 or 3	18 "
Films of Group 2	12 "
Films of Group 5B	21 "

The developers described cover practically the entire range of Leica photography and although there are hundreds of fine grain formulas offered almost every day, as matters stand now these should be considered best suited to successful Leica photography. These developers were chosen because of their simplicity, limited number of ingredients, for their comparatively rapid action and for their dependability. If used strictly in accordance with instructions they can be depended upon for consistently uniform negatives.

Although the following statement holds true of almost every phase of photographic procedure, it is of particularly great importance in connection with the preparation and use of developers: **A person not following a recommended procedure is, at present, entering a field of research where definite results cannot be promised.**

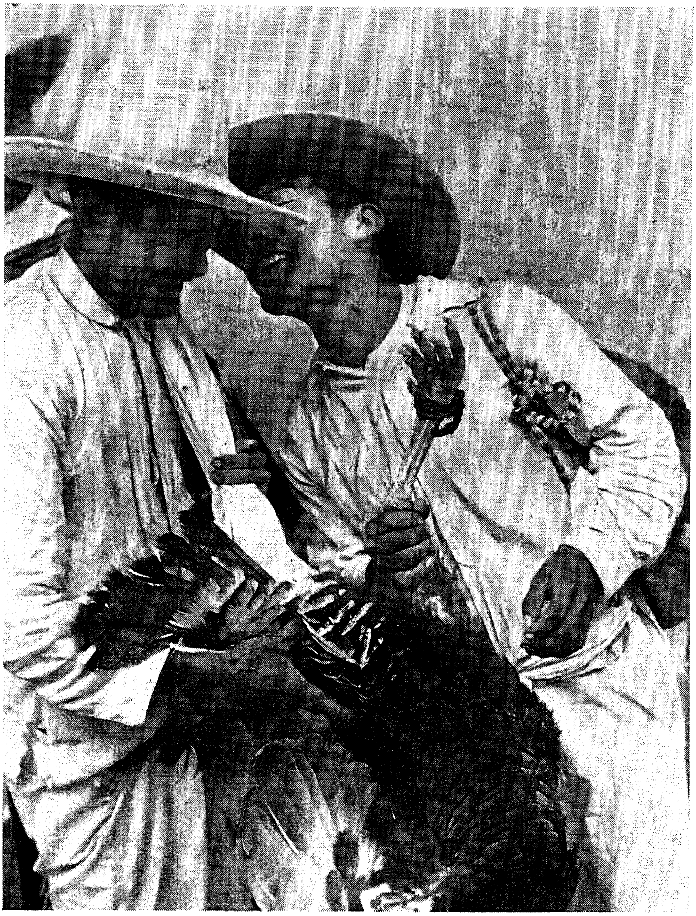


Fig. 111 Mixtecas Indians at Oaxaca Ralph E. Gray
Summar 50mm, 1/100, f:6.3, Panatomic Film

Re-Using Developers

Conservative use of developers which can be re-used permits the development of 8 to 10 Leica rolls per 1000 cc (32 ounces) of developer. A leading authority on the subject of fine grain developers suggests the following method of using developers for most consistent uniformity of densities in films. In the absence of other indications, the first three rolls of film should be developed for the standard time recommended in the formula. After first three rolls developing time should be increased by 10% for all other rolls up to ten per quart or liter. Then discard developer. Prepare fresh quart or liter.

Any one of the above formulas (except the Pyro "compromise" formula) can be re-used within reasonable standing periods, but exact figures as to their keeping qualities would be of little direct value because conditions of use and storage differ widely.

Between use the solutions should be stored in nearly full, well-stoppered amber glass bottles with a special label provided for marking the developer every time it is used. The developer should be poured back into the original bottle after each use, until it has been used on 8 to 10 rolls, after which it should be discarded or set aside for "priming" the next batch of developer.

It is worth noting that most fine grain developers produce finer grain and lower contrast the older they are or the more they have been used. Most freshly prepared developers work more energetically than those somewhat aged and used. The fresh solutions have that "fire" in them; and for those who wish slightly softer results and finer grain it is recommended that they "prime" the developer either by adding some 25% of the same developer ready to be discarded, or by developing in the fresh developer a length of say 5 to 6 feet of fogged film. This produces a certain amount of oxidation in the developer which takes the "fire" out of it and softens its action.

Agitation

As a general rule continuous vigorous agitation during development for finest grain is to be avoided, unless it is done by means of one of several electric agitators now on the market, which are specifically designed for that purpose. Too vigorous agitation is likely to make the developer foam with resulting uneven distribution of the solution along the films surface.

Continuous agitation increases the rate of development to an extent which depends upon the speed and character of the action of the device used. Increased rate of development must be compensated by a shorter time of development. Careful tests made with several of the most popular electric agitators on the market tend to indicate that when developing is done under continuous agitation the standard developing time should be decreased by some 15%—20%. Accurate data pertaining to each machine must be obtained from carefully and systematically made tests.

Occasional gentle agitation (stagnant development) is not only recommended but urged. A twist or two of the tank or its reel every two or three minutes will not affect the rate of development and is indicated to prevent vertical streaks along the perforations of the film.

Continuous agitation with an electric agitator is very useful for the intermediate short-stop bath and even more for the fixing and hardening procedure.

The Short-stop and the Fixing Bath

Before proceeding with the details of actual development, one should be familiar with the only other two solutions required for complete processing of Leica films:

The Intermediate Short-stop and Hardening Bath. The following solution seems to have many features which should make it indispensable in the processing of Leica films:

Intermediate Short-stop and Hardener

	Avoirdupois	Metric
Water	16 ounces	500.0 cc
Chrome Alum	145 grains	10.0 grams
Sodium Bisulphite	145 grains	10.0 grams

Dissolve Chrome Alum completely before adding Sodium Bisulphite; stir until Sodium Bisulphite is completely dissolved.
Use without dilution.
This solution should be used at the same temperature as that of the developer.
Film should be left in this bath for five minutes.
This solution should be prepared just before required and discarded once used.

Actual use of this short-stop on many of rolls of Leica films proved its value. It gently checks development and gradually hardens the emulsion, the hardening process being continued in the acid fixing bath which follows. This intermediate bath seems to correct the acidity of the subsequent acid fixing bath to a degree which eliminates the danger of **reticulation** at that point.

The hardening properties of this intermediate bath are such that negatives treated in it are almost impervious to scratches. It accelerates final drying of the film by contracting the layer of gelatine to its minimum thickness, thus expelling as much moisture from it as possible. The emulsion of a negative treated in this solution and the subsequent acid fixing bath shows a remarkably glazed surface which makes it almost difficult to distinguish the emulsion side from the back of the film. This glaze is proof not only of sufficient hardness of the emulsion and fineness of grain, but also of the absence of reticulation.

The Acid Hardening Fixing Bath. This is the final solution required for processing Leica films and its purpose is to dissolve the unexposed portions of the silver and thus render it insensitive to light. Another function of this fixing bath is to harden the emulsion.

While the packaged form of acid fixing powders, which merely requires solution in a given quantity of water, is quite satisfactory, far superior and consistently satisfactory results are obtained by the use of the newest formula offered by Eastman Kodak Company:

Acid Hardening Fixing Bath for Films

Formula E.K. F-5

	Avoirdupois	Metric
Water (at about 125° F. or 52° C.)	20 ounces	600.0 cc
Hypo (pea crystals or rice crystals)	8 ounces	240.0 grams
Sodium Sulphite, desiccated	½ ounce	15.0 grams
*Acetic Acid, 28% pure	1½ fl. ounces	47.0 cc
Boric Acid, crystals	¼ ounce	7.5 grams
Potassium Alum	½ ounce	15.0 grams
Cold water to make	32 ounces	1.0 liter

*To make 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Directions for mixing:

Dissolve the Hypo in about one-half the required volume of water; then add the remaining chemicals in the order given, taking care that each chemical is dissolved before the next is added. Then dilute with water to the required volume.
The film should be left in this hypo bath for 10 minutes (temperature should be preferably the same as that of the developer), and it is frankly recommended to use

the hypo for fixing of film once only, after which it may be collected in a separate bottle for fixing of paper. This may be considered by some as somewhat extravagant, but it should be worth while to know that this final step in processing some thirty negatives will insure their longevity, which greatly depends on the freshness and strength of the hypo.

For those who require larger quantities of acid fixing bath it is recommended that they keep a separate solution of straight Hypo and a separate Acid Hardener Stock Solution, mixing them in proper proportions just before using. This results in fresher solution when required:

Acid Hardener Stock Solution

Formula E.K. F-5a

	Avoirdupois	Metric
Water (at about 125° F. or 52° C.)....	20 ounces	600.0 cc
Sodium Sulphite, desiccated	2½ ounces	75.0 grams
Acetic Acid, 28% pure	7½ fl. ounces	235.0 cc
Boric Acid, crystals	1¼ ounces	37.5 grams
Potassium Alum	2½ ounces	75.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given, taking care that each chemical is dissolved before the next is added.

Add slowly one part of the cool Acid Hardener Stock Solution to four parts of cool 30% hypo solution (2½ pounds of hypo per gallon of water) while stirring the latter rapidly.

Washing the Film

After fixing, the film should be thoroughly washed to remove all traces of Hypo, otherwise the negatives may in time develop stains. Washing is best carried out while the film is still in the developing tank. A steady stream of water, not colder than 65° F.. (18° C.) nor warmer than 70° F. (21° C.), should be permitted to run into the tank through the opening in its cover for not less than 20, preferably for 30 minutes. If it be important to wash the film quickly, it is suggested to proceed as follows: Fill the tank with water, agitate it for one-half to one minute, pour the water out. Repeat this operation six or seven times. The film ought to be free from Hypo at the end of this procedure, and ready for drying.

Drying the Film

The film should be carefully removed from the developing reel and hung from one end by means of a clip. It is best to suspend the film so that it will not come in contact with the wall or other objects while drying. With a Viscose Sponge or soft clean chamois, wetted and thoroughly squeezed out, the excess water should be wiped carefully off both sides of the film in one slow, gentle and uniform stroke for each side. A well hardened film should dry of its own accord in 20 to 30 minutes after being suspended. For quick drying an electric fan may be used, provided one is sure the fan will not direct a stream of dust onto the film. Dust particles hurled at the delicate gelatine surface will become imbedded in it beyond hope of removal. It is therefore preferable that the current of air strike the uncoated celluloid back side of the film.

Soaking a Film Before Development

Unless the exposed film is old and brittle it should not be soaked in water before development. There seems to be no advantage in presoaking a film to be developed. It would be just one unnecessary operation. The old contention in favor of such a procedure was that it prevented formation of air bells and enabled the developer to start work more quickly and uniformly by presoftening the emulsion. Air bells are successfully eliminated by stirring the developing tank for about a minute immediately following its filling with developer, and then tapping the filled tank twice or thrice against some wood surface. As to presoftening of the emulsion of the film that seems superfluous for a procedure which takes some 20-30 minutes of slow and gradual building up of image within the emulsion of the film.

It is one of the features of the technique offered here to develop Leica film with the utmost of simplicity and effectiveness, with complete elimination of any and all steps of doubtful value.

Step by Step Developing Procedure

To develop a roll of Leica film proceed as follows:

Step 1. In total darkness wind film onto the spool of the developing tank, emulsion side in (facing center of reel). To do so, do not pull the film out of the closed or partly opened magazine. Open the magazine, take the spool out and hold it in the palm of the hand while rewinding it onto the reel of the developing tank. Be sure to close tank carefully and securely before turning on light.

Step 2. Cool developer to exact temperature required for given developer. While cooling developer, prepare short-stop bath and the hypo. Short-stop bath should be about the temperature of the developer. Hypo not less than 65°F. (18°C.) or more than 70°F. (21°C.).

Step 3. Pour developer in steady stream into developing tank. Directly after filling tank, observe time on clock and start agitating developer. Agitate for about one minute, not vigorously but steadily to prevent formation of air bells. Agitate every three to five minutes thereafter.

Step 4. One-half minute before expiration of full time called for by developing formula, start pouring out developer from the tank (pour into original storing container, unless developer life is exhausted). Shake all developer carefully out of tank.

Step 5. Without rinsing, pour the short-stop bath into tank in a steady stream. Observe time on clock and start agitating for about one minute. Leave short-stop in tank for five minutes, agitating occasionally. Pour it off at expiration of time. The short-stop should be used once only.

Step 6. Pour in hypo without rinsing tank. Start agitating directly after tank is filled with hypo and continue every two or three minutes. Fresh hypo should remain in tank for 10 minutes. At the end of 10 minutes, pour off hypo. Hypo should not be used for fixing film more than twice (preferably once). It can then be used for fixing out papers.

Step 7. After pouring out hypo, fill the tank with running water. Adjust it to a temperature of between 65°F. (18°C.) and 70°F. (21°C.). Water colder than 65°F. will not wash the film properly; warmer than 70°F. is likely to soften the film. After filling tank with water, agitate it briefly but vigorously, pour out water and put tank under tap, letting the water run down in a steady stream for about twenty to thirty minutes.

Step. 8. Remove film from tank. Hang it by film clips in a cool, dry, dust-free place and wipe off excess water gently from both surfaces of film by means of Viscose Sponge. The sponge should be wet, but thoroughly squeezed out. When wiping emulsion side only the gentlest pressure should be exerted to prevent scratching. The celluloid side of the film should be dried thoroughly with slightly more pressure. Film will dry normally in twenty to thirty minutes, but it is best to let it hang for about three times the length of time it requires for the film to become concave with respect to the emulsion side.

Step 9. Roll film carefully, emulsion side in and store it in a dry, dust-free, clean box. A small rubber band slipped over the roll will prevent film from scratching.

Step 10. It is best not to put the film into an enlarger for from six to twelve hours after it has dried out. Objectionable Newton rings will form if "green" film is placed in the enlarger.

General Suggestions

Utmost cleanliness should be observed throughout processing of Leica negatives.

Use only the best and purest chemicals, and once a brand is adopted continue to use it for uniform results.

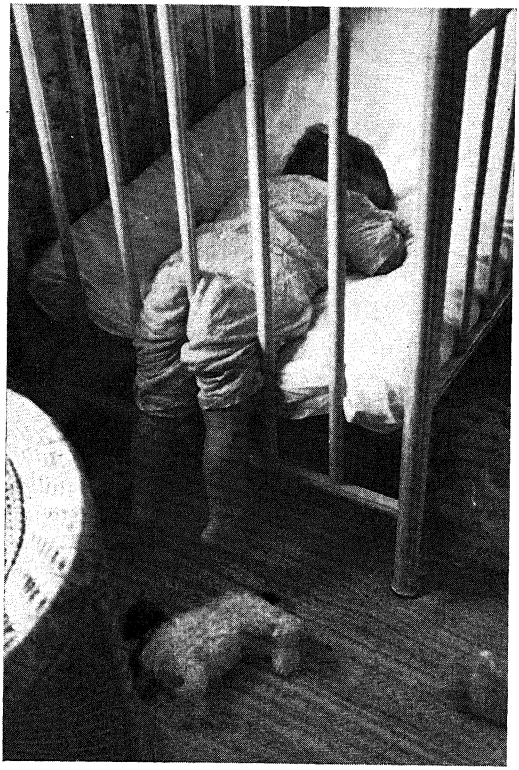


Fig. 112 Sleeping Acrobat. Photo by J. S. Mosher

Elmar 50mm, 1/20, f:3.5, Panatomic Film

Observe greatest accuracy in weighing and measuring chemicals.

Never permit fingers to come in contact with emulsion side of film either before or after developing.

Never handle film except by its edges.

If film becomes soiled, wipe it carefully with a soft chamois skin dipped in a suitable film cleaner (see page 155).

Apron of Correx tank should be removed when not in use, and kept suspended by one or both its ends.

Films should be kept as far away as possible from heat, radiators, hot water pipes, etc. It should be remembered that most of our negative material is nitrate stock and highly inflammable. Therefore films should be kept in a well ventilated cool dark place, away from open flame.

Developing and handling of Leica negatives should not be turned into an obsession, but should be considered as only one of the factors which contributes towards the final picture.

Reticulation

Reticulation is a peculiar phenomenon occurring on films, and in the case of Leica films it may actually ruin an otherwise perfect negative. It is due to local strains in the gelatine which may be caused by a sudden change in temperature of solutions, or atmospheric conditions. It occurs in different degrees, from an extremely mild form barely distinguishable by the eye, to a very severe form. Reticulation looks like miniature elephant skin shrivelled into a labyrinth-like pattern. In its severest form it produces actual tiny cracks in the emulsion; the accompanying illustrations shows this condition.

Reticulation can happen at any point during processing of film, including pre-soaking, during development, or at the point of change from developer to hypo. It can even occur while the finished film is drying.

To minimize the danger of reticulation, the pre-soaking of the film, and its washing between solutions should be entirely eliminated. **The use of the short-stop as an intermediate bath between the developer and hypo cannot be recommended strongly enough.** The chrome alum and sodium bisulphite short-stop has a beneficial effect upon the film by its gentle hardening and slightly acid action as a transition from the alkaline developer to the highly and hardening fixing bath. It is believed that the short stop carried over in small quantities into the hypo bath corrects the acidity of the latter to the point where it will not cause reticulation.

Fig. 113 Reticulation, mild (Anonymous!)

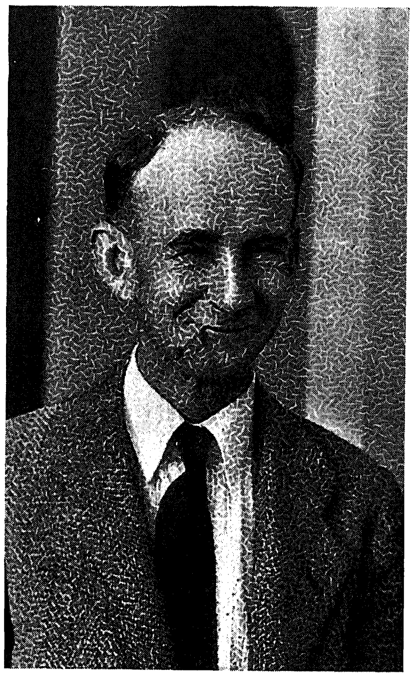


Fig. 114 Reticulation, acute—cracks in emulsion. (Anonymous!)

Newton Rings

Another source of considerable annoyance are the so-called Newton rings. These are irregular spots of all colors of the spectrum appearing on the surface of the enlarging paper while the negative is in the enlarger for printing. In appearance these Newton rings suggest those charac-

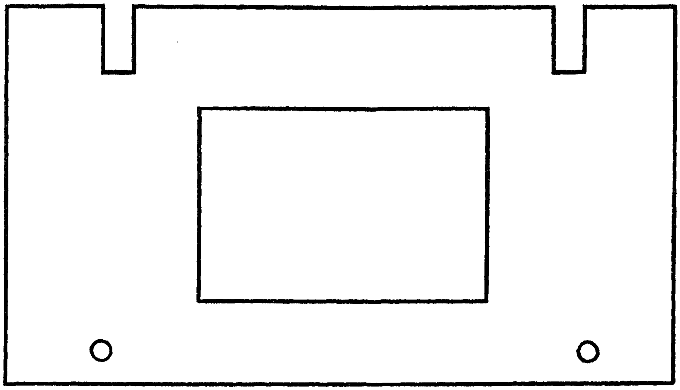


Fig. 115 Masking plate for eliminaton of Newton Rings, actual size for tracing.

teristic, rather pretty, patterns which oil forms on water. While pretty to look at, Newton rings are a decided nuisance for they will ruin any print, and are hard to eliminate.

They occur particularly on "green" film, that is, film that has just been dried but still contains moisture. For this reason it is recommended that films not be put into the enlarger for six to twelve hours after drying.

Newton rings are actually caused by the condenser of the enlarger not being in perfect contact with the entire back of the film, but merely touching it at several points, indicating that the film is not in a true plane.

Of most remedies suggested for correction of this annoying condition the one providing a special mask or spacer, as shown in the cut which is a full size tracing, is the most practical. This masking plate can be made from a thoroughly fogged, developed and fixed out piece of cut film, with the aid of a sharp razor blade. The regular masking negative carrying plate is taken out of the enlarger, the film placed over it as usual with the emulsion side down, and the special mask placed over the negative; the entire assembly is then slipped into the enlarger and from this point the procedure is carried on as usual.

Film Cleaner

Film that is dusty, dirty, shows finger marks, lint, etc., should be carefully cleaned before placing it in the enlarger.

An excellent all-around film cleaner is easily prepared as follows:

Ethyl Alcohol (pure grain alcohol)....	**85% (or parts)**
Methyl Alcohol (wood alcohol)........	**10% (or parts)**
Strong Ammonia	**5% (or parts)**

This cleaner is not "dry," as is carbon tetrachloride and similar cleaners. Because this cleaner is "wet," it does not charge the film electrically, thus leaving it without the usual tendency to attract lint and dust from the air. This cleaner should be applied to both surfaces of the film with a clean, lintless fine linen cloth, soft chamois or lens tissue.

Reducing or Intensifying Leica Negatives

These two processes are, to say the least, dangerous for miniature camera work, and their use is definitely discouraged. Either of these processes increases the grain considerably and destroys definition. However, for those who wish to save a valuable negative, the two formulas most suitable for miniature camera work are offered:

E.K. FORMULA R-5—PROPORTIONAL REDUCER

Stock Solution A

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Permanganate	4 grains	0.3 gram
Sulphuric Acid (10% solution)	½ ounce	16.0 cc

Stock Solution B

	Avoirdupois	Metric
Water	96 ounces	3.0 liters
Ammonium Persulphate	3 ounces	90.0 grams

For use, take one part of A to three parts of B. When sufficient reduction is secured the negative should be cleared in a 1% solution of sodium bisulphite. Wash the negative thoroughly before drying.

E.K. FORMULA IN-5—SILVER INTENSIFIER

For 35mm Negative and Positive Films

The following formula is the only intensifier known that will not change the color of the image on positive film on projection. It gives proportional intensification and is easily controlled by varying the time of treatment. The formula is equally suitable for positive and negative film.

*Stock Solution No. 1

	Avoirdupois	Metric
Silver Nitrate	2 ounces	60.0 grams
Distilled water to make	32 ounces	1.0 liter

* Store in a brown bottle.

Stock Solution No. 2

	Avoirdupois	Metric
Sodium Sulphite, desiccated	2 ounces	60.0 grams
Water to make	32 ounces	1.0 liter

Stock Solution No. 3

	Avoirdupois	Metric
Hypo	3½ ounces	105.0 grams
Water to make	32 ounces	1.0 liter

Stock Solution No. 4

	Avoirdupois	Metric
Sodium Sulphite, desiccated	½ ounce	15.0 grams
Metol	350 grains	24.0 grams
Water to make	96 ounces	3.0 liters

Prepare the intensifier solution for use as follows: Slowly add 1 part of solution No. 2 to 1 part of solution No. 1, shaking or stirring to obtain thorough mixing. The white precipitate which appears is then dissolved by the addition of 1 part of solution No. 3. Allow the resulting solution to stand a few minutes until clear. Then add, with stirring, 3 parts of solution No. 4. The intensifier is then ready for use and the film should be treated immediately. The degree of intensification obtained depends upon the time of treatment which should not exceed 25 minutes. After intensification, immerse the film for 2 minutes with agitation in a plain 30% hypo solution. Then wash thoroughly.

Complete Procedure for REVERSAL of Agfa Superpan Reversible Film

Reversible Superpan should be handled in total darkness. It can, however, be desensitized in a 1:2000 Pinakryptol Green Solution for two minutes, and then handled in bright green light such as the Agfa No. 103 green safe-light with a 25-Watt bulb.

The reversal procedure is divided into six basic operations, which are interspersed with appropriate periods of washing in running water.

1. DEVELOPMENT OF THE NEGATIVE IMAGE

First Developer.

	Avoirdupois	Metric
Water (125° F. or 52° C.)	24 ounces	750.0 cc
Metol	30 grains	2.0 grams
Sodium Sulphite	1 ounce	30.0 grams
Hydroquinone	180 grains	12.0 grams
Potassium Bromide	120 grains	8.0 grams
Sodium Hydroxide	265 grains	18.0 grams
Potassium Sulphocyanate	75 grains	5.0 grams
Cold Water to make	32 ounces	1000.0 cc

Develop normally exposed film for 6 minutes at 65° F. or 18° C. with constant, though not too rapid agitation. Do not use this developer more than once for consistently good results.

Wash film in running water for 10 minutes.

The accuracy of the first development and the thoroughness of washing following it are the two most important steps in the entire procedure.

2. REVERSAL

Reversal Bath (Bleach)

Water to make	32 ounces	1000.0 cc
Potassium Bichromate	75 grains	5.0 grams
Sulphuric Acid (Concentrated)	1.3 drams	5.0 cc

Add Sulphuric acid last, pouring it slowly while stirring.
Agfacolor Plate Reversing Salts put up in tubes, ready to be dissolved in 18 ounces of water may be substituted for above reversal bath.

After the film has remained in the Reversal Bath for at least 2 minutes, white light may be turned on in the darkroom and the remainder of the procedure may be conducted in white light.

Carry on reversal until both the negative image and the anti-halation undercoating are dissolved leaving only the undeveloped silver haloid. This requires about 5 minutes.

Wash film in running water for 5 minutes.

3. CLEARING

Clearing Bath

Water to make	32 ounces	1000.0 cc
Sodium Sulphite (desiccated)	1 2/3 ounces	50.0 grams

Clear in above solution for 5 minutes. Yellow stain is gradually removed and the emulsion assumes a clear white color.

Wash in running water for 2 minutes.

4. RE-EXPOSURE TO LIGHT

Thoroughly expose film to white light of a 200 watt bulb or of a Photoflood bulb (either bulb should be placed in a reflector). Hold film about 6 feet away from light, rotating it so that its entire surface, both front and back, is thoroughly exposed. Exposure required: 2-3 minutes. Direct sunlight should not be used. Film should not be held too closely to light source to avoid injury to emulsion from heat.

5. REDEVELOPMENT

Second Developer

Water (at 125° F. or 52° C.)	24 ounces	750.0 cc
Metol	30 grains	2.0 grams
Sodium Sulphite (dessicated)	370 grains	25.0 grams
Hydroquinone	60 grains	4.0 grams
Sodium Carbonate (monohydrated)...	295 grains	20.0 grams
Potassium Bromide	30 grains	2.0 grams
Cold water to make................	32 ounces	1000.0 cc

Develop until image has become thoroughly blackened, which requires about 5 minutes.

Rinse in running water for 3-5 minutes.

6. FIXING

Fix for five minutes in regular acid hardening fixing hypo bath (page 149).
Wash in running water for 10-15 minutes.
Wipe off surface water gently with the aid of viscose sponge.
Hang up film to dry.

All solutions and the running water should be maintained throughout the procedure at 65° F. or 18° C. Utmost cleanliness is required for successful results. Avoid contamination of solutions through carrying one into another.

Storage and Preservation of Films

This matter is again a question of personal preference. The writer knows of as many storing and filing systems as he knows Leica workers. There are transparent cellophane envelopes in book or box form holding strips of from three to eight negatives. There are books with flaps of transparent paper and books with pockets. There are filing cabinets and chests of endless variety.

Personally, the writer prefers to preserve, store and file Leica negatives in uncut lengths, in rolls firmly but not tightly wound. A small rubber band (about ½ inch in diameter) is slipped around the roll before placing it in a steel box divided into small sections of twenty-five to a box. Each roll is given a number and a brief description of the entire roll marked under the corresponding number on the inside lid of the box. Each box is marked with an alphabet number and a record kept in a loose leaf scrap book into which contact prints from every roll are pasted.

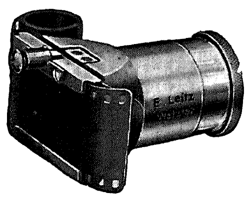


Fig. 116 The Negative Viewer and Marker is Convenient for Examining Completed Films

DRY HYPERSENSITIZING OF LEICA FILMS

F. DERSCH
H. DUERR

CHAPTER 6

Much of the lure and fascination of miniature-camera photography can be traced to the photographer's desire to tackle difficult subjects on which the miniature camera can show its real ability. This tendency, coupled with the miracle lenses of today and modern "supersensitive" films, has led the average Leica enthusiast to subjects undreamed-of but a few years ago. Theater shots with normal stage lighting, candid photographs in radio studios, and countless other subjects with unfavorable light conditions, have all given in to the progress of speed lenses and fast films.

But this taste of new subject material has merely whetted the serious worker's appetite for picture-making under difficult light conditions, and many have turned to the process used by some news photographers of "hypersensitizing" films to gain an extra bit of sensitivity. In many instances the added sensitivity afforded by such a method means the difference between success and failure in capturing a poorly illuminated subject. Until recently, hypersensitization was a discouraging procedure, for the work was messy, the results uncertain and far from satisfactory. However, the process is now practical, for from recent work carried out in the Agfa Ansco Research Laboratories in Binghampton, N. Y., the details of a simpler and better method of increasing film sensitivity have been developed.

Mercury Vapor Treatment

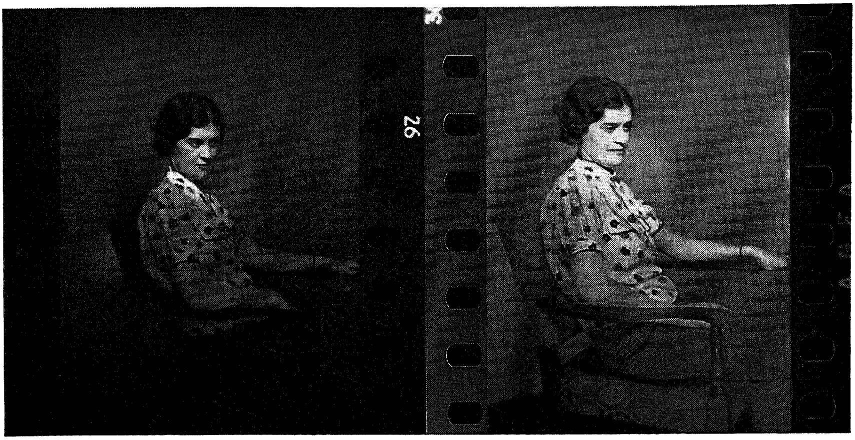
This new method makes use of the action of mercury vapor and eliminates the need of any wet treatment, solutions, drying of film or other unpleasant operations. The treatment is simplicity itself, for the hypersensitizing is effected merely by storing film in a sealed container with a few drops (half a gram is sufficient) of mercury for several days at normal room temperature. The mercury is placed in a small non-metallic cup or wrapped up in a small piece of porous blotting paper. If preferred, silver or zinc amalgam, which can be obtained as a powder at any drug store or through your dentist, may give greater convenience than is afforded by liquid mercury. Two grams of the amalgam is sufficient for a one-liter container if the powdered amalgam is spread out as much as possible. The hypersensitizing can be carried out in any closed, non-metallic container and in this connection developing tanks can be used with care if they are clean and dry. Unvarnished or unpainted metallic containers (except those of iron) should be avoided as they greatly prolong the time necessary for treatment due to the absorption of mercury vapor by the metal of the container.

For the most rapid results, film should be unrolled to allow free access of the mercury vapor. This can be done by hanging the film in spirals in a light-tight box or by reeling it onto the clean, dry reel of a Correx or Reelo developing tank in the center of which the small amount of mercury or amalgam has been placed. The tank should be sealed with scotch cellulose tape around the edges and the center opening plugged with a rubber cork to prevent leakage of the mercury vapor.

Length of Treatment

For the method outlined, hypersensitizing should be effected in about 70 hours at normal room temperature, although it is difficult to specify this as the definite time for treatment, since the time required varies somewhat with prevailing conditions for hypersensitizing. Large containers, low temperatures, or the presence of metal which can absorb mercury on its surface, may increase the time necessary for treatment appreciably. It is therefore best to run a sample of perhaps three short lengths of film under your own working conditions first, allowing the film strips to be treated for different lengths of time. Inspection of the negatives after a standardized exposure and development will indicate which time of treatment should be used to obtain maximum increase in sensitivity. As a general guide upon which to start your tests, the three films should be treated for perhaps 40, 60 and 80 hours at room temperature.

More definite recommendations than this for length of treatment are of little value as the time required for a maximum hypersensitizing effect depends greatly, as stated above, on the conditions of treatment. Furthermore, while all makes of film have been found suitable for treatment with mercury vapor, considerable variations in the time required for maximum effect have been experienced in hypersensitizing film produced by different manufacturers. This condition makes it all the more advisable for you to run a brief test on the kind of film you use, to determine the optimum of time of treatment with mercury vapor. Treatment can be continued as short strips of film are removed at intervals, given a standard exposure and developed until no further increase in sensitivity is noticeable. The presence of any slight amount of fog not due to unsafe darkroom illumination or improper development is an indication of extreme over-treatment with mercury vapor and should be remedied by reducing the time of treatment somewhat.



Courtesy Agfa Ansco Corp.

Fig. 117. Left, untreated film: Right, film treated with mercury vapor before and after exposure. Both negatives on Agfa Superpan film of same emulsion number exposed 1/200th second at f:4.5, developed in Agfa 17 at 65° F. for 14 minutes, enlarged together on the same sheet of Agfa Brovira Hard paper without dodging or print manipulation. Subject gave an average reading on a Weston meter of 65.

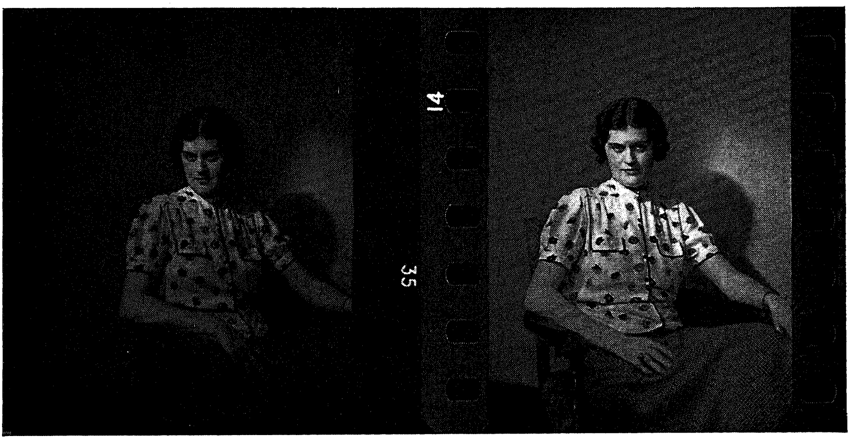


Fig. 118. Left, untreated film: Right, film treated with mercury vapor before and after exposure. Both negatives on Agfa Finopan film of same emulsion number, exposed 1/200th second at f:3.5, developed in Agfa 17 at 65° F. for 10 minutes, enlarged together on the same sheet of Agfa Brovira Soft paper without dodging or print manipulation. Subject gave an average reading on a Weston meter of 65.

If sufficient time is available, films can be treated without being unwrapped or removed from their cartridge or spool; 36-exposure cartridges with foil removed, or longer lengths on spools, may be treated directly by placing them in a sealed container with the mercury or amalgam. An ideal container for treating film in cartridges is provided by the familiar fruit jar with a glass top. With the top clamped down against a rubber washer, the jar becomes an air-tight hypersensitizing outfit that is convenient in size and easily accessible. The amalgam may, as before, be wrapped in blotting paper or a small shelf can be inserted to support film cartridges. Treatment in such a manner should continue for 8 to 10 days for maximum effect, and longer if the cartridge is constructed with a large amount of metal.

The time of treatment can be shortened by carrying out hypersensitization above room temperature—but this is *not* recommended, as the presence of excess mercury vapor formed at higher temperatures can be detrimental to health. Mercury and amalgam should be handled carefully; but with normal care in washing hands there is no risk of "mercury poisoning." Hypersensitized film is perfectly safe to handle.

Increasing Sensitivity From 75% to 150%

The amount of increase in sensitivity by this method is approximately 75%, depending on the kind of film, slower emulsions having been found to give usually a slightly greater response to treatment than the fast emulsions. However, this is not the limit of speed increase obtainable through dry hypersensitizing. It has also been found that while treatment before exposure gives an increase of approximately 75%, treatment of the film after exposure will show a still greater increase, and treatment both before and after exposure of the film will result in a maximum gain in the sensitivity of about 125% to 150%. The treatment after exposure and before development known as ''intensification of the latent image'' can be carried out in the same manner as hypersensitizing before exposure.

Several other characteristics of mercury vapor hypersensitization are interesting—particularly since they are possessed only by this method. Of greatest interest, perhaps, is the fact that experiments have shown no change in gradation between completely treated and untreated films. Tests have also shown that color sensitivity and grain size are unaffected by sensitization with mercury vapor.

Practical Applications

Faster film gives us the obvious advantage of shorter exposures. There are several ways in which we could gain by using proper judgment as to how the exposure should be shortened to serve our needs best. Assuming that hypersensitizing results in 100% increase in the sensitivity of the emulsion, making our film twice as fast as its original rating, we have several ways at our disposal any one of which will give us an obvious advantage:

Adjustment possible:	Resulting advantage:
1. Increased shutter speed (lens diaphragm unchanged)	Easier to stop motion; prevention of blurred images
2. Smaller lens stop (shutter speed unchanged)	Greater depth of focus; better definition
3. Less (artificial) light (same shutter speed and lens stop)	Less heat and discomfort to subjects photographed indoors
4. Use of color filter requiring twice normal exposure (same shutter speed and lens stop)	Better color correction without slowing down of exposure or increase of lens stop.

Any one or a combination of all or some of the above factors may be used as long as the sum total of their respective light retarding properties remains approximately within the scope of the increase of film sensitivity secured by the hypersensitizing method. Careful consideration should be given to this aspect of making the best of this advantageous treatment of the film.

Fig. 119 Bessie J. Winton Lemen

Keeping Qualities and Storage of Film

The keeping qualities of hypersensitized film vary considerably with storage conditions. At room temperature, treated film retains its increase in speed from one to two weeks. After this period, the sensitivity falls off gradually until the entire increase in speed has disappeared in from four to twelve weeks according to the type of material. The increase in speed of hypersensitized film may, however, be kept over longer periods of time by storing the film in a refrigerator. Tests have shown that film stored at —10° Centigrade will retain the greater part of its hypersensitizing effect for over two months.

This fact suggests the possibility of a film storage control plan whereby a supply of treated film may be kept "on tap" to be used as needed. Two or three treated cartridges may be kept, for example, in their metal containers within the freezing compartment of your kitchen refrigerator. Meanwhile an extra cartridge can be given unhurried treatment at room temperature. When a film is withdrawn from the refrigerator for use, the next film that has received treatment can be placed in "cold storage" allowing a new cartridge to take its place in the container used for hypersensitizing. This "cold-storage" technique is especially valuable if you do not know the exact time at which you will need hypersensitized film, and want to have the treated film on hand ready for use. *Only one word of warning:*—allow at least an hour for the film to warm up to room temperature before loading to avoid condensation of moisture on the film in the camera.

Film that has lost its increase in speed may be treated again without ill effects. In fact, tests have shown that several such hypersensitizations may be made without causing deterioration of the film, and it is believed that film can be retreated as often as is desirable and convenient if hypersensitization is not carried to the point of fog. Since experiments have shown the presence of fog only after extreme over-treatment, little need be feared on this account, and in normal practice no fog will be encountered. Treated film that is used after the hypersensitizing effect has disappeared shows no deterioration or any effect upon the keeping properties or original photographic characteristics.

For Leica work requiring the greatest possible film sensitivity the mercury vapor method of hypersensitizing will prove very helpful. Users will find it not only effective, but clean, convenient and simple. Many photographers will find it valuable for stepping up the speed of a fine-grain film of moderate speed. Others may prefer to use it for normally-exposed fast films which are to be developed in fine-grain formulas requiring an increase in exposure. Certainly, for those interested in hypersensitizing, it provides a method that is far superior and more reliable than the usual wet methods used heretofore.

Fig. 120 Beale Street Memphis, Where the "Blues" Began

Joseph J. Steinmetz

Summar 50mm, Agfa Superpan Film

Fig. 121 Direct Enlargment

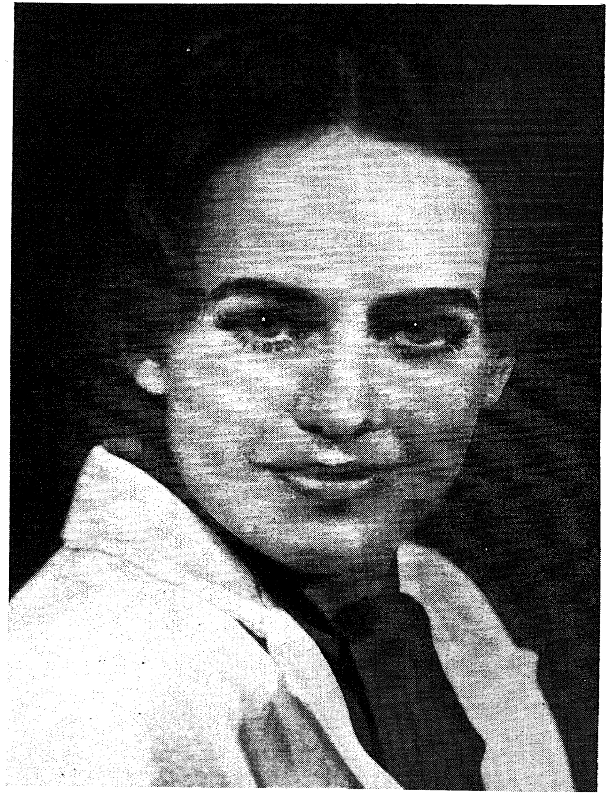


Fig. 122 Contact Print From an 8 x 10 Inch Reversal Negative Retouched

MAKING OF ENLARGED NEGATIVES: THREE METHODS

JOHN N. HARMAN, JR.

CHAPTER 7

Probably everyone who has ever made a Leica shot and "blown it up" to a good sized enlargement has wished for an opportunity to do a bit of retouching on minor parts of the negative. But a microscopic eye is needed for work as exacting as this, and retouching and spotting have as a result been relegated to the final print.

Many a cynical megacamist has seized this apparent fault as the clinching point in his arguments against "postage stamp" negatives. And this with little reason, for there are **three ways** by which Leica photographs may be conveniently put into the form of enlarged negatives for retouching before the final print or enlargement is made.

Retouching, however, is not the only advantage offered by the use of enlarged negatives—for they come in handy in many ways. Whenever several enlargements requiring dodging or projection control are desired to be made identical with one another, the use of an enlarged negative not only simplifies the procedure and cuts the over-all working time, but insures the uniformity of the final prints. All the dodging and retouching may, for example, be done upon one master enlarged negative of from 4 x 5 to 8 x 10 inches in size, and all prints of any size may be contact printed, enlarged, or reduced from this with unvarying results. The contrast of originals that are too dense or too flat may also be improved in the preparation of the enlarged negative. Furthermore, enlarged negatives offer an excellent medium for the combination of parts of different negatives when, as is sometimes the case, the final print is built of several separate images.

There are three methods which may be used to obtain good enlarged negatives without excessive time or trouble in processing.

The first involves the use of a new and singular photographic material, "**Direct Copy Film.**" This unusual film produces a negative directly from a negative—although it is processed in a manner no different than that regularly used for chloride printing paper.

The second method is based upon the use of a **reversible film** for the original exposure in the Leica. Upon special development, this reversible film produces a positive (normally used for projection purposes) which is then enlarged on a process or commercial film to give the enlarged negative.

The third method embraces the preparation of an **intermediate film positive** from which the enlarged negative is made. This is naturally the longest process in point of time but it is well known and will do the trick admirably if the special films required for either of the first two methods are not obtained.

Direct Copy Film is a new material which is being manufactured by the Agfa Ansco Corporation of Binghamton, N. Y. The emulsion of this remarkable film has properties by means of which it can produce in one single exposure and development a negative from a negative (or for that matter, a positive from a positive). The emulsion of the film is treated during manufacture so that when developed without any exposure whatsoever, a maximum density of opaque silver is produced. However, for every increasing amount of exposure the film shows a corresponding increase in transparency after development. Thus, light parts of an original are duplicated by transparent portions of the copy film and shadow regions of the original are represented with equal accuracy. Aside from this unusual characteristic the emulsion of Direct Copy Film resembles a chloride printing paper in color sensitivity, required exposure, and general handling and processing in the darkroom. Because Direct Copy Film has an extremely fine-grained emulsion no additional graininess is produced in the final enlargement by this method.

Because of its peculiar properties, Direct Copy Film makes the preparation of enlarged negatives a rapid and simple procedure. The only operations requiring special mention are those of exposure and development. Fixation and washing are done in the conventional manner.

Since Direct Copy Film has approximately the same speed as the standard soft grades of contact printing paper, Leica negatives may be enlarged onto it without unduly long exposures when a photoflood bulb is used in the enlarger. A small strip of chloride printing paper such as Convira may be used in making a preliminary test exposure, and the correct printing time determined from the test exposure. The piece of Direct Copy Film should be mounted on the enlarging easel with the emulsion side up. The Leica negative to be enlarged should be inserted in the enlarger, not in the usual way, but with the *emulsion side facing upward* instead of downward. This will give a reversed (from left to right) image on the easel and a correct image in the final print. The density of the enlarged negative should be controlled by adjusting the exposure and not by modification of the developing time. Thin copy negatives indicate over-exposure, while an enlarged negative that is too dense is the result of under-exposure. Amber or bright orange light may be used in the darkroom.

Development of the enlarged negative on Direct Copy Film can be carried out in any soft-working film developer, but the three following formulas are recommended for best results.

For Normal Gradation on Direct Copy Film (Formula: Agfa No. 17)

	Avoirdupois	Metric
Water (about 125° F. or 52° C.)	24 ounces	750.0 cc
Metol	22 grains	1.5 grams
Sodium Sulphite, desiccated	2½ oz. 80 grains	80.0 grams
Hydroquinone	45 grains	3.0 grams
Borax	45 grains	3.0 grams
Potassium Bromide	7½ grains	0.5 gram
Cold Water to make	32 ounces	1000.0 cc

Use without dilution.
Develop 12 to 20 minutes at 65° F. (18° C.).

For Moderate Brilliance on Direct Copy Film (Formula: Agfa No. 47)

Water (about 125° F. or 52° C.)	24 ounces	750.0 cc
Metol	22 grains	1.5 grams
Sodium Sulphite desiccated	1½ ounces	45.0 grams
Sodium Bisulphite	15 grains	1.0 gram
Hydroquinone	45 grains	3.0 grams
Sodium Carbonate monohydrated	88 grains	6.0 grams
Potassium Bromide	12 grains	0.8 grams
Cold Water to make	32 ounces	1000.0 cc

Use without dilution. Develop 8 to 10 minutes at 65° F. (18° C.).

For Maximum Brilliance on Direct Copy Film (Formula: Agfa No. 30)

Water (about 125° F. or 52° C.)	24 ounces	750.0 cc
Metol	50 grains	3.5 grams
Sodium Sulphite desiccated	2 ounces	60.0 grams
Hydroquinone	130 grains	9.0 grams
Sodium Carbonate monohydrated	1 oz. 150 grains	40.0 grams
Potassium Bromide	30 grains	2.0 grams
Cold Water to make	32 ounces	1000.0 cc

Use without dilution. Develop 4 to 5 minutes at 65° F. (18° C.).

As mentioned above, variations in results should be controlled more by adjustment of exposure rather than by modification of developing time. Best results will be obtained by keeping within the times recommended for each developer. Stains will be avoided by the use of a conventional acid short stop bath between development and fixation.

Enlarged Negatives from Reversible Film Original

The second method of preparing enlarged negatives relies upon the use of a **reversible film** in the Leica for the original exposure. This film is developed by a reversible process to a positive, usually for projection purposes. A film of this kind, prepared especially for the Leica, is made by the Agfa Ansco Corporation of Binghamton, N. Y., and is sold under the name of Superpan Reversible. It is a high speed, panchromatic material which may be compared to the supersensitive type in group 1 (See page 122). Because it is a reversal film it gives positives which have an exceptional fineness of grain—a noteworthy point for all miniature camera work. The positive resulting from the processing of the Superpan Reversible Film can be easily enlarged onto a piece of Commercial, Commercial Ortho or Process Cut Film and developed in a standard negative film developer. The exposure required by Process Film will be about the same as that needed for the faster grades of Bromide enlarging paper, while Commercial and Commercial Ortho Film will require about one-tenth as much exposure.

The processing of the reversible film original will be done at a nominal charge by the film manufacturer but it can be carried out satisfactorily in about two hours by the procedure outlined in detail on page 157 of this volume.

Enlarged Negatives by the Positive—Negative Process

The third method by which enlarged negatives may be made from Leica originals requires the preparation of an **intermediate positive film.** This may be made, of course, by contact printing onto 35mm positive film stock and proceeding as with the reversible film positive. However, greater convenience is undoubtedly afforded by the preparation of the intermediate film positive in an enlarged form. This is easily done by enlarging the original Leica negative onto a sheet of Process or Commercial Film instead of the usual bromide paper. Development can be carried out in a conventional negative film developer such as the following:

Metol—Hydroquinone Developer (Formula: Agfa No. 47)

	Avoirdupois	Metric
Water (about 125° F. or 52° C)	24 ounces	750.0 cc
Metol	22 grains	1.5 grams
Sodium Sulphite desiccated	1½ ounces	45.0 grams
Sodium Bisulphite	15 grains	1.0 gram
Hydroquinone	45 grains	3.0 grams
Sodium Carbonate monohydrated	88 grains	6.0 grams
Potassium Bromide	12 grains	0.8 grams
Cold Water to make	32 ounces	1000.0 cc

Tray Development: Use full strength. Normal development 5 to 7 minutes at 65°F. (18°C.)

Tank Development: Dilute one part of above developer with one part of water. Normal development: 12 to 14 minutes at 65° F. (18° C.)

This enlarged positive film when fixed, washed and dried can then be contact printed or enlarged onto another piece of Process or Commercial Film to produce the final enlarged negative. Retouching and dodging can, of course, be done at either of the two intermediate steps—intermediate positive, or final enlarged negative. If Process Film is used for both intermediate positive and final master negative, developing time should be decreased to avoid results of excessive contrast.

EDITOR'S NOTE: For finer gradation, softness and minute details expected of pictorial work, it may be found that substitution for the positive Process or Commercial film, suggested by the author, by a softer film may be more effective. Reference is made to the type of film offered by orthochromatic emulsions such as Eastman Portrait or Safety Ortho films, Agfa Plenachrome or Defender Pentagon. These films are more sensitive to light in general and a shorter exposure is required than for the positive film. The Safelight, of course, would need to be changed from yellow to ruby, according to recommendations contained in each package of film. Otherwise the procedure is not different from that outlined by the author.

YOUR OWN LEICA DARKROOM

WILLARD D. MORGAN **CHAPTER 8**

A photographic darkroom can be the source of many enjoyable hours. Here is a place where you can try out some of those new photographic ideas of yours, make your exhibition enlargements, try out the latest developing formula, make photo-montages, lantern slides, develop color film and experiment with various enlarging papers. As you complete your darkroom it will quickly become the meeting place for your friends who have similar interests. After a hectic day at the office or some other occupation the evening hours in your darkroom will be one of the most enjoyable relaxations you can experience.

Make the darkroom a model of convenience, cleanliness and neatness. If you cannot find space for a separate room for your work don't worry but fix up the kitchen sink for your developing and enlarging equipment. Dark shades over the windows will exclude all light, and the darkroom safety light may be easily installed over the sink. If the kitchen is not convenient explore the bathroom and confiscate one corner for your equipment. A wide board over the bathtub will hold several trays, while the bathtub and sink may be used for washing the prints or films. There are thousands of "bathtub finishers" located in every section of the country who are doing excellent photographic work. The writer belonged to this fraternity of "bathtub finishers" for many years before he had an opportunity to enjoy the thrills of having a separate darkroom completely equipped for his work.

If you happen to be living in a small apartment and wonder how you can solve the darkroom situation try converting the kitchenette into a darkroomette. Such a transformation has been cleverly done by John T. Moss, Jr. of New York. The accompanying photograph will give a complete plan of Mr. Moss's darkroomette. Note that the folding doors may be closed or opened as required. The refrigerator can be used for keeping solutions cool, or it may be a source of ice cubes when required. It is surprising how small a space can be utilized for doing all one's developing and enlarging work, so don't let the space problem worry you when you set up a place to do your finishing work. J. Harlan Davis of Mt. Vernon, Ohio has solved his space problem by constructing a "folding darkroom" right in his library. He has constructed a wall cabinet which holds all his equipment, and the door swings down to make the work table.

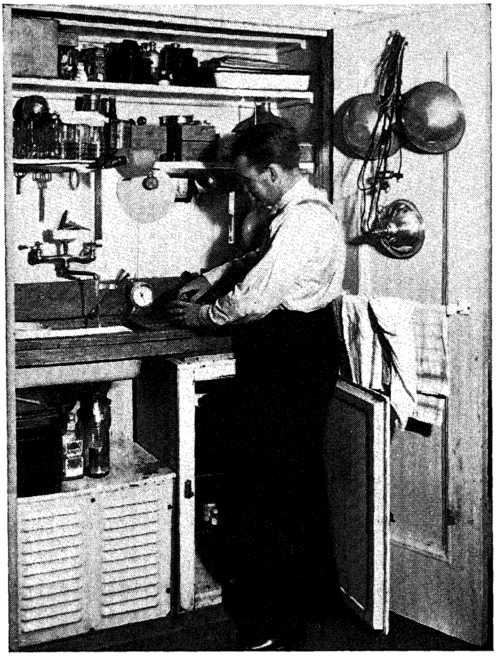


Fig. 123 "Darkroomette" of John T. Moss, Jr., utilizing facilities of the modern kitchenette

A Model Darkroom

In order that we may obtain a complete picture of what an amateur darkroom should look like let's take the model darkroom recently constructed by Lee Parsons Davis of New Rochelle, N. Y. The accompanying photographs and drawings will give you complete information, even better than any long detailed descriptions. Mr. Parsons based his plans upon a similar darkroom constructed by Clifford H. Beegle of Beaver Falls, Pa.

The inside dimensions of Mr. Parsons' darkroom are seven feet by six feet. Although this space may at first seem small it is surprising how much room there is to work and also how much space there is for storing equipment and supplies. The secret of this space utilization is that there are many storage drawers, and several shelves for chemical storage. Space has been made for print drying racks, ferrotype tins, and a large sink five feet long by sixteen inches wide and one foot deep. The sink is constructed of California white pine $1\frac{1}{4}$ inches thick. The side and end boards are $12\frac{1}{2}$ inches wide, and the bottom is one wide board. These boards were grooved to fit at a planing mill, and set together without glue or nails, then bolted on the ends and bottom.

There are three faucets over the sink, two of which are combination faucets which permit the proper temperature regulation of the water. One of the faucets has a small under valve which permits an outlet for tray washing of prints as shown in the accompanying illustration. A removable drainboard for the sink provides for additional working space when required. The 11 by 14 inch developing trays will fit across the sink while the space below can be used for a larger washing tray. Plenty of electrical connections, safety lights, as well as the regular white lights are provided.

Finally, and one of the most important points to consider in the darkroom is the ventilation. A fresh air inlet has been provided for through the door of the darkroom, while the foul air is sucked out through a light-tight duct by an electric fan. This permits constant circulation of air, and when two or three people are working in the darkroom at one time there is always plenty of good clean air.

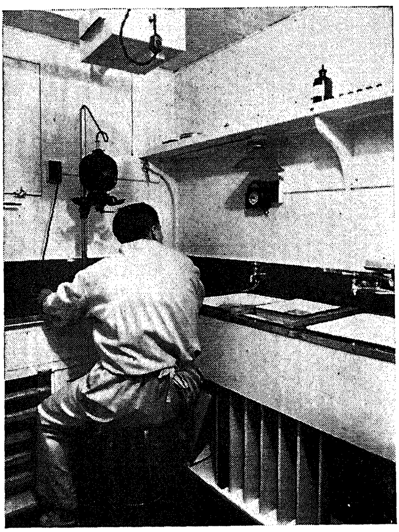


Fig. 124 Interior of photographic laboratory of Lee Parsons Davis

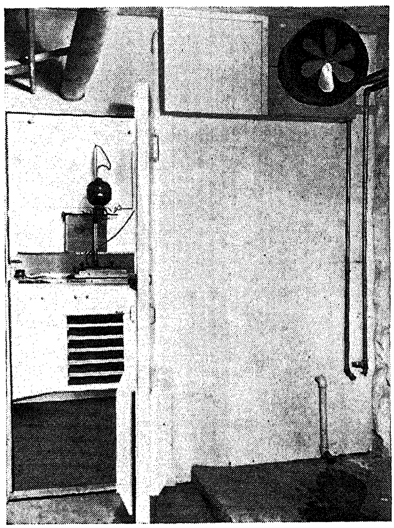


Fig. 125 Outside of Mr. Davis' photographic laboratory showing position of exhaust fan.
Note light trap ventilator on door

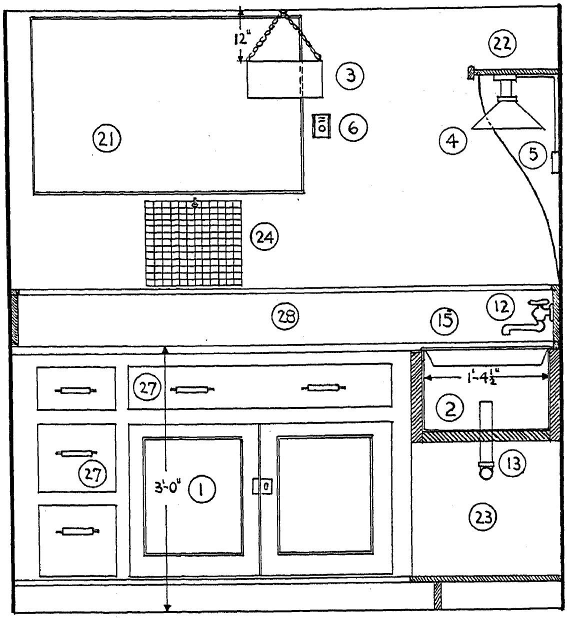


Fig. 126 Elevation facing work bench showing enlarging table, cabinets and cross-section of sink

Key to drawings (figures 126, 127, 128):

No. 1 Work bench and cabinet for print drying racks
No. 2 Sink—lead lined
No. 3 Wratten safe light, series No. 3, 40-watt Mazda bulb
No. 4 Safe lights
No. 5 Electric convenience outlets
No. 6 Electric outlet for enlarger
No. 7 Electric bright light
No. 8 Electric exhaust fan
No. 9 Fresh air inlet (light trap)
No. 10 Foul air discharge duct
No. 11 Cold water faucet
No. 12 Combination hot and cold water faucet
No. 13 Variable overflow drain pipe
No. 14 Removable drain board
No. 15 Sliding enameled developing trays
No. 16 Towel rack
No. 17 Light-tight door gasket
No. 18 Air thermometer
No. 19 Coat hook
No. 20 Stool
No. 21 Light-tight blind for exterior window
No. 22 Storage shelf for chemicals, etc.
No. 23 Storage space for solutions
No. 24 Trimming board and cutter
No. 25 Tray storage racks
No. 26 Storage space
No. 27 Equipment and supply drawers—full depth of work bench
No. 28 Bench top and back board covered with acid and alkali proof Micarta 1/16″ thick, with chromium trim
No. 29 Foul air outlet grille
No. 30 Proposed recessed cabinet for books and film storage

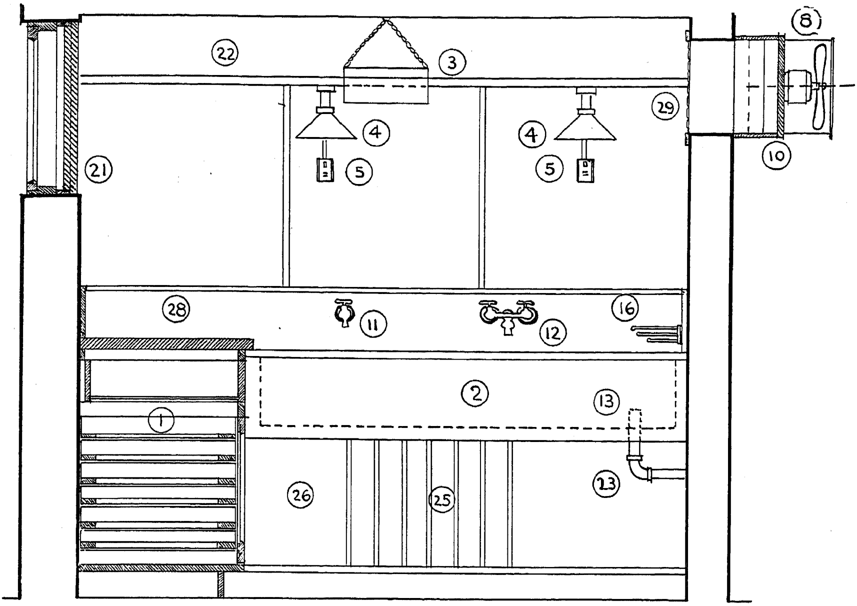


Fig. 127 Elevation showing sink, exhaust fan, safe lights, drying racks, etc.

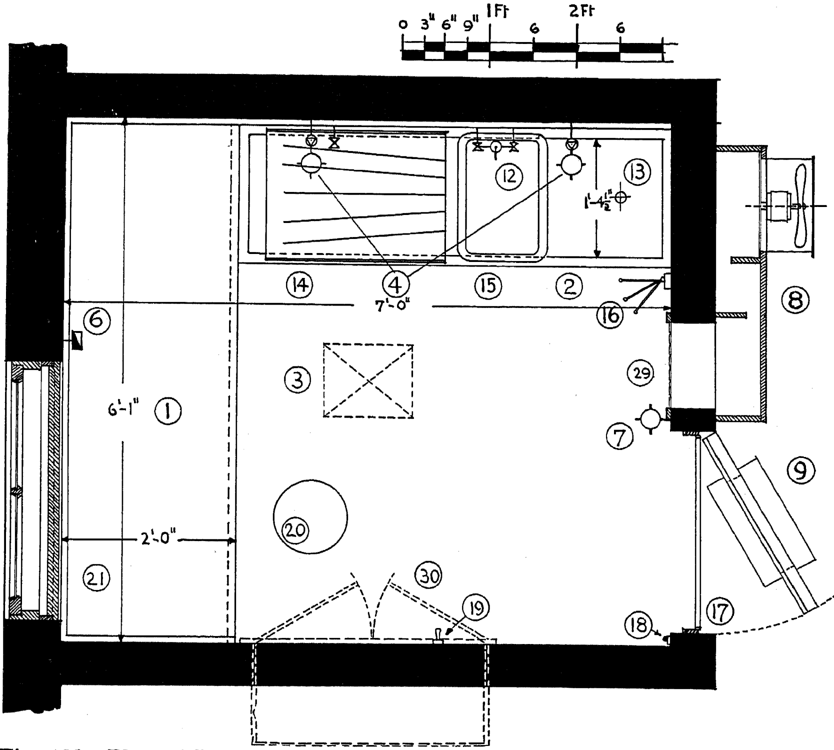


Fig. 128 Plan of Lee Parsons Davis' model darkroom

Stocking the Complete Laboratory

Naturally one's darkroom equipment and supplies will be determined by individual tastes and requirements. Here is a list to consider when stocking your laboratory with everything but the "kitchen stove."

Developing tanks for film . . . developing trays for paper enlargements . . . enlarging equipment . . . film and glass slide contact printers . . . illuminating control rheostat for use with photoflood bulb in enlarger . . . paper cutter . . . safety lights for paper and films . . . chemicals and chemical weighing scale . . . electric agitator for film developing tank . . . thermometer . . . cotton and viscose sponges . . . supply of bottles for keeping solutions . . . supply of beakers and graduates for mixing and measuring solutions . . . small electric stove for heating solutions . . . metal clips for hanging film to dry . . . developing glass drum for color films or reversing other films . . . supply of enlarging paper . . . filing boxes for **negatives which must be kept free from dust at all times** . . . and finally a small corkboard mounted on the wall for tacking up formulas and special data which is often referred to such as weight conversion tables, developing times at various temperatures, etc.

A Two Room Laboratory

Now let's study still another darkroom or laboratory which is a little more elaborate and has the double room feature with a small separate nook for the chemical mixing department. This darkroom was designed by Clarence Slifer of Hollywood, California and described in the August 1934 issue of the American Cinematographer. Mr. Slifer describes his laboratory as follows:

In keeping with the progressiveness that is so apparent in Miniature Photography, herewith is presented a plan of a model laboratory. This room in which photographic processing is carried on, is not called a darkroom, simply because that word is a misnomer. It is not dark, for at all times, with the exceptions of when loading magazines or developing tanks, there is an abundance of light: properly filtered light for printing and daylight for other operations.

Removed is the stigma that the word darkroom has implied. This model laboratory is not a poorly ventilated closet, under the cellar stairs, but is a room planned for comfort, convenience, and practicability. All of which are conducive to better photographic work and the full enjoyment of miniature photography.

From the plan, it will be noticed the room is divided into two main divisions; the laboratory proper and the study. The laboratory, to take care of all photographic work from glossy prints to the advanced pictorial processes. The study, to serve as a place for working out photographic problems or as a place where you may argue with friends about the gammas, the paraphenylenes, and the reticulations of photography, without having your sanity questioned by other members of the household or being relegated to that esteemed position now held by butterfly-chasing professors.

The essential features of the model laboratory are:

1. A shallow wooden sink provided with removable slats for tray supports. Its six-foot length easily handles three trays up to 16″x20″ in

size. Swing faucets practically "cover" the entire sink. Above the sink are shelves for stock solutions, etc. Below the sink, are racks for trays, box for waste and space for miscellaneous equipment. In the wall, above the right end or the sink, is a light-tight ventilator. This ventilator withdraws all hpyo or chemical fumes arising from developing or toning prints. Also at this end of the sink, is a light fixture containing a day light bulb. The light from this fixture is concentrated down upon the hypo or toning tray, and is actuated by a foot switch. This permits examining prints for tone or contrast without drying the hands. The safe-light used for observing the developing of prints, has two degrees of brilliance: dim and bright. The bright light is controlled by a foot switch and is used only for limited periods of print examination. For cleanliness, liquid soap and paper towels are a part of the sink equipment.

2. A film developing bench especially equipped for miniature negative developing. The importance of agitation in small film processing is recognized by the inclusion of an electric agitation machine in the laboratory equipment. Also provided is a negative viewing box (a white light behind opal glass). Affixed to the glass are gamma films of different densities for use in judging the progress of development. An ice chest for cooling solutions may be placed under the bench.
3. A print washing machine preferably of the Kodak rotating type. This provides a quick, efficient, and thorough means of washing prints with little handling.

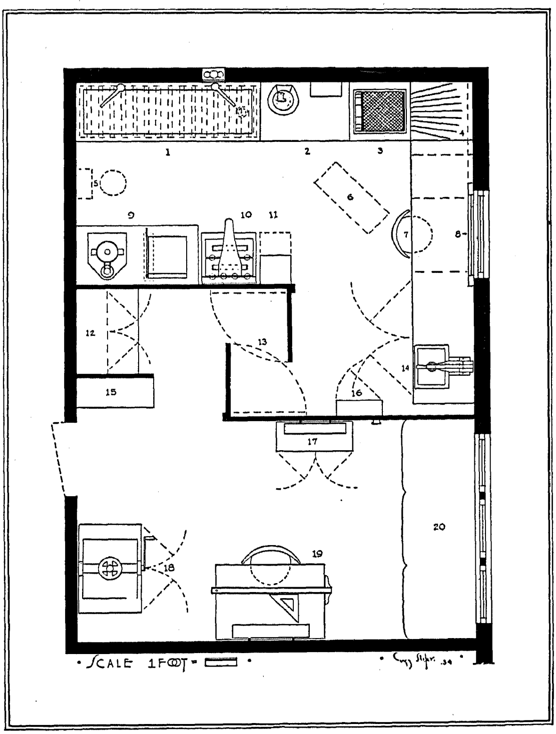


Fig. 129 Plan of two room laboratory designed by Clarence Slifer

4. A drain-board for prints after they have been removed from the washer.
5. A holder for paper towels and a shelf for the radio (the companion in the laboratory). Indicated here, is a stool, as much printing may be carried on while seated.
6. A double, indirect safe-light for general room illumination.
7. A long cabinet of an exaggerated desk-like appearance, with shelf or cabinet space above. Underneath the left end is a set of drawers for keeping Bromoil brushes, paints, and other materials. Space is provided for leg-room when seated before the portion of the bench at the window. Here is an ideal place to work upon Bromoils, spot or color prints, retouch enlarged negatives, etc. Underneath the right end of the bench, are frames with stretched cloth-net for laying prints upon, to dry.
8. A sliding light-tight shutter for the window.
9. A cabinet-bench for a miniature negative enlarger of the Leitz Focomat or Valoy type. The enlarger is controlled by a foot switch, thus leaving both hands free for "dodging". This freedom is further enhanced by the use of a metronome for timing prints audibly, during difficult exposures. At other times a large electric clock serves the purpose. On the wall, back of the enlarger, is an Illumination Control Rheostat for use with a Photo-flood lamp, when enlarging upon chloride (contact) papers. Light-tight drawers are in the cabinet, for the storage of photographic paper. To the left of the enlarger, is a print trimmer. To facilitate print trimming, the edge of the print trimmer is illuminated by a light, sunk in the cabinet.
10. An 11"x14" contact printing machine, which is used for printing enlarged negatives and also strips of Leica film, for proofs.
11. A film loading and negative filing desk.
12. Chemical closet, for chemical storage and mixing. In the lower part of the cabinet, is a bin for hypo crystals and a fixture for supporting a five-gallon bottle of distilled water. Due to its location, chemical dust in the laboratory is eliminated.
13. Light-tight entry to the laboratory, affording easy access and ventilation. The partitions fold back, whenever it is desirable.
14. Dry mounting press, for mounting photographs.
15. Bookshelves, for those indispensable photographic books and magazines.
16. A light-tight film drying cabinet, six feet high. Air is drawn in, through silk screens, from the study, thus minimizing the nuisance of dust. The cabinet may also be used for drying hyper-sensitized film.
17. A cabinet for camera equipment. Upon this cabinet is an easel for holding prints to be admired or glared at. A conventional, picture-illumination fixture is used for light.
18. A Bromoil transfer press and a cabinet for card stock, etc.
19. Desk-like drawing table with long fixture for diffused light above.
20. Long, comfortable window seat.

The plan of this model laboratory is based upon the knowledge gained from a number of years' experience in many photographic "darkrooms". So turn back and study the plan over, for perhaps you may find some ideas for your Ideal Laboratory for Leica Photography.

ENLARGING AND CONTACT PRINTING

WILLARD D. MORGAN **CHAPTER 9**

After the Leica negative has been made the next step is to have it printed, either by contact upon paper or film, or by direct enlargement. The choice in printing really depends upon individual requirements. Some prefer to make paper contact prints of all their negatives for reference purposes, while others would rather make enlargements direct. In order to reproduce the finest qualities in a Leica negative it is necessary to either make positive film or glass slides for projection upon a screen or to make enlargements upon some of the various printing papers now available. We will discuss the methods for enlarging first.

Making positive prints from Leica negatives offers many distinct advantages.

1. There is the choice of many fine enlarging papers which may be secured in various surfaces and grades of contrast. The chapter on enlarging papers will give complete information on this point.
2. Enlargements may be shaded or dodged during the printing in order to emphasize or hold back any portion of the picture. For example an overexposed sky may be printed longer than the underexposed foreground.
3. The unattractive or disturbing parts of a negative may easily be omitted to improve the composition of the finished picture.
4. The enlarging easel and the enlarger housing may be tilted for correcting the perspective in a picture. This feature is especially valuable when enlarging architectural pictures which have been taken close to the subject with the camera pointed slightly upward or at a sharp angle.
5. The slow printing contact or chloride papers can be used when a photoflood bulb is placed in the enlarger.
6. Enlarging screens, gauze, special effect filters, and other accessories may also be used with the enlarger for securing special effects in enlargements to please the various individual tastes.
7. The Leica enlargement of post card size or larger produces a picture which can easily be studied by anyone.

Selecting the Enlarging Equipment

Before the actual enlargements can be made it is necessary to select the proper enlarging equipment. A good enlarger will last a lifetime. By actually enlarging your own negatives you will learn many things about your pictures. You will have a keener sense of the proper composition, a better judging of correct exposures, improper focusing will show up instantly, and even when you are making your original picture you may have in mind certain enlarging papers for the subjects taken. So in order to gain these advantages let's become more familiar with the actual working equipment available.

The Valoy Enlarger

The present Valoy enlarger is actually the outgrowth of the former Filoy and Fylab enlargers. While these latter enlargers are still producing excellent enlargements for those who still own them, the present Valoy enlarger was constructed to give a few additional conveniences in handling the negatives. This enlarger may be described as follows:

1. Baseboard 15½ x 18 inches in size, for holding the paper easel and the metal upright bar which supports the enlarger lamp housing.
2. Upright metal bar, 1¼ inches in diameter, available in 80cm and 120cm lengths. Electric connecting wire passes through the center of the metal upright. At the base of the upright is a grounding connection marked "E" for attaching a ground wire if desired.
3. Lamp housing supported by an extension arm which clamps around the metal upright bar.
4. Adjustable lamp base for centering and otherwise moving the enlarging bulb into the best position to give an even illumination over the entire negative area.
5. Removable condenser with adjusting lever for clamping Leica negative into position for enlarging.
6. Space for accommodating various masks for single frame, Leica double frame, 3 x 4cm, and 4 x 4cm negatives. Hinged glass negative holders also available for use with single negatives which have been cut from the regular rolls.
7. Focusing lens mount will accommodate the various Leica lenses. The 50mm lenses are recommended for use in this enlarger.
8. The condenser may be removed for cleaning by turning the clamping ring inside of the lamp housing, removing the spring, and then lifting out the condenser. It is a good plan to remove this condenser frequently and carefully clean the surface with lens tissue or a clean linen.
9. An intermediate ventilating ring and an intermediate diffusing condenser are recommended for use with the Valoy enlarger when a photoflood bulb is used.
10. A small snap switch is attached to the baseboard of the enlarger for making the exposures.

The Focomat Enlarger

The Focomat Enlarger is very similar to the Valoy Enlarger with the exception of the automatic focusing features. The lamp housing, movable condenser and method of inserting the film in the Focomat Enlarger is just the same as in the Valoy Enlarger. The differences may be mentioned as follows:

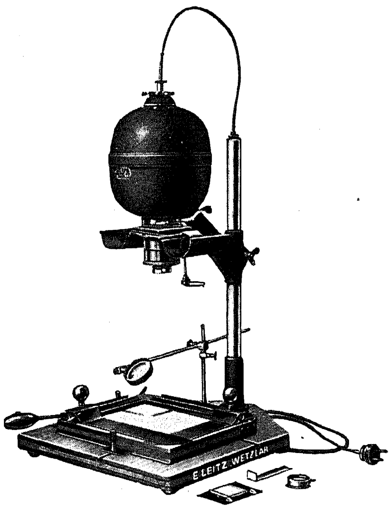


Fig. 130 Valoy Enlarger, complete with easel, magnifier, orange filter and negative masking carrier plate

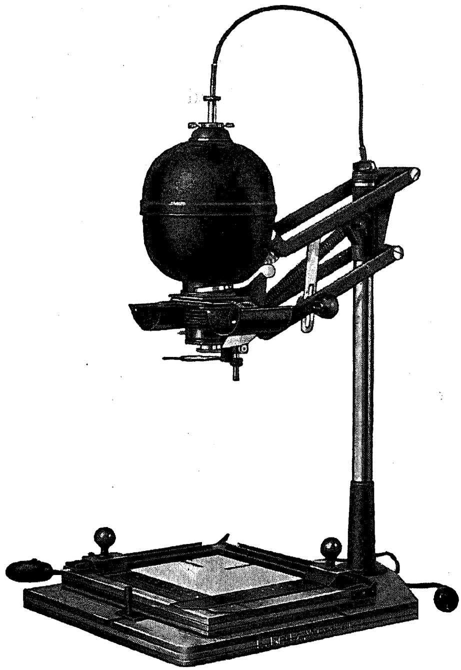


Fig. 131 Focomat Enlarger, complete with easel and orange filter

1. As shown in the illustration the Focomat Enlarger has two extension arms which attach the lamp housing to the upright pillar. The upper arm holds the lamp housing, while the lower arm likewise holds the lamp housing in a vertical position and at the same time makes the changes in the focus of the lens.
2. The Focomat Enlarger can be adapted for use with any 50mm Leica lens.
3. There are three different settings on the focusing ring of this enlarger. These settings are used with the different film holders, such as, the regular holder for receiving rolls of Leica film, the glass plate holder for single Leica negatives, and the glass holder for 3 x 4cm negatives which hold the film in a slightly different plane for enlarging.
4. A magnification scale is included.
5. On the upright pillar there are two holes. The upper one is for use with the enlarger when the paper holding easel is in position. The lower hole is used for marking the position of the bracket on the lamp housing when the easel is not to be used.

The Focomat Enlarger is focused for one of the Leica lenses by the photographer. This operation is quite simple. The enlarger head is first raised to the highest position (10x enlargement) and the image sharply focused on the easel by turning the lens mount of the enlarger. For this purpose a negative with a sharp, line image is best. When the image on the easel is in sharp focus the first clamp to the left on the focusing mount of the enlarger, is slipped under a spring catch and the clamp secured by set screw.

The enlarging head is then brought down to its lowest position (2x enlargement). A set screw near the automatic cam is loosened which allows a screw with a knurled head to be moved. The latter is adjusted until the image on the easel is extremely sharp and then the set screw is tightened. The enlarger is now permanently adjusted for the particular lens. When greater enlargements than 10x are desired the enlarger head is raised on the upright and focusing done by turning the mount of the enlarger. After the enlarger head is returned to its normal position on the upright the focusing mount is turned to again bring the clamp under the spring catch.

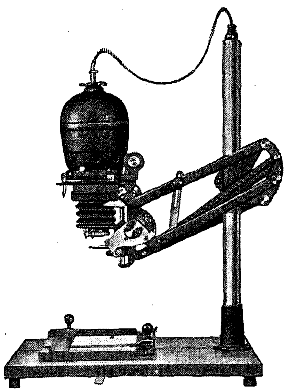


Fig. 132 Focomat Enlarger which accommodates all negative sizes up to 2½ x 3½ inches

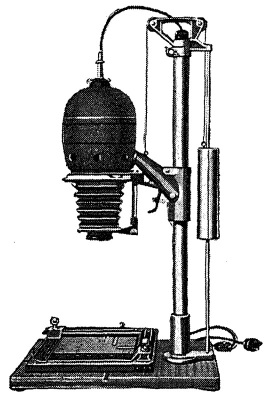


Fig. 133 Vasex Enlarger for use with all negatives up to 2½ x 3½ inches. Note counterweight for balancing weight of enlarger

There are two holes in the upright to accommodate a special cross pin for holding the enlarger arm at a fixed position. The upper hole is used when the enlarger is adjusted for use with an easel, and the lower hole is employed when automatic focusing is adjusted for the baseboard.

Any of the 50mm Leica lenses, with the exception of the Xenon f:1.5 can be used or the special Varob Enlarging Lens can be employed. The Varob lens is really recommended because this lens can be left on the enlarger continually and it will not be necessary to use the lens from the Leica Camera.

The large Focomat enlarger accommodates negatives up to 6.5 x 9cm (2½ x 3½ in.). This enlarger is used with two lenses, a 50mm and a 95mm. The latter is supplied with the enlarger, and in the case of the 50mm lens a special Varob Enlarging lens can be obtained with the enlarger, or a 50mm camera lens (except the Xenon f:1.5) can be used. For negatives up to 4 x 4cm the 50mm lens is used and the 95mm lens is employed for the larger negatives. Enlarging range is 2 to 13x with the 50mm lens and 1-1/3 to 4¾x with the 95mm lens.

Because two lenses of different focal length are employed there are two different automatic focusing cams. The enlarger is supplied already adjusted for the 95mm lens, so that only adjustment for the 50mm lens is necessary, which is done in a similar manner as with the small Focomat Enlarger. Below and in back of the lens mount there are two holes. A cam roller on an axle is supplied, and when this is inserted in the upper hole the roller operates the cam for the 50mm lens and when placed in the lower hole it operates the cam for the 95mm lens. The negative carrier is an optically flat sandwich plate similar to the one supplied with the Vasex Enlarger.

Enlarger Accessories

There are various accessories for use with the Valoy and Focomat Enlargers. Masking plates for use with single frame, double frame, 3 x 4cm, and 4 x 4cm negatives may be used in these enlargers. Glass plate negative holders are also available for enlarging single negatives. The 2½ x 3½ Focomat and Vasex Enlargers accommodate all film sizes up to their maximum areas. Orange filters are also of value when making enlargements or glass lantern slides. A special attachment ring is available for fitting to the Elmar or Hektor 50mm lenses. This ring permits the operation of the iris diaphragm by turning a knurled ring with a special calibrated scale on the side. In this way it is very easy to read the lens stops from the side of the ring. As most enlargements are made with the lens closed down at least two or three stops in order to reduce the light intensity and compensate for any slight error in focusing, such a ring is recommended. Preliminary focusing is done with the lens wide open.

If the Leica is used without the Adjustable Diaphragm Ring the figures engraved on the lens mount represent the following ratios:

Relative Aperture:	1.9 (2.0)	2.5	3.2 (3.5)	4.5	6.3	9	12.5	18
Ratio of Exposure:	0.36	0.63	1	2	4	8	16	32

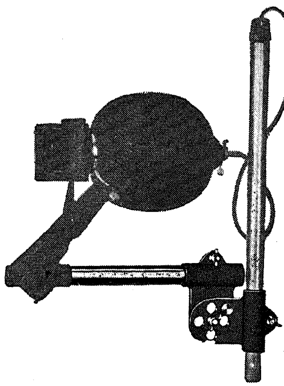


Fig. 134 Offset arm for making great enlargements

Fig. 135 Diaphragm Ring available for Elmar 35mm and 50mm, and for Hektor 50mm lenses when these lenses are used on enlargers

A special Offset Arm is also available for use with the Valoy and Focomat Enlargers. This Offset Arm is of special value when making big enlargements because the lamp housing is extended an additional 6 inches away from the upright pillar. As the Offset Arm contains a short rod itself, it is possible to raise the lamp housing of the enlarger about 18 inches higher than the top of the regular upright bar which comes with the enlarger. Even when making huge enlargements up to 2 or 3 feet or greater, this Offset Arm can be used very successfully in the horizontal position. The arm may be moved vertically or horizontally by loosening the set screw and turning the attachment in various positions. In the horizontal position as shown in the illustration, the picture may be projected upon a wall for making the huge enlargements.

There are two accessories available for correcting distorted lines in the negative, due to tilting the camera. One is a metal frame which is attached to the top plate of the film stage, known as the Distortion Eliminating Device. Two small bars on either side of the device have spring clips into which a hinged glass negative carrier containing the film is slipped. These bars are so mounted that they may be pushed up or down, or turned in almost any direction enabling the negative carrier to be so positioned that the distorted lines in the negatives will be straightened on the easel.

The extent to which the negative can be tilted through the use of the Distortion Eliminating Device is limited so that in cases where it is not sufficient to overcome distortion of lines in the negative it will also be necessary to tilt the easel. This is facilitated through the use of an Auxiliary Baseboard, which is a small rectangular board upon which is mounted a ball-jointed tripod head. The latter has an adapter allowing it to be attached to a paper easel. With the aid of the ball-jointed tripod head the easel can be tilted in most any direction.

To overcome distortion of vertical lines, the negative and easel are tilted in opposite directions, that is in V manner. This also serves to overcome elongation which would be produced if only the negative were tilted.

The Vasex Enlarger

The Vasex Enlarger is designed for enlargement of all sizes of miniature camera negatives. This enlarger will accommodate all film from the single frame size of 35mm film to 2½ x 3½ inches. Its optical system is so arranged that the Leica interchangeable lenses can be used in it. As standard equipment a 95mm lens is available. The focusing bellows is adjustable for use with other interchangeable Leica lenses. The Vasex Enlarger as well as the large size Focomat Enlarger have stationary condensers. A special optically flat glass sandwich plate is used for holding Leica films or cut films up to 2½ x 3½ inches, otherwise the method of using the Vasex Enlarger is practically identical with that of the Valoy or the small Focomat Enlarger.

Making the Actual Enlargements

Now let's suppose that the Valoy Enlarger has been selected and we are ready to make our first enlargements. First, check up on the darkroom equipment and make certain that the following materials are available:

1. The Valoy Enlarger.
2. Developer, short stop, and hypo solutions as well as trays. The trays can be selected for the size of enlargements which will be made. A set of 5 x 7 and 8 x 10 inch trays are always of value.
3. Enlarging paper. (See next chapter on Enlarging Papers).

4. Check up on the proper safe-light and other accessories for the darkroom use. (See chapter on the Leica Darkroom).

After all, there is very little equipment required for making Leica enlargements. You can easily confiscate the kitchen sink and drain board for this work after the windows have been covered with a blanket or black cloth. The darkroom chapter will give you more complete information about becoming *a bathtub finisher.*

Before placing the Leica negative into position in the Valoy Enlarger, make certain that there are no dust particles clinging to the film. If there are, remove them with a soft brush or with a clean lintless linen cloth. The movable condenser should always be inspected for dust or dirt particles. These points are very essential because small dust particles may spoil an otherwise perfect enlargement if they are not removed beforehand. The Negative Viewer and Marker can be used very successfully for picking out the best negatives for enlarging. With this attachment, it is possible to make a small nick in the edge of the film. Then, while working in the darkroom, the negatives can be picked out very quickly by running a thumb along the edge of the film.

When the correct negative has been selected, insert the film into the negative carrier of the enlarger **with the emulsion side down.** Snap on the light and move the film so that it appears in the frame which is projected down onto the paper holder. This can be done while the condenser is in the raised position. Next, move the clamping lever forward in order to release the condenser and thus clamp the film into a plane position. Now, raise or lower the lamp housing and turn the focusing mount, into which the Leica lens has been screwed, until sharp focus has been secured over the entire picture area.

Some Leica workers secure critical focusing by placing special negatives with sharp line drawings in the enlarger before the regular negative to be enlarged is inserted. Then, when perfect focus is secured by projecting the lined negative onto the enlarger easel, the focusing negative is removed and replaced by the regular film strip. A black over-exposed frame can also be used for this purpose providing a few fine scratches are made on the emulsion side of the film.

A hand magnifier or reading glass can also be used for viewing the projected image on the enlarging easel. Sometimes this latter method is very convenient for securing critical focus.

The enlarging easel should be set for the proper size of the enlarging paper. The two adjustable masking bands can be moved for making the proper adjustments. It is best to have a small white margin around the finished enlargement. This white margin can be varied according to requirements.

After the projected negative is properly focused and centered on the enlarging easel, you are now ready to make an exposure test. Select a small strip of enlarging paper and place it on the easel with the emulsion side up. Stop the lens down to one or two diaphragm stops. A small pencil flash light may be used to make the adjustment of the lens diaphragm. This flash light can be covered with a piece of red paper. With the proper lens stop set you are now ready to snap on the switch and expose the test strip. Two or three different exposure times should be made on this test. A small card can be moved across the test strip at one or two second intervals, depending upon the speed of the paper and also the density of the negative. With a little practice it is very easy to count seconds without watching a clock. There are various methods used for counting. For example, seconds can be counted in this way: Thousand 1— Thousand 2— Thousand 3—. Or, if this may be too monotonous, try the following: 1 chimpanzee, 2 chimpanzee, 3 chimpanzee, etc. There are excellent darkroom clocks with second hand dials for use in timing negatives on enlarging papers.

The diaphragm stops on the enlarging lens can be more easily seen if a small white card is placed just below the lens in order to throw the reflection of the light back onto the lens. The card can be bent in such a way that the light will even be thrown around to one side of the special attachment ring in case it is used for adjusting the diaphragm stops.

After the test strip has been exposed, place it in a developer and develop for a full time of 1½ to 2 minutes in case of bromide papers. If the slow chloride contact paper is used, the developing time will probably be about one-half the time required for bromide paper. After the test strip has been fully developed, rinse it in the fixing bath for a few seconds and then turn on the white light and examine the exposures. The correct exposure can usually be determined very quickly. Now place a full size sheet of enlarging paper in the enlarging easel and snap on the light for the required length of time. Remove the paper and place it in the developing tray. After proper development, rinse the picture in the acetic acid short stop which is made up as follows:

Acetic Acid (28%)	**1½ oz.**	**48cc**
Water	**32 oz.**	**1000cc**

From the short stop the print is placed in the acid fixing solution for about 15 minutes. See the next chapter on Printing Papers for information about the acid fixing solution.

After the picture has been thoroughly fixed, it should be washed in a tray in running water for at least one hour before placing out to dry on blotters or in the special blotter roll which is now available.

Estimating Print Density

Some people have a very easy time turning out excellent prints which embody everything that is known as *quality.* Others have a hard time making good prints. It is true that some people have a gift for such work, having the ability to put *quality* into their prints by instinct or intuition, but even the average person who lacks that *spark* should be able to turn out most satisfactory prints after once getting the *feel* of making them.

Let's see what is involved in the process of producing a latent image upon a sensitized paper and subsequently converting that latent image into a real image in terms of black and white and the intermediate tones of these two colors.

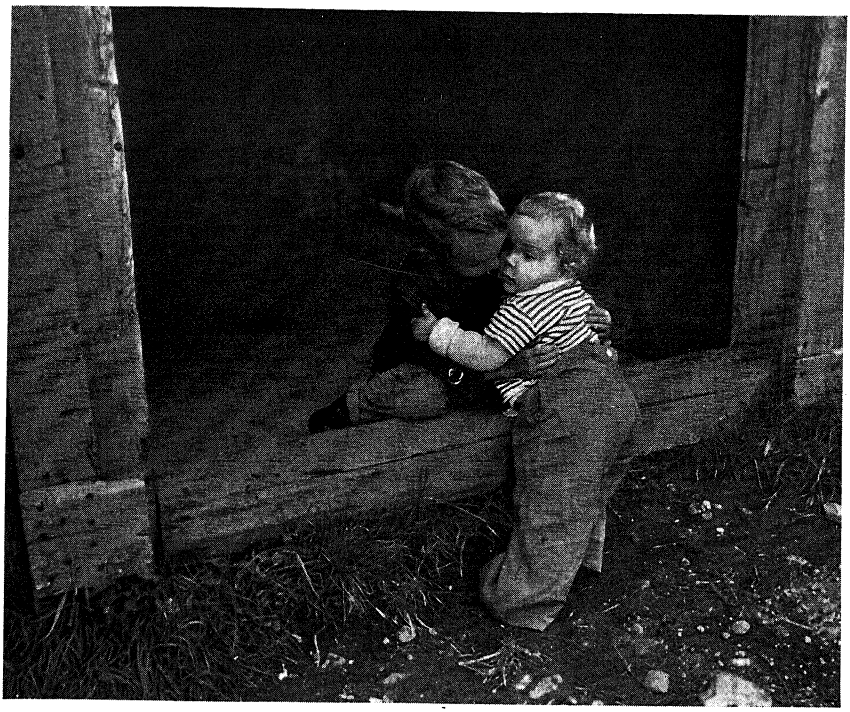


Fig. 136 Getting a Lift — Willard D. Morgan
Elmar 35mm. 1/100. f:6.3. DuPont Superior Film

The emulsion of the paper coats the surface very similarly to that of a coat of paint. Paint consists of a vehicle, which is usually linseed oil or other more or less volatile substance, and tiny particles of pigments suspended in the vehicle. The emulsion of the sensitized paper consists of gelatine, the vehicle in which particles or grains of light-sensitive silver bromide, chloride or a mixture of both are suspended. The emulsion has a thickness. This thickness may vary with the different types of papers. There are particles of sensitive silver salts that are near the upper surface of the emulsion and some that are joined to the surface of the paper. And there are particles of these salts scattered in between. When light strikes the surface of the paper, after passing through the negative, it strikes the sensitive silver salt grains. If little light reached the surface of the emulsion, only those silver grains become affected by it that are nearest the surface. The more light that reaches a certain point of the paper, the deeper it penetrates into the emulsion and the more particles of silver salts are affected by it. Obviously a certain minimum amount of light must be admitted to the surface of the paper to affect the lower layers of silver salts imbedded in the emulsion.

After exposure, the latent image produced upon the emulsion of the paper must be developed through conversion of the silver salts into metallic silver grains. When the print is immersed in the developer its chemicals begin to react with the silver salts in the emulsion after the water of the developer softens the dry gelatine. The particles of developer gradually penetrate into the thickness of the emulsion until they reach all the way through it to the paper proper. Obviously a certain minimum of time must elapse between the time when the uppermost grains of silver are developed and the time when the lowermost grains are converted into silver.

This is the reason for the requirement of paper to be developed for a minimum time before withdrawing it from the developing solution. In most instances that minimum time for bromide and chlorobromide is set at one and one-half minutes. That is the **minimum** time of development. If after the printing has been developed for one and a half minutes, and not less, it appears weak and flat, it apparently has been underexposed and more exposure should be given. If it appears to be too dense it has been apparently overexposed and the subsequent exposure should be shortened.

Longer development than the minimum of one and a half minutes is frequently indicated. Some prints acquire a certain tone quality through longer development. Thus it can be said that with certain developers for instance after a minute and a half development almost all details of the picture are available and the development is continued for another half minute with very little apparent change taking place in the print. But when finished and dry such print will have that *quality* and *richness* which we always look for.

An excellent and frequently overlooked method of learning how to make good prints consists of making some prints on lantern slides or on positive cut film. The emulsion of lantern slides and positive cut film is similar to that of bromide papers Lantern slides and transparencies made on positive cut film have a greater brilliance and greater latitude than bromide papers. This is only measurably true. Their emulsions being almost the same, the difference of quality results from the viewing method employed, slides being viewed by transmitted light while bromide prints are viewed by reflected light. This difference will become quite apparent

Fig. 137 Reflection in Mirror Top Table Alfred Eisenstaedt

Summar 50mm, 1/8, f:2.8, Super-X Film

when one will visualize a cross-section of an emulsion similarly exposed. Bromide paper emulsion and lantern slide or transparency emulsions of a similar negative would show under great magnification that the densities of the deposit of black silver grains are almost identical and they form terrace-like recesses or slopes ranging from blackness merely at the surface of the emulsion to total blackness of the entire thickness of the emulsion. It is easy to see that transmitted light penetrates through these layers of different degrees of blackness with a different intensity, thus forming degrees of intensity that can be likened to shades of gray. Light, however, that is reflected from a black surface backed with white paper can produce only a very limited range of tones of gray which would depend on the thickness of the black.

Thus if one would use positive cut film or lantern slide stock instead of bromide or chlorobromide papers for enlargements or portions of enlargements one will begin to evaluate these differences of the thickness of silver deposits. Lantern slides or transparencies must be viewed by transmitted light. Viewing them in a developing tray will produce unfavorable, erroneous results. A transparency that may look fully developed in the tray will look flat when viewed against a light box. And one that looks totally black in a developing tray will show excellent brilliance and contrast when viewed against an adequate light source. A dozen lantern slides or pieces of positive cut film would be an excellent invest ment and one will get more information from such experiments than from a whole volume written on the subject. That is the only way to get the *feel* of the matter and it cannot be recommended strongly enough. Later on, after having made a number of prints in the form of transparencies one may adopt the same method for judging prints: when they are developed according to a standardized method and fixed, view them against some strong source of white light, while wet, and if your print looks good that way, it certainly will be good when dry and finished.

Prints should be wet when viewed through transmitted light, particularly those made on double-weight paper which may require a stronger source of light than those made on single-weight paper.

Incidentally it should be remembered that lantern slides and cut film transparencies can be developed in the same developers which are used for developing of bromide or chlorobromide papers.

Printing Control During Enlarging

The enlarging of a negative permits much greater latitude in the actual printing control as compared to contact printing. During enlargement, it is possible to introduce soft focus lenses, special diffusion screens, and also use special paper masks or other means of *dodging* the picture during exposure. While contact printing permits very little variation in the finished print, a little shading is about all that can be done above the negative during exposure.

Dodging may be necessary when printing a negative in which the sky is considerably overexposed while the foreground may be normal or even underexposed. The correct exposure is made for the foreground and then a cardboard is used to mask out the foreground while

Fig. 138 Tea Time Morgan Heiskell

the sky is given a few additional seconds in order to bring out the clouds or to keep the sky from printing white. With a little practice and ingenuity the operator can devise various methods of *dodging or shading*. For example, a large cardboard can be cut with a round hole through which the picture may be projected as required for bringing out certain effects in the print. Also, small cardboard discs can be attached to a thin wire when it is necessary to hold back certain portions of the picture during exposure. In case there is considerable dodging to be done on a print, the diaphragm on the enlarging lens can be stopped down several stops more in order to give a longer working time. During the shading process, it is quite essential to keep the cardboard moving in order to prevent a sharp line from appearing where different exposures are made. A little practise will eliminate this trouble. Many enlargements can be shaded simply by moving the hand below the enlarging lens and thus blocking out any part of the picture which may be necessary.

Still other methods of control are possible by using a supplementary soft focus lens in front of the enlarging lens or a thin piece of tulle may be mounted in a holder and moved around just under the lens during the exposure. Also, special effects may be secured by placing screens directly over the enlarging paper. Sometimes these screens are printed on glass plates in order to give a small space between the screen and the paper and thus permit a slightly softer result. Still another method of obtaining special effects on the enlargement is by using a clear glass plate with fine sand sprinkled around the plate where the background of the picture is to be held back or diffused. For example, the backgrounds of portraits may be printed by this method.

Although many people like to use these special methods of securing certain results, the ideal way is to make the enlargement naturally without diffusion or the use of special screens which only give a false effect in an attempt to imitate etchings and lithographs. It is not necessary to make the original Leica negative through a diffusion lens. Once a sharp negative is available, it can be used for any purpose thereafter.

Some enlargements may be greatly improved by skillfully using an ordinary flash light for overexposing certain areas, while the rest of the paper is covered. In doing this, the orange filter is moved over the lens of the enlarger in order to prevent exposure on the paper. However, the projected red image will guide you in flashing the light over the areas which are to be darkened. Thus a sky may be made almost black for special effects, or, the background of a portrait may be darkened or graded off. Still another method of using a flash light is for making a small narrow black margin around the printed picture while it is still in position in the enlarging easel. To do this, cut a sheet of cardboard slightly smaller than the final picture will be. This cardboard is placed over the sensitized paper in the enlarging easel. By moving the card into one corner there will be two sides left with a margin of possibly 1/8 or 1/4 of an inch. Slowly pass the flash light along this exposed margin. Then, push the card into the opposite corner and continue around the other two sides. When the paper is developed, the image as well as the black margin will appear on this same print.

The Use of Photoflood Bulbs in the Enlarger

With the introdutcion of the photoflood bulbs, it is now possible to use greater illumination in the Leica enlargers. With a photoflood bulb, the slow chloride contact papers can be used very successfully. As these papers require considerably longer exposure as compared to bromide papers, the photoflood illumination is perfect for making the exposures. Very dense negatives can likewise be used with the higher illumination available from photoflood bulbs.

A rheostat or illumination control is recommended for use with the photoflood bulbs. Such controls are available at your photographic dealer. The Leitz Illumination Control is made for one photoflood bulb and contains seven different stops for varying the intensity of the illumination. Also, there is another illumination control known as the Variac manufactured by the General Radio Company in Cambridge, Mass. The Variac Transformer can be used for delivering voltages between zero and 130 volts from the 115 volt circuit. The Variac does not overheat if operated continuously and this transformer will control any number of photoflood lamps up to four. Such a method of controlling the photoflood bulb in the enlarger is ideal because it is not always necessary to have the bulb burning at its brightest intensity for making enlargements. By turning down the voltage and using the bulb at less illumination, it is very easy to do all the focusing of the negative and thus prolong the life of the photoflood bulb as well. The Variac Transformer is designed for use on alternating current lines only.

It should be noted that only photoflood bulbs especially designed for enlarging purposes should be used. Ordinary photofloods have the manufacturer's emblem at the tip of the bulb which will cast an objectionable shadow upon the image. This emblem cannot be removed by ordinary methods. Special enlarger photofloods are made with the manufacturer's emblem placed along the bulb's neck. Subsequently a photo enlarger bulb made by the General Electric Co. frosted inside and out for better diffusion is known as the 200-watt, 105 to 120 volt photo enlarger bulb.

Occasionally a photoflood bulb may break or crack in the enlarger. Therefore, it is a good plan to place a small square of clear class over the movable condenser in order to prevent it from being scratched by a bulb which may possibly break. Also, a special ventilating ring is available for placing below the upper half of the lamp housing. This ventilating ring will keep the enlarger from overheating when the photoflood bulb is burned for any length of time for making the longer exposures. An additional diffusing condenser is also employed to insure even illumination when using the photoflood bulb.

Frequently it is possible to make a number of interesting pictures from one negative. In other words, a negative may contain two or three different compositions of special interest. Individual portraits can be selected from a group picture by greater enlargement of the negative. Naturally when negatives are to be enlarged to any considrable size, it is quite essential that they have fine grain development in their original processing.

Reproduction of Leica Negatives by Projection

In the chapter on Making Leica Film and Glass Positives, there is special information about reducing Leica negatives, or, printing

Fig. 138 Lois
Joseph J. Steinmetz

Leica negatives in natural size. Considerable interest may be created by preparing a series of Leica enlargements as well as a number of Leica reductions from the normal size of Leica negative. When making the small prints, a 3, 6 or even 9cm Extension Tube may be placed between the enlarger and the enlarging lens. In this way it is even possible to reduce a Leica picture to 1/4 of an inch in diameter if necessary. Such small miniature pictures may be used for ring or locket settings as a novelty.

Micro slides can be successfully enlarged by direct projection in one of the Leica Enlargers. Many medical and professional workers will find this method of enlarging micro sections of special value for study and filing purposes.

Contact Printing

It is also possible to make your "contact" prints by projection. Once the correct setting has been determined, the entire strip of film can easily be printed within a few minutes after a few test strips have been made. With a little skill it is also possible to print all these test strips onto one large sheet of paper and then the entire sheet placed in the developer. This method is recommended for filing purposes especially. The individual prints can be numbered and the number of the roll as well as any other data may be placed at the top of the sheet of paper. If desired, a master negative 8½ x 11 inches in size could be made for printing the numbers as well as the outlines of the picture spaces before the contact prints are made on the sensitized paper. For this purpose, a special enlarging easel can be constructed with notches or guide lines and the easel is thus moved from frame to frame as the prints are made.

Actual contact printing is done by placing the Leica negative in direct contact with the sensitized photographic paper. The emulsion, or dull side of the negative, must face the emulsion side of the paper. In other words, contact printing is really natural size printing where the printed picture is exactly the same size as the original negative. While working in the darkroom one may be doubtful about the emulsion side of the paper. A quick test can be made by touching the tongue at one corner of the paper. The side which feels slightly sticky is the emulsion side which is also slightly shiny.

The most elementary way to make a contact print is to place a strip of photographic paper, emulsion side up, on a smooth surface. Then, place the negative face down on the paper and force complete contact by pressing a glass over both. This setting is naturally done under the usual darkroom safelight for paper. The white light is turned on for making the exposure on the contact print. The enlarger can also be used as a light source for this purpose very readily. In case the enlarger light is too strong, one or two sheets of tissue paper placed in the film plane of the enlarger may be used to soften the illumination. After exposure the paper is developed.

However, most workers prefer a neat printer for making their contact prints. Such a printer can either be made or purchased. The Eldia, Eldur, and Kopat (formerly known as Laver) Printers supplied by the Leitz Company can all be used for making paper contact prints as well as for contact printing on film or glass slides. The Willo strip printing frame made by Willoughby's or the Agfa printer can also be used for printing single frame and double frame negatives.

The chapter on Printing Leica Positives gives detailed information about using the Eldia, Eldur and Laver Printers. These printers are also illustrated in that chapter. In the Eldia Printer, the paper can be wound around the spool with the negative. Then, the empty spool on the opposite side of the printer is turned so that the paper and film both advance at the same time. The exposures are made by turning on the enlarger light or any other strong source of illumination. This same method of printing can likewise be used in the Kopat Printer. The Eldur Printer and also the Glass Slide Printing Attachment for the Kopat Printer can be fitted with a small metal pressure plate for use when making individual contact prints on 2 x 2 inch paper which has been previously cut for the purpose.

A number of Leica users have even made a contact printer by taking two pieces of plate glass cut 5 foot strips and 35mm in width, or the exact size of the film. One side is hinged with tape. With this printer it is very easy to place a negative film in position and a strip of unexposed contact paper over the film. The two glass plates hold both in perfect contact during the exposure when the white light is turned on. Such a method is very rapid although it is necessary to make a normal estimate of the exposure for the entire strip of film.

Single contact prints or paper strips containing 4 or 5 exposures can easily be developed in trays. However, when longer strips of 3 or 5 feet are to be developed, it is necessary to use a special developing tray with a roller weight at the bottom under which the paper strip is passed. During development, the paper strip is quickly passed back and forth through the developer in the tray. Such developing trays may be secured from your photographic leader. These trays can also be used for developing film strips if special care is taken. When using the Azo 35mm perforated or unperforated paper which may be secured in 200 foot rolls, the developing time will be approximately 45 seconds, when using the D-72 Eastman Formula at a dilution of one part of developer to two parts of water. A different developer and time must naturally be given when developing negative or positive films in this type of tray.

Still another method of developing strip paper is by using the Correx or Reelo Developing Tanks. The paper is wound into the reels similar to the method used for inserting and developing film negative strips. When development is complete, the reel can be quickly immersed in a short stop solution for a few seconds and then placed in the fixing bath. If additional paper strips are to be made, the paper must be unwound from the reel, the reel and apron are then thoroughly washed in running water before using again for development. The exposed strip of paper should be left in the fixing solution for at least 10 minutes.

The Agfa Ansco Company supplies the fast Convira paper in perforated 35mm width for contact printing. The Azo paper supplied by the Eastman Kodak Company as well as the Brovira paper may be secured in the various degrees of contrast.

After the contact print has been made, the single prints can be mounted for quick reference for indexing purposes on individual cards or in a special photo album. Special mounting masks are available for preparing the individual contact prints for filing. There is also the Willoscope available for viewing single contact prints. This little device has a magnifier and also a place to hold the single contact print for viewing. This viewer also contains a space for the contact prints and at the same time it can be folded in a very small space and carried in the pocket. The method of printing or mounting the individual pictures on a sheet 8½ x 11 inches in size may be of great value for filing purposes. In fact, contact prints could be used more generally than they are, not only for filing purposes and keeping track of negatives, but also for making attractive contact print albums. Contact prints assembled according to subjects and special layouts with a few captions would certainly make an attractive album. It is surprising how much may be seen even in a small contact print.

Fig. 139 His Master Suffers — Robert Disraeli
Summar 50mm, f:6.3, Photoflash, Super X Film

ENLARGING PAPERS AND PRINTING

ELBERT M. LUDLAM **CHAPTER 10**

The average user of a miniature camera has relatively little difficulty in turning out negatives of reasonable quality. Exposure meters representing but a fraction of the first cost of the camera have eliminated the guess-work in negative making, particularly since miniature negatives are developed uniformly for a given time at a fixed temperature. Nevertheless, the prints of most workers do not seem to satisfy them, and one is continually asked, "Why don't my prints have *life?*"

The answer is fundamental to miniature photography. In order to obtain a minimum grain size, we are using developers of very low power and are developing only to some point of compromise between normal contrast and the smallest grain. Photographers using larger negatives develop in solutions of considerable power and carry development much further. Consequently, the contrast of their negatives is considerably greater than that of ours. Years before the advent of miniature photography paper manufacturers recognized the need for papers whose inherent contrast corrected for mistakes in development and began producing papers in several degrees of contrast (soft, medium, hard, etc.). It was found that a negative of a certain contrast had become the accepted standard and the manufacturers designated as normal, or medium, that paper which produced the most pleasing print from a negative of this quality. Since the formulas recommended by manufacturers in every package of paper are based on this average negative, we must consider our negatives in the class which manufacturers call *weak* or *flat,* and accordingly must use the contrasty formulas or papers recommended for such negatives.

Because of the misleading nature of the term *normal* or *medium* as applied to papers, most workers in miniature photography believe that they should not have to use any other paper if their negatives have been correctly exposed and developed. Rather should the beginner, if he must follow a hard and fast rule, consider the use of papers of greater than normal contrast as being the standard with miniature negatives. In those cases where the paper is furnished in only one grade the contrast formula recommended by the manufacturer should be used. If this rule is followed, nine out of every ten negatives which at present are unsatisfactory will become valuable additions to the tyro's file.

Choice of Paper Stocks and Surfaces

Printing papers today are produced in so many surfaces that it would be impossible to give any comprehensive list. Different manufacturers use widely differing designations for papers of very similar surfaces, so that the only satisfactory way of choosing some special surface is through an inspection of samples. If the prints are to be reproduced they should be made on glossy paper and ferrotyped unless the reproduction is to be considerably smaller than the original, in which case semi-matt papers are quite suitable. One of the most beautiful surfaces is obtained by using a matt or rough matt paper and waxing the finished print with a waxing solution obtainable in any photo supply house.

The paper stocks most commonly used are white, cream and buff; the most common weights being the single weight, generally used for contact work, and the double weight or light card, usually associated with enlargements. Prints which are not to be mounted in albums or on regular mounts are much more satisfactory on double weight stock, while prints for mounting, particularly in albums, are best made on single weight stock. No hard and fast rule, however, can be attempted. With regard to the color of the stock itself, it should be remembered that black and white prints are not satisfactory on buff tinted mounts, nor are buff tinted stocks satisfactory on gray mounts.

Tone Gradation

It is impossible to reproduce on paper every gradation of gray available in the negative. This holds true of contact printing as well as enlarging. The reason for this is the fact that a picture is seen on paper by reflected light while a negative is examined by transmitted light. The white of the paper will not reflect more than 50 per cent of the light falling on it while the blackest part of the print will still reflect at least 2 per cent of the light leaving a difference in tone of perhaps 25 to 1 as compared with 60 to 1 in the negative, since the densest part of a negative may only transmit one-sixtieth of the amount of light which the clearest parts of the same negative will transmit. Thus, for instance, if our subject has an extremely long scale, say the highlights (sky) reflect to the camera 100 times as much light as do the deep shadows, what will happen? First, our negative material will fail to reproduce the tones at either end of the scale. If we underexpose to preserve the clouds, we will have no detail in the shadows and if we overexpose to get detail, the clouds will be lost. On the other hand, if we expose so as to utilize the middle tones of the subject, we will lose detail in the deepest shadows and the brightest highlights. We must decide in taking our picture in such a case just which detail can be done without or perhaps later corrected in the negative.

We then come to printing the negative on a paper whose reflecting power is only, say, 20 or 25 to 1 as explained above. The process repeats itself. If we expose to print through our densest highlights, we blacken the shadows until all detail is obliterated, and if we expose for the shadows, the highlights have no detail. We compromise again, losing some detail in both shadows and highlights and find ourselves with a print having only one-fifth the tone range of the original subject.

This, of course, is a rare case although we have all tried it, I am sure. A picture of a woodland scene having a large area of sky showing through a break in the trees is a typical example.

We must learn then to anticipate this selection when we take our pictures, remembering that our finished print will be a reproduction of the subject before us with the exception that all objects which are brighter than some limit will appear to be no brighter than the limiting value, while all objects darker than a certain gray tone in the subject will appear to be black. We can, to some extent, control the point at which all brighter objects appear white by altering the printing time but the difference between the brightest and darkest object printed is determined by the limits of the paper.

This sounds very complicated, but it is fundamental. Unfortunately, it cannot be stated in any simple rule, but if the foregoing is read over and studied and good pictures are studied from this point of view, a new understanding of photography will be developed. Once this has been mastered and we are producing good pictures on some chosen paper in some particular developer, then we are ready to go further and discover how to control those tones in our original subject by reducing, making transparencies and paper negatives, etc., to produce ever better pictures. But, we must first learn to make excellent pictures with the fundamental process of photography.

Generally the tone gradation scale is shortest in fast projection papers and is longest in slow papers. It is claimed that the longest scale range can be obtained in contact or so-called chloride papers. Contact papers are available in as many as six grades of contrast while projection papers only in two or three. Thus the choice of a proper degree of contrast in contact paper will enable one to obtain sometimes a better print on contact paper than on projection paper, provided a suitably strong light is available in the enlarger. Although I have myself recommended the use of contrast grades of paper at the beginning of this chapter and again here, it must be remembered that this is only for beginners. Normal and soft grades of paper produce beautiful middle tones even in the contrast developers recommended by the makers. Contrast, hard, vigorous papers etc. have not as yet been perfected to the point where they can produce the full tone scale of a medium grade paper. The more advanced worker has found other means of building up the contrast, either in development of the negative or in later steps such as the enlarged negative processes or by properly lighting of the subject. However the beginner will get very acceptable prints by following the simple process of using the contrast grades of paper or the contrast developers.

Fast Projection Papers

Fast projection papers are commonly known as bromide papers because silver bromide is the sensitive agent in their emulsions, in fact, the emulsion is very similar to that of slower plates and films. Most of these papers are made in several degrees of contrast as well as a variety of surfaces and stocks as mentioned above. Some idea of the papers commonly used, which fall in this class, can be obtained from the following list:

Brovira	produced by the	Agfa-Ansco Company
Velour Black	" " "	Defender Company
PMC Bromide	" " "	Eastman Kodak Company
Novabrom	" " "	Gevaert Company
Press Bromide	" " "	Haloid Company
Portrait Enlarging	" " "	Agfa-Ansco
Ilford Bromide	" " "	Ilford Ltd.
Wellington Bromide	" " "	Wellington & Ward Ltd.

Slow Projection Papers

Slow projection papers are known as chloro-bromide papers because their emulsions are made up of both chloride and bromide of silver. Because of the presence of silver bromide these papers are considerably faster than ordinary contact papers whose emulsion is made up entirely of silver chloride; they are therefore suitable for enlarging, the exposure in general being approximately four times that necessary for a regular bromide paper. The long range of tones which can be obtained with these papers is making them very popular for portrait and pictorial work as is also their moderate speed which makes them available both for direct enlargements and for contact prints from paper negatives. The papers most commonly used, which fall in this class, are as follows:

Indiatone	produced by the	Agfa-Ansco Company
Charcoal Black	" " "	Dassonville Company
Veltura	" " "	Defender Company
Illustrators' Special	" " "	Eastman Kodak Company
Vitava	" " "	" " "
Gevalux	" " "	Gevaert Company
Projecto	" " "	Haloid Company
Clorona	" " "	Ilford Ltd
Mezzotint	" " "	Wellington & Ward Ltd.

Contact Papers

Contact papers are often called chloride papers because they depend for their sensitivity on chloride of silver alone. Being very slow they were seldom used for enlargements until the development of the photo-flood lamp and its use in miniature enlargers. Proper selection of the contrast of the paper will reward the user with very pleasing results. There are so many contact papers available on the market today that any attempt to list them would be wholly inadequate. However, contact papers manufactured by the firms making the projection papers listed above are as follows:

Convira	produced by the	Agfa-Ansco Company
Apex	" " "	Defender Company
Azo & Velox	" " "	Eastman Kodak Company
Novagas	" " "	Gevaert Company
Industro & Nomis	" " "	Haloid Company
SCP	" " "	Wellington & Ward Ltd.

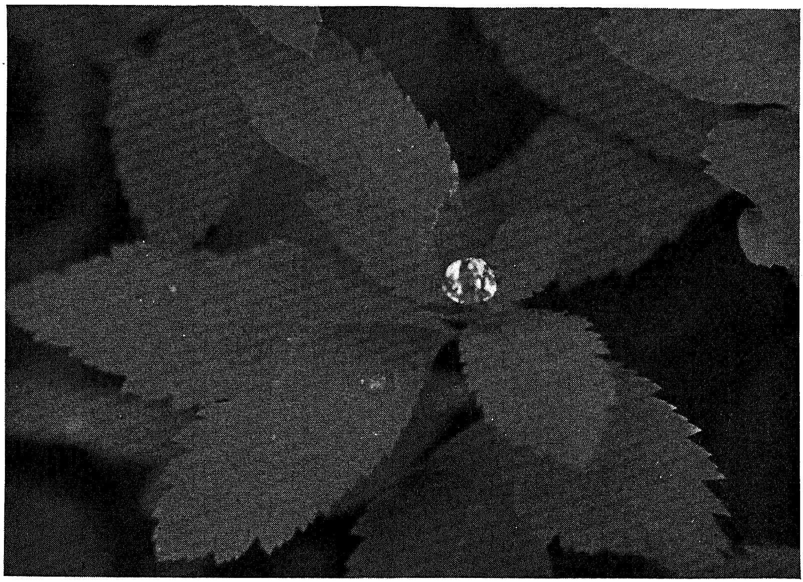


Fig. 140 Liquid Diamond — J. M. Leonard
Elmar 50mm, 1/60, f:6.3, DuPont Superior

Development

The following tables give the formulas recommended by the paper manufacturers for their papers most commonly used in enlarging. The formulas have been grouped in three classes, soft, medium and hard as an indication of their action. This table is given in this manner for the sake of compactness. It is not recommended that different formulas and papers be tried one after another, to get prints from poor negatives. Admit the poor negative and take the picture over, improving the contrast by more careful selection of lighting and filter.

SOFT PAPER DEVELOPERS

	NvBr		*GVA*		*D64*		*Artura*		*NvBrMed*	
	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams
Metol	80	5.7	29	2.1	26	1.8	23	1.6	48	3.4
Sod. Sulphite	438	31.0	350	25.0	185	13.0	164	12.0	356	25.0
Hydroquinone	24	1.7	42	3.0	28	2.0	20.5	1.5	40	2.9
Sod. Carbonate	328	23.0	280	20.0	145	10.0	64	4.5	328	23.0
Pot. Bromide	15	1.1	14	1.0	19	1.4	11+	0.8	15	1.1
Water to make	Avd.—32 Ounces				Metric—1000 cc					

Novabrom really suggest using any mixture between their softest and hardest formulas to obtain the particular contrast required.

MEDIUM PAPER DEVELOPERS

	D72		*D73*		*Artura*		*D52*		*Haloid*		*V.B.*	
	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams
Metol	9	0.6	13	1.0	12	0.9	11	0.8	12	0.9	16	1.1
Sod. Sulphite	131	9.3	193	14.0	178	13.0	164	12.0	176	12.5	164	12.0
Hydroquinone	35	2.5	32	2.3	41	2.9	45	3.2	48	3.4	48	3.4
Sod. Carbonate	197	14.0	365	27.0	136	10.0	109	7.7	176	125.	273	19.0
Pot. Bromide	6	0.4	4	0.3	6	0.4	11	0.8	6	0.4	16	1.1
Water to make	Avd.—32 Ounces						Metric—1000 cc					

	Soft *Agfa*		Med. *Agfa*		*NvBr*		*D64*		*Wel.*	
	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams
Metol	14	1.0	17	1.2	16	1.1	13	1.0	16	1.1
Sod. Sulphite	219	16.0	274	19.0	274	19.0	185	13.0	560	40.0
Hydroquinone	50	3.6	55	3.9	56	4.0	66	4.7	48	3.4
Sod. Carbonate	278	20.0	383	27.0	328	23.0	145	10.0	560	40.0
Pot. Bromide	5	0.4	6	0.4	15	1.1	19	1.4	5	0.4
Water to make	Avd.—32 Ounces				Metric—1000 cc					

VIGOROUS PAPER DEVELOPERS

	GVA		*DsV*		*D64*		*D11**	
	Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams
Metol	21	1.5	24	1.7	13	1.0	14	1.0
Sod. Sulphite	350	25.0	328	23.0	277	20.0	1094	80.0
Hydroquinone	80	5.7	83	5.9	117	8.3	130	9.3
Sod. Carbonate	525	37.0	219	15.0	217	15.0	360	25.0
Pot. Bromide	15	1.1	31	2.2	25	1.8	70	5.0
Water to make	Avd.—32 Ounces				Metric—1000 cc			

* D11 is for positive film and is shown to indicate the high sulphite content required for film processing as compared to paper.

VvBr—Novabrom. GVA—Gevalux. V.B.—Velour Black. DsV.—Dassonville.

Several two-solution developers could be recommended for use with papers produced in only one degree of contrast. The purpose of separating the developer into two stock solutions is to permit the contrast of the developer to be altered by altering the proportion of the two stock solutions. It will be noticed, for instance, in the previous tables that Eastman's D64 formula approximates the average in each contrast group.

For those who require plenty of developer for various purposes: enlarging, contact printing, making of lantern slides, positive films, slides, copy negatives, transparencies, etc., a UNIVERSAL DEVELOPER (Stock Solution) is being offered. It will keep well, if stored in an amber-colored bottle, filled to the neck and tightly corked. This developer is highly concentrated, in fact it is almost a saturated solution. It must be prepared strictly as outlined below.

Universal Developer (Stock Solution)

for Contact and Enlarging Papers, Slides, Positives, etc.

Water (at 125° F. or 52° C.)	**28**	**ounces**	**850.0**	**cc**
Sodium Sulphite (desiccated)	**110**	**grains**	**7.5**	**grams**
Metol	**75**	**grains**	**5.0**	**grams**
Hydroquinone	**300**	**grains**	**20.0**	**grams**
Sodium Sulphite (desiccated)	**2¼**	**ounces**	**67.5**	**grams**
Sodium Carbonate (monohydrated)	**4**	**ounces**	**120.0**	**grams**
Potassium Bromide	**30**	**grains**	**2.0**	**grams**
Cold Water to make	**32**	**ounces**	**1.0**	**liter**
When solution is cool add:				
Alcohol (Methyl, wood)	**4**	**ounces**	**125.0**	**cc**

Dilute for use as follows:	**Stock Solution**	**Water**
For Bromide Paper, Lantern Slides, Positive Film, Transparencies	**1 part**	**6 parts**
For Chloro-Bromide Paper, Velox Paper	**1 part**	**4 or 5 parts**
For Contact Papers	**1 part**	**3 parts**

Temperature of working solution should be about 70° F. (or 21° C.).

Above Stock solution contains the minimum amount of Potassium Bromide. It is fully adequate for slower and contrastier papers. Different amounts of Potassium Bromide are required for papers of different contrasts. The more bromide is used in a developer the slower will be the action of that developing solution, and the more "olive"-toned the print. Thus when developing lantern slides, positive films or faster negative emulsions or papers add from 1-3 drops of 10% Potassium Bromide Solution for every ounce (or 30 cc) of above Stock Solution used in preparing the working solution. Working solutions should be prepared only as required and discarded after use.

10% Potassium Bromide Solution is prepared by dissolving 1 ounce (30 grams) of Potassium Bromide in a small volume of water (distilled) and adding enough distilled water to make a total of 10 ounces (300 cc) of solution. Keep this solution in a "dropper" bottle.

Amidol Developer will give strong prints with excellent blacks, if used without dilution. It will not keep, however, and should be prepared freshly whenever required and discarded after use:

Water at 125° F. (or 52° C.)	**24**	**ounces**	**750.0**	**cc**
Sodium Sulphite (desiccated)	**1**	**ounce**	**32.0**	**grams**
Potassium Bromide	**20**	**grains**	**1.4**	**grams**
When dissolved add:				
Amidol	**80**	**grains**	**5.5**	**grams**
Cold Water to make	**32**	**ounces**	**1.0**	**liter**

For Chloro-Bromide paper or colder blacks on bromide prints reduce contents of Potassium Bromide to 5 grains (0.35 gram).

The staining of the fingers will not occur if the precaution of rinsing the fingers every time they have been in solution is observed. This should be done in all developing to avoid carrying back into the developer the oxidized solution left on the fingers.

Altering Developers

The amount of bromide given in the stock solutions is the minimum amount required to keep the highlights clear; it may be increased from this point, increasing the warmth of tone, up to the degree of warmth manifested in an olive brown tone. The maximum is about 40 to 50 grams per 32 ounces of ready to use developer.

Aside from modifying the bromide content of developers, variations can be obtained by adjusting the proportion of metol, hydroquinone and carbonate in any MQ developer. For instance, to gain additional contrast, the Hydroquinone, Potassium Bromide and Carbonate can be increased in equal proportion. The increase in bromide is necessary to prevent too vigorous action and will not appreciably alter the color of the print, the additional carbonate offsetting this tendency as well as increasing the developing action. For softer results the metol can be increased considerably if the hydroquinone is decreased proportionately and, if extreme softness is required, the carbonate can also be decreased. Decreasing the carbonate slows up development and gives olive tones, whereas increasing the carbonate increases the speed of development and gives very black tones.

So much for developers. Each package of paper and every magazine offers some variation of the foregoing with sufficient instructions to cover their preparation and use. Because of the complex nature of the developing process and the uncertainty of results, if different developers are used, it is advisable for the beginner to definitely choose one formula and stick to it until he has learned to produce consistently satisfactory results with it, making only such modifications as seem necessary to obtain greater or less contrast or colder or warmer tones, as he becomes more familiar with its behavior.

Exposure

This brings us to the most difficult problem of all, determining the correct exposure for the print.

It should be borne in mind that the final print density is the result of both exposure and development, thus if a test were made and the test strip developed for say two minutes, the subsequently correctly exposed print should also be developed for two minutes.

However, having determined the exposure by these means, it is still necessary to make one or more tests before the final exposure will be decided upon. Most of us in making test prints attempt to conserve our paper by using a small strip, and find it extremely difficult to decide from an inspection of the strip whether or not the exposure really was correct. It has been my experience that if the test includes the whole picture it could be extremely small (same size as the negative) and still a very good estimate of the necessary variation from the exposure given could be made; far better than from a test strip the same size or larger comprising but a small portion of an 8 x 10 enlargement.

Therefore, I prefer to make my test prints 2x3 inches in size using the entire negative. From this slight enlargement (2x) a critical examination can be made in bright light after the print has fixed for a minute or two. Not only can the correct exposure be determined but the picture itself can be studied. By cutting an 8x10 sheet into four strips each two inches wide a total of twelve 2x3 test prints can be made with very little waste of paper.

How to Judge Exposures

In examining test prints to determine if the exposure has been correct, the appearance of highlights and shadow areas are the most accurate guides. Study the highlight area for detail. If present, the exposure has been sufficient, if not present, the exposure must be increased. If detail is not present in the shadow areas the exposure has been too great. A correctly exposed print should show detail in all but the smallest bright highlights and deep shadows.

If on the contrary, detail is present in both highlights and shadows but the print has no sparkle or snap, looking sort of clouded or muddy in appearance, the use of more contrasty paper is indicated. If a good print cannot be obtained even then, study the best print you can make, determine what was wrong with the picture when you took it. Either the lighting was too flat or you used panchromatic film on a subject sparkling with brilliant colors, which, of course, made all colors come out in the same gray, and the snap was lost. Then go back and take the picture over, don't waste time and energy trying to improve a bad job.

If detail is lacking both in highlights and shadows, you are using a paper too contrasty for that negative and a softer paper is indicated. Sometimes the detail may be lacking in highlights and shadows but the middle tones are just what we want. This calls for careful dodging and manipulation, that is, while the exposure is being made in the enlarger the hand or a torn piece of paper is held so as to shade the shadow portions to prevent their getting too much light. The exposure should be the same as for test print, and when complete the highlights should be given a short additional exposure through a hole in a large card to bring out detail.

All tests for an evening's work are made at one time and a record of the correct exposures kept. Sufficient fresh developer must be used so that it will not deteriorate appreciably. The correct exposure for the final print is then determined by multiplying the correct exposure for the test print by the necessary factor to compensate for the increased enlargement, as given in the table below:

Exposure Factors at Various Magnifications

	Multiplying Factor		
SIZE OF ENLARGED IMAGE OF FULL NEGATIVE (Neg. 1x1½ in.)	*If original test print was* 1x1½ in.	*If original test print was* 2x3 in.	*If original test print was* 3x4½ in.
1x1½ inches	1	½	¼
2x3 "	2	1	½
3x4½ "	4	2	1
4x6 "	6	3	1½
5x7½ "	9	4	2
6x9 "	12	5	3
7x10½ "	16	7	4
8x12 "	20	9	5
9x13½ "	25	11	6
10x15 "	30	13	7½
11x16½ "	36	16	9
12x18 "	42	19	10
13x19½ "	49	22	12
14x21 "	56	25	14
15x22½ "	64	28	16

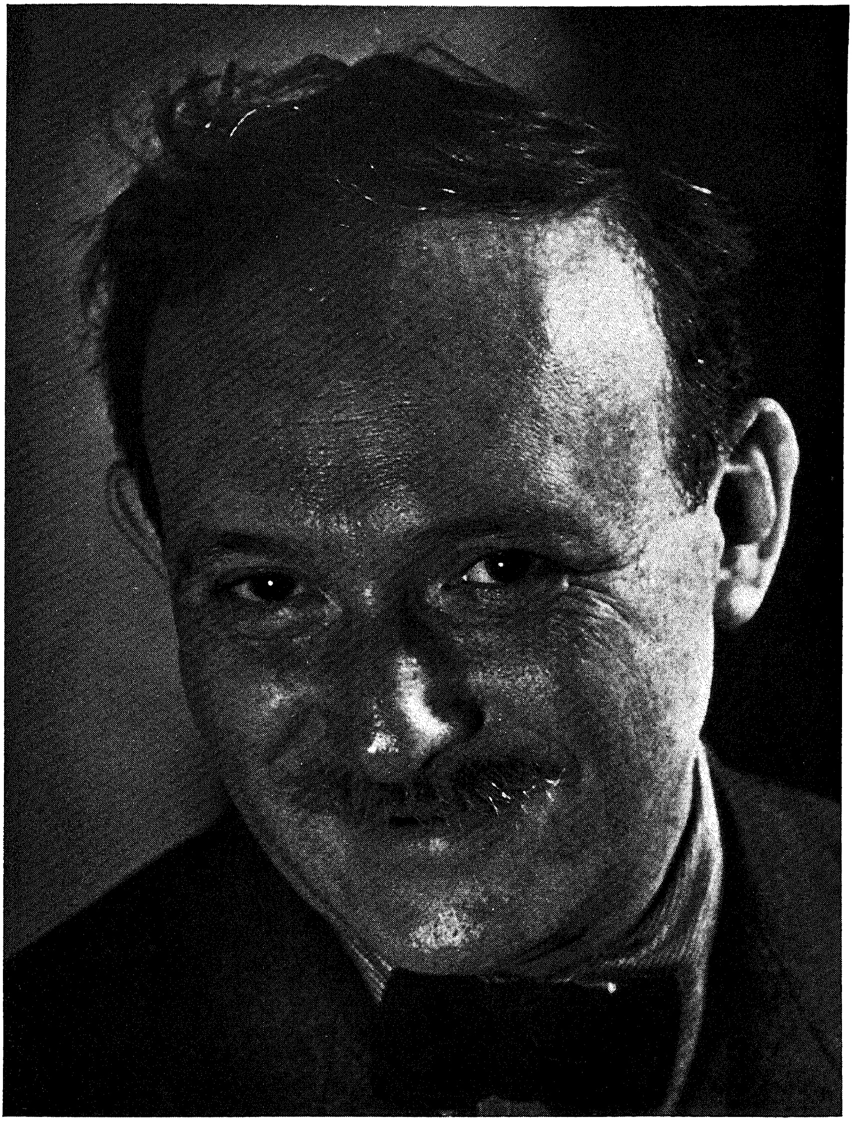
Another table which is very helpful and is given below: increase or decrease of exposure with a proposed lens opening—for a known exposure at some other opening used in making the original print.

RATIO OF EXPOSURE: FIRST STOP USED TO PROPOSED STOP.

First Stop Used—f:	Proposed Stop—f: 1.9	2.2	3.2	3.5	4.5	5.6	6.3	8	9	12.5	18	25
1.9	1	1	3	3	6	8	11	18	22	40	90	170
3.5	1/3	1/2	1	1	2	3	3	5	7	13	30	50
6.3	1/10	1/10	1/4	1/4	1/2	3/4	1	2	2	4	8	16
12.5	1/40	1/30	1/15	1/10	1/8	1/5	1/4	1/2	1/2	1	2	4
18	1/100	1/70	1/30	1/30	1/15	1/10	1/8	1/5	1/4	1/2	1	2
25	1/200	1/100	1/60	1/50	1/30	1/20	1/15	1/10	1/8	1/4	1/2	1

A few examples I believe will suffice to show the use of these tables.

First, supposing we have made a test print using the full negative enlarging it to 3x4½ inches. The correct exposure was 10 seconds at f:6.3. Our final enlargement is to be 11x14 losing only a small portion of the negative at each end; i.e., the enlarged image



Manuel Komroff Harold Harvey

on the easel would measure 11x16½ inches from a 1x1½ inch negative but we will use only an area 11x14 in size.

Consulting our first table we find that the exposure should be 9 times that required for our test print or 90 seconds.

Consulting the second table we find that if an exposure at f:4.5 is made it need be only ½ that at f:6.3, so we can open our lens to f:4.5 and expose 45 seconds.

Similarly if we have made an exposure of 30 seconds at f:6.3 and we wish to double the exposure without increasing the time, we find from the second table that f:4.5 requires ½ the exposure of f:6.3, so we open to f:4.5 and use the 30 second exposure, getting the same result as 60 seconds at f:6.3 would have given.

One other problem frequently occurring is that when we have made an excellent print 8x10 in size we wish to repeat it on 11x14 without wasting paper.

Consulting our first table we find that an 8x12 print requires 20 times the exposure of a 1x1½ and that an 11x16½ requires 36 times the exposure of a 1x1½. The 11x16½ inch print would then require 36/20 or 9/5 the time required for the 8x12. An exposure double the exposure given the 8x12 would be close enough. This ratio will hold true regardless of the amount of the negative used providing the larger print includes the same proportion of the negative as the smaller print did.

Fig. 142 Wickie and Suzanne — Ed. Schaefer
Summar 50mm, 1/100, f:6.3, Peromnia Film

Comparative Speed of Various Projection Papers

Another bit of information which each worker must determine for himself, but which is invaluable, is the relative exposure required for each brand of paper as compared with any others he may use. This is particularly desirable if expensive papers are being used, all preliminary work being done on the less expensive paper and the final print being made at considerable saving.

Figures opposite each paper stand for **UNITS of Exposure Time.**
UNITS: *seconds, minutes or counts.*

These data are approximate only and should be used with caution as papers vary greatly in their sensitivity to light:

Agfa	
Brovira	
Soft	1
Medium	1⅓
Hard	1⅓
Extra Hard	1⅓
Portrait Enlarging	6
India Tone	12
Dassonville	
Charcoal Black	2
Defender	
Velour Black	
Soft	2
Medium	3
Medium Hard	5
Contrast	6
Veltura	12
Ivoura	2
Gevaert	
Novabrom	
Extra Soft	1
Soft	1½
Gevaert	
Novabrom	
Normal	2½
Vigorous	4
Extra Vigorous	6
Gevalux	15
Eastman Kodak	
P.M.C. Normal	1
P.M.C. Medium	2
P.M.C. Contrast	3
News Bromide Soft	1
" " Medium	1½
" " Contrast	2½
Portrait Proofing	12
Vitava Projection	16
Vitava Opal	16
Illustrators' Special	15
Tuma-Gas	20
Contact Papers	200-300

It should be borne in mind that there is a definite relationship between the exposure time given a print and the time of development required to bring out as many details of the negative as possible. Most of the developers used for papers are so compounded as to produce a fully developed image in one and a half to two minutes. Prints developed for less than that will lack richness in the shadows, while those developed for longer are apt to appear flat with veiled highlights.

Short Stop

After the print has been fully developed it should be immersed for a few seconds (from 5 to 10) in a so-called *short-stop* bath. This bath is indicated for two reasons. It instantly stops the developing processes of the print, and it neutralizes the alkalinity of the developer, preventing the carrying over of traces of developer into the acid hypo fixing bath. If this acid rinse bath is used, it will fix out almost twice as many prints as it would if no short-stop bath were used. One quart (one liter) of the short-stop bath will process about twenty 8 x 10 prints or their equivalent of smaller prints. Properly prepared, an acid fixing bath (one quart) will fix out approximately thirty 8 x 10 prints or their equivalent in other sizes if the short-stop bath is used between development and fixation or about one-half that number of prints if only an ordinary water rinse is used.

A short-stop bath is prepared by diluting one and a half ounces of acetic acid (28%) with 32 ounces of water (or 48cc to one liter of water). if 28% acetic acid is not available, it may be prepared from glacial acetic acid (a much more economical way) by diluting three parts of glacial acetic acid with eight parts of water. It should be remembered that only a short rinse in this short-stop bath is required (from five to ten seconds) longer immersion (one minute or more) will degrade the tones of most enlarging paper and may cause blisters and general disintegration of the emulsion of the print.

Fixing

Fixation is of utmost importance, as upon its thoroughness depends in a large measure the permanence of the photographic print. Preparation of an acid fixing bath should be done as carefully as that of development. Fixation is generally complete within ten to fifteen minutes, provided every surface of the print has full access to the bath and the prints are not allowed to stick together. It is best to keep turning over the prints while fixing.

There are three ways of preparing an acid fixing bath: First, for the workers who do not turn out great quantities of prints a very satisfactory way of preparing hypo is by purchasing ready put up packages of powders, which contain all necessary ingredients, and follow instructions on each box.

Second, for those who do more work and like to prepare their own, the following formula is most satisfactory and generally used:

Water	**64 ounces**	**2 liters**
Hypo	**16 "**	**480 grams**

When thoroughly dissolved, add the entire quantity of the following:

Hardening Solution Separately Prepared

Water (at about 125° F.)	**5 ounces**	**160 cc**
Sodium Sulphite (dry)	**1 ounce**	**30 grams**
Acetic Acid (28%)	**3 ounces**	**96 cc**
Potassium Alum	**1 ounce**	**30 grams**

Dissolve the sulphite completely before adding the acetic acid. After the sulphite-acid solution has been mixed thoroughly, add the potassium alum with constant stirring. When the alum is dissolved entirely, hardening solution should be cooled after mixing and slowly added to the cool hypo solution while stirring the latter rapidly.

The third method, for those who require large quantities of hypo to be kept for considerable time, is to prepare an acid fixing bath by dissolving two pounds of hypo in a gallon of water and keeping it in a well stoppered bottle. Separately a stock hardener solution is prepared as follows:

Water (at about 125° F.)	**56 ounces**	**1700 cc**
Sodium Sulphite (dry)	**8 "**	**240 grams**
Acetic Acid (28%)	**24 "**	**750 cc**
Potassium Alum	**8 "**	**240 grams**
Cold water to make	**1 gallon**	**4 liters**

Dissolve the chemicals in the order given, following instructions given for formula above.

The fixing bath is quickly made by adding one part of this stock hardener to four parts of cool hypo solution.

Finally, a very effective and economical method of securing hypo for prints is to provide a large bottle and to pour into it all the hypo that has been used once and not more than twice for fixing of negatives. Such hypo is good enough for prints and makes it more practical to use fresh hypo for every film treated.

It would seem unnecessary to warn against the use of old worn out baths, but somehow everybody seems to do it. Hypo, Acetic Acid, Alum and Sodium Sulphite are cheap (even the water hasn't been so highly taxed as some things as yet). Your time and effort in getting a print as you want it are valued at your own price; a worn out bath can stain every print and you won't know it until you turn the bright lights on. Don't take the chance! Another suggestion, thirty seconds devoted to moving each print about in the hypo when first brought over will insure even fixing and prevent unaccountable rings, and other marks from appearing during any later treatment. One more, when a bath becomes milky, either through use or old age, throw it away.

Washing

Having brought a print to this point with success, one looks forward to the prideful joy he will experience when showing it to friends and then tosses it into a tray of water into which a dozen other prints will be similarly tossed before the first is removed,

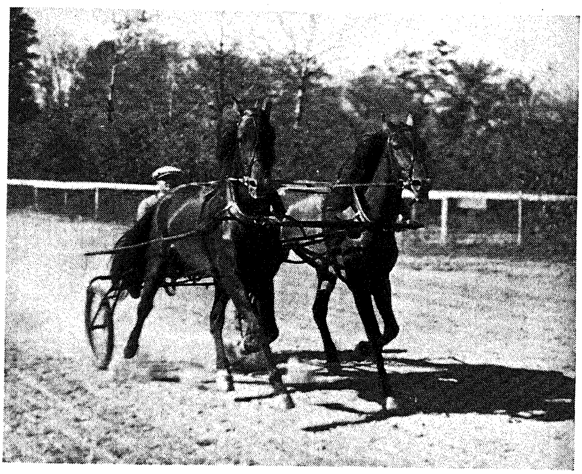


Fig. 143
Trotting Team
J. A. Latta

Summar 50mm,
1/200, f:6.3,
Agfa Superpan

supposedly completely washed. With the water running full force a print cannot be thoroughly free of hypo if other prints have been continually brought over from the hypo bath. **Washing should continue for at least a full hour after the last print has been brought over, preferably rinsing each print as it is taken from the hypo and frequently separating all prints while the washing is going on.** Washing cannot be stressed enough if permanency is desired, as any trace of chemical left in the paper will discolor or fade the print, perhaps not in the first six months, but a well washed print will last for years.

Thoroughness of washing after fixing is just as important as every other step in preparing a good print. A print insufficiently washed will deteriorate just as a print insufficiently fixed. The water used for washing prints should not be colder than 65° nor warmer than 75 to 80°. Washing should be complete in an hour's time if the prints are moved about and the water constantly changed. The Eastman Kodak Company makes and sells an excellent tray syphon which if used in accordance with instructions accompanying it, makes a most ideal aid for thorough washing of prints. This device is easily attached and is absolutely fool-proof and safe in its operation.

Hypo Test

It is highly advisable to apply a very simple hypo test to be sure that the prints are completely *washed.*

The following **Hypo Test Solution** is recommended by the Eastman Kodak Company and is known as **Formula HT-la:**

	Avoirdupois	Metric
Potassium Permanganate	**4 grains**	**0.3 gram**
Sodium Hydroxide (Caustic Soda)...	**8 grains**	**0.6 gram**
Water (distilled) to make	**8 ounces**	**250.0 cc.**

To make the test, take 4 ounces (125cc.) of distilled water in a clear glass and add ¼ dram (1cc.) of the permanganate-caustic soda solution. Pour ½ ounce (15cc.) of this diluted solution into a clean 1-ounce graduate. Then take six 4″ x 5″ prints or their equivalent from the wash water and allow the water from them to drip for 30 seconds in the ½ ounce of test solution. If a small percentage of hypo is present the violet color will turn orange in about 30 seconds and become colorless in about one minute. In such case the prints should be further washed until no color change is produced by the test which proves that the hypo has been eliminated.

Drying

Drying the prints offers very little difficulty if a few points are remembered. Curling is due to uneven drying more than anything else. If the surface water is not wiped off, it will collect in pools leaving, at times, dents in the print which, when finally dried out, shows strain marks in the gelatin. A print carefully wiped dry with a viscose sponge and then dried on cheese cloth, face down, will have so little curl as to flatten of its own accord when filed away. Even when dried face up on a blotter, the curl is not objectionable. The Eastman Kodak Company produce a print drying roll consisting of a long length of corrugated paper together with two similar lengths of blotting paper, the one faced with a specially prepared cloth to prevent sticking to the face of the print. The two lengths of blotting paper and the corrugated paper are rolled over a cardboard tube, forming a roll approximately 10″ in diameter. Prints to be dried are laid between the blotters facing the cloth. The roll may be placed before a fan or left standing. When the prints are dry they will be found to have a backward curl, quickly becoming flat when removed.

Ferrotyping

There are two type of tins available for ferrotyping prints requiring a high glossy finish. The least expensive are black enamel tins. Slightly more expensive but very practical are chromium plated tins. Either type will produce excellent results indefinitely if they are well cared for. They scratch easily and should be protected from rough handling, grit and dirt. They should be carefully washed with a wet chamois or viscose sponge directly after use. When stored they should be interlined with line paper or wax paper, placed face to face. Do not allow your chemicals or solutions to remain on your ferrotyping tins for any length of time as they will eat into the enamel eventually causing blisters and corrosion, thus rendering the tins useless.

Ferrotyping to produce really glossy prints is not a difficult matter if a few precautions are followed. Glass, coated with paraffin or beeswax has been suggested from time to time but is never really successful. Ferrotype tins are too cheap to consider such substitutes. The tin must be thoroughly cleaned with a soft cloth and a few drops of benzene or hot water every time any particle is noticed to be adhering to the surface. The tin should then be lubricated with a solution of paraffin in benzene (10 grains of paraffin to 1 oz. of benzene, 1 gram to 50cc). A few drops of this solution rubbed evenly over the tin and then polished gently with a soft cloth is sufficient; this need not be repeated unless it becomes necessary to clean the tin with hot water or benzene to remove particles stuck to the tin. Normally it sufficies to polish the tin with a soft cloth each time it is used. Only glossy paper, specially coated for ferrotyping during manufacture, should be used. The print should be brought from the wash water, rinsed under the tap, and without draining laid face down on the tin and squeezed dry. Too much pressure may cause the prints to stick; insufficient pressure and the gloss will be uneven because the print contact with the tin has not been good. Little difficulty, however, will be experienced as the latitude is considerable. The tins are then set aside to dry in any warm spot with a current of air, such as a window. Drying should take an hour at least; artificial heating is not good, causing sticking and uneven drying which leaves strain marks. If, on the other hand the prints are left in a damp place, or sufficient air is not allowed around them, such as setting one tin next to another separated by only a fraction of an inch, the drying will proceed from the edges in and a ring shaped strain mark will develop. When dry, the prints fall off of their own accord or will peel off readily if a corner is loosened with a knife. Brown stains sometimes appear on the surface of ferrotyped prints, due to insufficient rinsing of the print or the tin. A slightly damp cloth will wipe this dirt away without affecting the gloss. Insufficient washing will leave hypo in the print which turns yellow and cannot be remedied. Grains of dirt or bits of gelatine stuck to the tin produce little holes in the print which cannot be remedied. Ferrotyping on glass produces a waxy looking surface which is anything but desirable. Cleaning with benzene, soaking in water, and referrotyping on a tin will produce excellent results.

Toning

There are two relatively simple methods of sepia toning depending for their action on the conversion of the silver image to silver sulphide. By bleaching the regular bromide print in a solution of Potassium Ferricyanide and then redeveloping the bleached image in Sodium Sulphide very excellent sepia tones may be obtained. The bleaching solution will keep indefinitely and is as follows:

Water (cold)	**32 ounces**	**1 liter**
Pot. Ferricyanide	**200 grains**	**14 grams**
Pot. Bromide	**200 grains**	**14 grams**
Liquid Ammonia	**20 drops**	**20 drops**

When prints have been fixed, wash thoroughly to remove any trace of hypo; prints on rough surface papers should be thoroughly dried before bleaching, others may be bleached without intermediate drying. Bleach until the image is but faintly visible. Wash all the yellow stain away under the tap and redevelop in the following:

Water	**32 ounces**	**1 liter**
Sodium Sulphide	**200 grains**	**14 grams**

Redevelopment takes but a minute, after which the print should be thoroughly washed and dried. To obtain Brown-Black tones do not bleach completely. Dilute the bleaching bath 5 to 1 to facilitate even bleaching and rinse off when the image is about half bleached.

The second method depends on the action of alum on hypo to form the sulphide. The bath is made up as follows:

Water	**32 ounces**	**1 liter**
Hypo	**4 ounces**	**100 grams**
Alum	**1 ounce**	**30 grams**

The above solution is milky in appearance and should not be filtered, but before use it must be ripened to avoid bleaching the prints. Toning is done between 90° and 115° F. taking from 30 to 60 minutes.

The bath may be ripened by toning three or four old discarded prints or by the addition of the following:

Silver Nitrate	**8 grains**	**0.5 grams**
Common Salt	**8 grains**	**0.5 grams**
Water	**2¼ ounces**	**70 cc**

Toning may also be carried out in the cold solution, taking from 6 to 24 hours. An excellent plan is to keep the bath in the dark room at all times and tone all discarded prints as well as those which it is purposely planned to tone. By using the cold solution the process is fool proof, toning being even throughout the print if it is first moved about to insure even wetting. The prints may be left in the bath almost indefinitely without harm. By toning discarded prints, many unusual things will be discovered.

Those prints which it is planned to tone should be printed slightly darker than is desired as the toned print is several shades lighter than the black and white original. If the hypo alum bath is not ripened the first few prints will lose their delicate details.

There are numerous other methods of toning to obtain different colors, but their use is not recommended to the beginner. Many manufacturers issue pamphlets, obtainable through their dealers, describing these processes.

Spotting

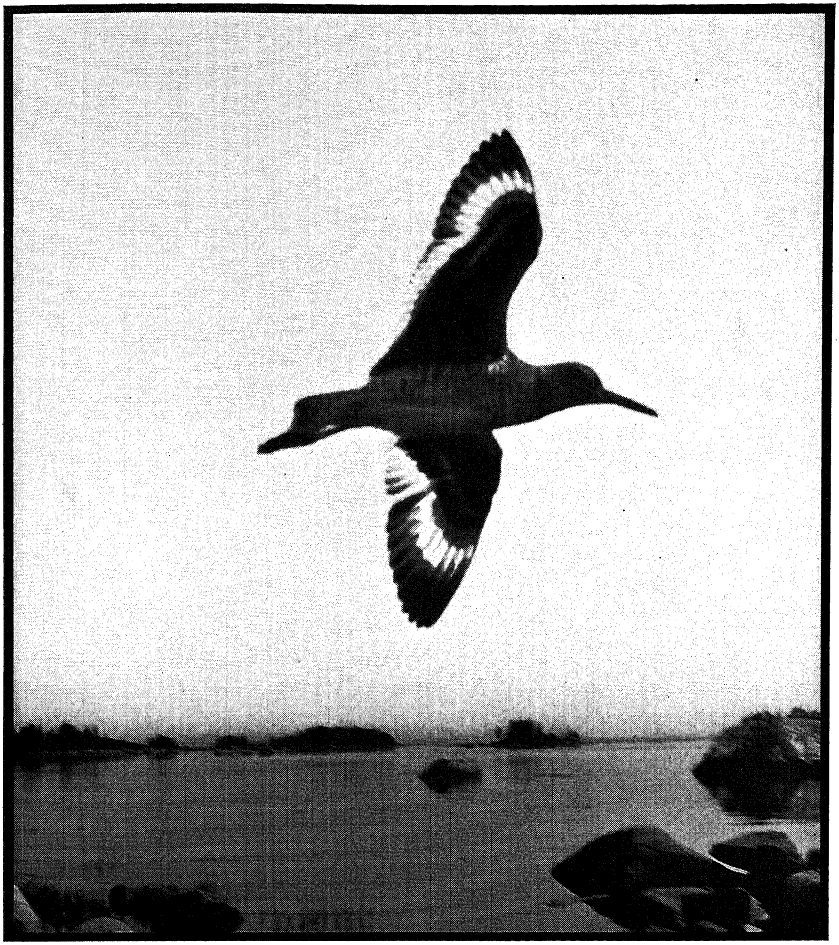
Miniature camera work requires great care and cleanliness in every step of the process, including the storing of the negatives and their handling during inspection or use. However, no matter how much care is exercised, prints will show occasional dust spots and more rarely, dark spots, due to pin holes or minute scratchings in the film. The removal of the latter is difficult, being impossible on glossy prints and requiring very delicate use of the retouching knife on matt and semi-matt prints. Spotting the former is not so difficult with a little experience.

Fig. 144 Water Lily — Yasuo Kuniyoshi

The hardest part of spotting prints is to find a pencil, crayon or paint which will match the print not only in color but also in gloss. Pencils are effective only on a matt or rough surface where the slight gloss of a pencil closely matches that of the paper. For most papers with matt surfaces, the carbon type pencils, which have almost no gloss at all, are very satisfactory. On the semi-matt papers ordinarily soft retouching pencils are often quite satisfactory. For sepia toned prints on semi-matt surfaces, sepia crayons can be used. Fine spotting brushes with chinese ink are very satisfactory if the tones of the print are real black, such as obtained from contact paper when very little bromide has been used in the developer.

For really good results on all kinds of papers, a medium such as paint which is flexible both as to color and gloss is necessary. The one drawback to paint, however, is the fact that for single prints or even to spot less than say half a dozen prints at one time, it is necessary to go to considerable bother in preparation. Some spotting colors are available on glazed paper cards but the most satisfactory method is to obtain artist's water colors, coming in tiny trays. Three colors are really necessary, lamp black—dull, blue black—dull, and burnt sienna—slightly glossy. For mixture with the above to obtain the necessary gloss a tube of Talen's blackish and another of Talen's brownish should be obtained. The total cost of the above, together with a good spotting brush, would be about two dollars and would last for many years.

Using a piece of opal glass for a palette, carry a bit of the dull color on your wet finger to the glass. To this should be added some of the glossy color, until, as mixed with the finger on the glass, the color appears to be slightly more glossy than the print. Some experimenting will be necessary before the right sheen can be recognized, but it should always be remembered that the dull paints have less sheen than has the roughest matt paper, with the possible exception of such special finishes as Gevalux. Moisten the brush with a turning motion in a drop of water on the palette, wiping off any excess water with the same turning motion on a bit of photographic blotter, still turning the brush in the same direction, take up a bit of the mixed color and apply to the print in very small dots. Do not attempt to finish the job in one operation, keep the dots separated, letting them dry while working on a different portion of the print and then coming back, several times if necessary, to fill in the spaces between the dots. If the brush is not too wet and if the minimum amount of water has been used in mixing the colors, it will be found that by *very* light strokes nice even dots can be made which will



Willett Albert Simmons

not smear or vary appreciably in color when dry. The smallest pin holes appearing in a print usually require about three of these fine dots to be properly concealed. If it is attempted to put one large dot in these holes, the paint will dry in a little lump which will usually rub off after it has dried. In using an etching knife to remove dark spots, such as are caused by pin holes in the negative, it will usually be found most successful to carry the operation a shade beyond the adjoining tones, spotting with the proper color so as to obtain the right gloss, since on glossy prints any knife work leaves a matt surface and on matt prints knife work leaves a semi-gloss surface.

Another method of spotting matt prints, particularly suitable for portrait work, or where large areas are to be covered, such as working in backgrounds or clouds, is the use of chalks. These can be obtained in blocks from artists' supply stores. The only things which must then be bought are stumps and pumice powder (used by draughtsmen on tracing cloth for making the ink hold and obtainable from most artists' supply stores). Excellent stumps can be made at home after a little practice by rolling lengths of paper on a diagonal so as to obtain different sized points. However, soft chamois and paper stumps cost little.

The print is first rubbed lightly with pumice to eliminate any possible grease and the chalk, mixed with a little pumice, is then rubbed on and worked with a stump to the necessary shade. For large areas, such as working in backgrounds or clouds, a ball of cotton dipped into the mixture of pumice and chalk is used to cover the area, the larger stumps then being used to work in the shading and detail. In working in backgrounds a soft eraser can be used to break the outline in long slanting strokes, a soft bit of clean cotton then being used to soften the edges of the breaks and smooth out the outlines. Some experimenting and a considerable study of studio portraits will be necessary before really good work of this sort can be done. To fix the chalk to avoid rubbing, etc., provide a large tray of water. The tray should be considerably larger than the print and should contain about 2 inches of water. Holding the print by both ends, give it a considerable curve and in one movement draw it into the water, to the bottom of the tray and out at the other end of the tray. Allow the water to drain off one end and without shifting the position of the print hang it up to dry. Streaks will appear in the movement of the print through the water is jerky or if the print is moved around while the water is draining off.

When Matte and Semi Matte Papers are used a light coating of wax often lends a beautiful luster to the print. Waxing preparations may be obtained from your dealer. In applying them it is best to use a small pad of cheesecloth to apply a little wax over the entire print, then quickly rubbing off the excess with a clean cloth. Some preparations require considerable time to dry; others can be handled within an hour. The bottle should give all necessary information.

Presentation of the Finished Prints

One phase of photography which is almost totally ignored by the average worker, is the presentation of his print. Not that the frame is required to appreciate the beauty of a picture, but it does help considerably. The average album of snapshots is undoubtedly the best illustration of the worst method of presenting prints. If the prints are to be mounted in albums, considerable thought should be given to the size of the prints, the widths of their borders, and the color of the stock in comparison with the size and color of the album. Prints in black and white do not show up effectively on buff or ivory stock nor are they as effective in an album the pages of which are of buff or have a brown tone. They should be mounted, preferably, on white or gray. Similarly, buff prints or sepias look their best against the background having brown or buff tones. The mounting

Fig. 146 Pila en la Merced Antigua, Guatemala

Photo by B. Isfort

Elmar 35mm, 1/100, No. 1 Filter, Perutz Persenso Film of the prints in the album should be tasteful rather than convenient. The use of tissue, black, brown or white, under the print and showing a narrow edge, is very effective. After some experience, the amateur with a taste for modern contrasts will learn to use tissues of such striking colors as red or blue.

For prints to be shown separately, mountings on heavy stock are to be recommended. The simplicity and taste which is shown in the choice of the stock and the method of mounting will be the key-note of its success, yet it is a relatively simple matter to prepare such mountings.

Embossing Prints

The simplest of all is the embossed print. For this, it is necessary to carefully plan the print so that no trimming of the picture is necessary. Sufficient border is left to properly frame the finished picture, somewhat more at the bottom than at the top and sides. A piece of card is then chosen, about the same thickness as the stock or slightly thicker; this is trimmed the same shape as the picture but a trifle larger. If a heavy glass plate is available a light is placed under it, the card just trimmed laid on that and the picture placed face down over the card and adjusted to leave an equal border around the picture. With an embossing tool, the back of a tooth brush or knife handle, the stock is rubbed equally all around the edge of the card, causing the picture area, when viewed from the face, to be sunk behind the border. Many variations will suggest themselves to the imagination, such as beadings, double borders, etc. The print thus embossed may then be trimmed to equalize the borders. The edges may be roughened by laying the print on the table with the edge out to the table edge and scraping with a sharp knife.

In cutting the card so as to make window mounts, cut from the back and against a hard surface so as to leave a smooth edge. To cut on an angle, lay a steel or other thin ruler under the knife, holding the knife firmly and keeping the blade of the knife and the nail of the index finger firmly against the guide—thus maintaining a constant angle.

The final step in mounting, particularly for Christmas cards, is the book or folder. The print may simply be placed in the folder, or a card mount nicely embossed, or again a window mount may be prepared and the whole placed in the folder. The folder preferably should be of lighter material than the card used as a mount in the last two cases, although like everything else, this is really a matter of taste and individuality. A tissue paper fly leaf may or may not be inserted. The cover may have some design embossed into it or may be printed with a linoleum or wood block. Any number of variations suggest themselves and much pleasure will be derived from making individual mounts.

One word about pasting. Library paste, homemade paste and any glue will do the job. Some contain products which will injure a photograph, but most are quite satisfactory. However, for a neat and convenient, as well as reliable job, nothing is as satisfactory as dry mounting tissue. A hand iron, kept nicely warm, or if of the automatic type, set at a low heat, is just right for mounting pictures up to 11″ by 14″ and the thinnest mounts will lie flat.

Rubber cement is probably the best and the cleanest mounting. It should be spread with a large brush over both the mount and the print and allowed to dry for more than a half hour. The print must then be carefully adjusted to guide marks previously made on the mount, for once placed it will be impossible to move the print. Any excess cement around the edges can be removed with a soft cloth. Do not get rubber cement on waxed prints as it removes the wax. When using paste glue or cement the mounted print should be placed under light pressure for a short while before putting in a press or under heavy pressure for final drying. When transferring from the light to the heavy pressure a careful inspection should be made to be sure no paste or cement has oozed out at the edges of the print.

Many advanced workers are using thin papers for paper negatives; a beautiful result can be obtained by printing on the thinnest papers available and carefully mounting on medium weight mounts. This is particularly satisfactory for Christmas cards. Thin papers must be treated carefully to avoid air bells in the developer and hypo.

And so a little has been said regarding many things. Perhaps a first reading has confused some or led others to believe that the whole matter is unnecessarily involved. I hope, however, that in some way many who have read this chapter will become more keenly appreciative of the importance of printing as one of the major steps in producing a photograph; far too little has been said to date regarding this angle of photography, each newcomer apparently being expected to struggle along until somehow he succeeds in turning out one or two good prints from each package of paper he buys. **If, as has been stressed several times before, the beginner will stick to one paper, one developer, etc., until he is turning out a fair average of good prints, he should find that he has learned to do this with very little waste of paper and time.**

Fig. 147 A Dandelion Gone to Seed...Photo by Wm. M. Harlow

135mm Elmar lens, f:36, 5 seconds. Panatomic. Sliding Copy Attachment used

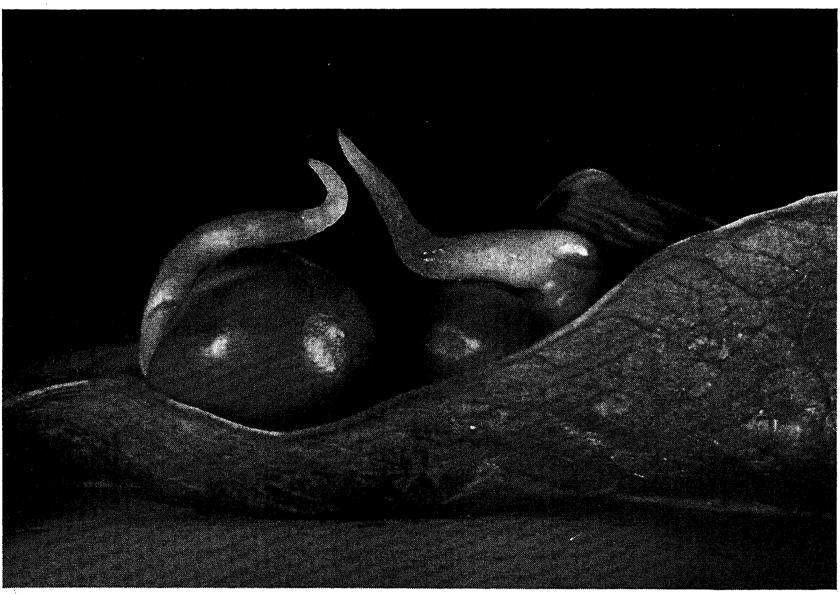


Fig. 148 Sprouting Peas J. M. Leonard

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WILLARD D. MORGAN

Data Tables by Henry M. Lester

CHAPTER 11

In ordinary use the Leica cannot be adjusted for photographing objects at distances less than 3½ feet without the aid of special supplementary front lenses or one of the copy attachments. Thus the 3½ foot mark becomes the dividing line or norm for the Leica user who is interested in photographing large or small objects. Let us step across the threshold of this 3½ foot mark and explore the wonders of the world of small objects. What a contrast! In the large object field we were photographing people, buildings, mountains, and even the moon or sun far out into the space of infinity. Yet in the small object world there is a universe in itself to be explored by the inquisitive mind. Here a book page may be copied or a micro-organism photographed on the Leica negative with a 2,000 times magnification. A truly amazing contrast from infinity to 2,000 times magnification. The user of a Leica can readily span this gap.

Intensive work in photographing the large object world has been carried on for nearly a century. However it has only been in recent years that small object or micro photography has become an essential part of our daily living, mainly because of the important advances in camera design. The eye of the camera was made to peer into the inner structure of the world. All the large hospitals and educational institutions have elaborate photographic departments equipped for the close-up micro photography of specimens which are invaluable for future reference by the medical and teaching staff. Police departments use the camera for close up photography just as nimbly as they use their guns. Industrial firms keep constant photographic records of their products which may be used for reference, sales, or advertising purposes. The visual education field is an important user of close-up or small object photography for presenting thousands of different subjects on the projection screen or by actual photographs to millions of students. Such examples show us how immense and likewise important the field of small object photography has become. Let us now learn how to use our Leica camera for this type of work.

Practically everyone who uses a camera has had the occasion to make close-up photographs of objects. Such pictures may have been more or less successful depending upon the camera and experience of the operator. The copying possibilities of a camera should really be looked upon as the visual note book which is indispensable for keeping accurate records of any object, such as machine parts, drawings, manuscripts, geological specimens, medical subjects, or small magnified pictures of insects. In fact it may be said that anything can be copied that can be illuminated adequately for photographic purposes.

If you are a student, the copy camera outfit can quickly be applied for illustrating your biology note book, or possibly you may need references from rare books which can not be removed from the library. In the latter case the camera can be utilized perfectly and at a minimum expense. The developed negatives may be placed in a projector or enlarger and read directly from the projected image.

Importance of Small Object Photography

This chapter on Small Object Photography should be studied carefully because it is the basis upon which other chapters have been prepared. A thorough knowledge of the copying equipment and methods will enable you to grasp a complete understanding of the following chapters which are so closely related to the present chapter:

A. The Leica as an Ophthalmic Camera.
B. Miniature Camera for Miniature Monsters.
C. Making Leica Film and Glass Slides.
D. Dental Photography with the Leica.
E. Photomicrography with the Leica.
F. The Leica in Visual Education.
G. Historical Research with a Leica.

Close up photography of small objects really has a field and technique quite different from the usual type of photographic work which is practiced by everybody who can focus a camera and click the shutter. When we start taking photographs of a butterfly, newspaper clipping, flower, mineral specimen, or any small object, a number of special problems arise.

1. The camera requires additional equipment.
2. Focusing becomes more critical as depth of focus decreases.
3. Exposure factors change and are calculated according to the degree of magnification required.
4. Proper illumination becomes an extremely important problem.

5. It is often necessary to use color filters in order to obtain certain results.
6. The Leica camera and auxiliary equipment must be mounted on a rigid base, free from vibration.
7. The proper film must be selected for use with the various types of copy work.
8. Even the specimens to be copied should be mounted or properly arranged in order to insure a perfect reproduction on the negative. As the final picture will be reproduced in black and white, or monotone, it is important to select objects which will produce the best contrasts and details required.
9. As most of us are not equipped with spacious photographic studios our camera equipment shoud be small, light, and easily portable.
10. Even the developing technique is of great importance for films made of small objects.
11. Once the proper equipment has been assembled for any type of close up photography there will be many interesting objects to photograph. In fact you will begin to see a new world in miniature.

Accessories for Close Up Photography

There are a number of accessories provided for covering every possible demand which may arise for the Leica user who wishes to use his camera for copying. Each copy attachment will be individually described in order to present the features of each one in such a way that the Leica worker may easily make the proper choice to fit any special requirement.

Sliding Focusing Copy Attachment

Shortly after the introduction of the Model C Leica with the interchangeable lens feature in the Fall of 1930, I started experimenting with the use of various extension tubes placed between the camera and lens. These extension tubes actually take the place of the familiar long extension bellows to be seen on the larger view cameras. My results for this type of close-up copy work were very encouraging and I saw the possibility of developing a new field for Leica users. Following the work with the metal extension tubes I designed the first Sliding Focusing Copy Attachment which has since been manufactured and distributed to thousands of Leica users during the last few years.

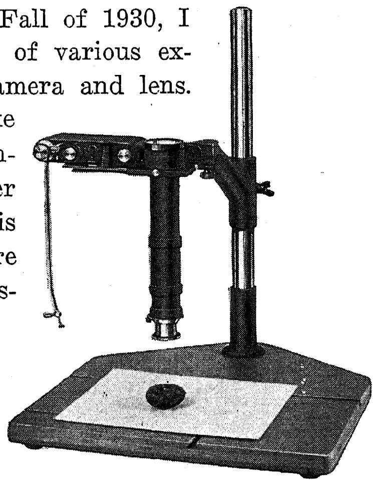


Fig. 149 Sliding Focusing Copy Attachment (Fuldy) Set-up in Position for Copying

Basically the Sliding Copy Attachment, also known as the Fuldy Copy Attachment, consists of two metal plates, one for attaching to the camera and the other for holding the lens and extension tubes. On the part which holds the camera there is a ground glass with a masked out area equal to the size of the Leica negative. This ground glass screen is in exactly the same plane as the film in the Leica camera. Therefore when the image of the object being photographed is in sharp focus on the ground glass it will also be in perfect focus when the camera is moved into the same position directly over the lens.

The Fuldy Copy Attachment has been designed for use in any position required for photographing either horizontal or vertical subjects. A tilting top or Ball Jointed Tripod head may be used for securing this attachment to a tripod for indoor or outdoor use. A special bolt can be secured for inserting into the hole of the Sliding Arm which is also used for holding the rod of the illuminating bracket. When this bolt is in position the Leica or the copy attachment can easily be secured in a horizontal position for photographing such objects as the human eye, maps on a wall, or mounted specimens. In fact after a little experience with the Sliding Copy Attachment it will be found that any photographic angle may be quickly secured.

Around the focusing plate there is a clip mount for attaching the special mangnifier which is of value when obtaining extremely critical focus. Once the Leica is attached to the sliding plate of the Fuldy accessory it can readily be reloaded at any time without removing from this plate. A Wire Release must be used for releasing the shutter in order to avoid any possibility of jarring the camera at the time of exposure.

Description of Sliding Copy Attachment Parts

The accompanying illustration gives complete information about the various parts of the Fuldy Copy Attachment. This copy attachment is adapted for use with the various Leica models which have the interchangeable lens feature. Owners of the early Model A Leica can have their cameras converted so that the lens will be detachable, for use on this attachment as well as for the Leica enlarger and projector.

1. Light shield to prevent stray light from entering camera opening while focusing.
2. Threaded opening for securing the attachment to a tripod, extension arm of the reproduction stand, or the Sliding Arm for use with the upright pillar of the Leica enlarger.
3. Dove-tail groove into which the sliding plate (No. 8) moves while focusing and making exposures.

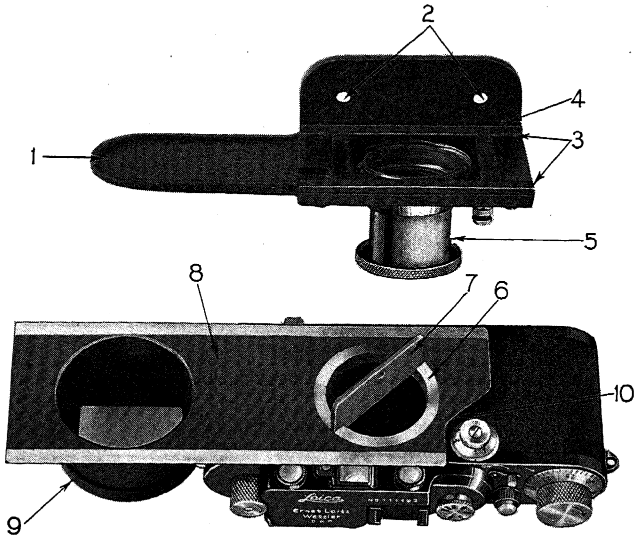


Fig. 150 Essential Parts of the Sliding Focusing Copy Attachment

4. Stop for use when changing from focusing to photographing position.
5. Leica lens screwed into position.
6. Clamping ring for holding the Leica camera securely to the sliding base plate.
7. Key for turning clamping ring (No. 6).
8. Sliding base plate for holding the Leica camera, focusing ground glass, and also the magnifier.
9. Focusing ground glass in exact plane with the film in the camera. There is also a place to attach the magnifier when necessary.
10. Space cut from the sliding plate (No. 8) to permit the Model F or G Leica camera to fit properly.

The Fuldy Attachment in Use

The Fuldy device may be set up as follows:

A. Attached to the Sliding Arm which is secured to the upright column used for the Leica enlargers.

B. Mounted on the Collapsible Reproduction Stand.

C. Secured to a ball jointed or tilting top tripod head which in turn is attached to a firm support such as a tripod.

Before the set up is complete the subject to be copied must be placed into position and properly illuminated. Finally the correct focus is determined by moving the camera close or away from the object. Fine focusing is obtained by using the focusing mount on the lens, or in the case of the 50mm lenses the lens barrel is moved back and forth in its mount. Once perfect focus has been secured on the ground glass the camera is slid into position ready for making the exposure. Stop the lens down as far as practical after focusing and before making the exposure.

When the regular 50mm Elmar lens is used on the Fuldy Attachment directly without the use of additional extension tubes it is possible to photograph any object which comes within the maximum area of 15 x 20 inches and a minimum area of 4 x 6 inches simply by moving the lens mount in or out and setting the camera in the proper position. On account of the sliding feature of the Fuldy Attachment, when greater areas than 15 x 20 in., up to infinity, are to be included the lens has to be collapsed so far that it will interfere with the top plate being pushed over to the photographing position. To avoid this the focusing collar of the lens should be set at infinity while the actual focusing of the lens is accomplished in the usual manner, by collapsing the lens in its mount. To enable the plate to slide properly the focusing collar should be moved to the 3.5 position at which point the sliding plate will move freely. With the camera in photographing position the focusing collar should be moved back to the infinity mark.

The Extension Tubes

In order to secure proper focus at the higher magnifications it is necessary to move the Leica lens away from the film plane. Instead of using a cumbersome bellows similar to the larger view cameras for holding the lens in proper position I designed the 12mm, 30mm, 60mm, and 90mm metal extension tubes for this purpose. With such a set of tubes together with one of the collapsible 50mm lenses, any combination can be secured to obtain the proper magnification and focus upon an object which might be as small as a pinhead. Such tubes are small and light and keep the lens in a rigid position at all times.

When the Fuldy Attachment is used with the 30mm tube and the 50mm lens, natural size or 1:1 pictures may be made. By pushing the lens barrel into its mount additional areas may be covered. The 60mm tube is very useful for securing slightly higher magnifications and also for use when the Fuldy Attachment is used with the microscope. An unusually long set-up of extension tubes may be seen in the arrangement for insect photography illustrated in J. M. Leonard's chapter.

The introduction of the Sliding Focusing Attachment in connection with extension tubes of various lengths greatly increased the Leica's usefulness. Every day new fields are being reported where the application of these accessories was at first found useful and later became indispensable.

Most of the information concerning the use of these accessories was available for the 50mm lenses because they are the most popularly used. It will be found however that lenses of longer focal length are extremly useful for certain types of work. In order to facilitate and simplify the use of these accessories with any of the Leica lenses and tubes the Editors now offer a special table and some basic formulas which will enable the average worker to determine certain important factors for the different lenses and extension tubes without resorting to tedious experimental or mathematical work.

The table given on pages 232, 233 was computed for the 55mm lenses (either Elmar, Hektor, or Summar). This table should be consulted not only for information regarding the use of these three lenses, but also as an example of information that can be obtained by the use of the few simple formulas which follow.

It should be noted that the figures contained in this table referring to the depth of focus are based upon the diameter of the circle of confusion of .03mm (approximately 1/750 of an inch). This is the only part of the table affected by the size of the circle of confusion. Should a smaller circle of confusion be required, or a larger one be found sufficient, the data given in the table should not be used, but other figures computed with the aid of the formulas appended.

Use of Extension Tubes Directly on the Camera Without Sliding Focusing Attachment

It is frequently desirable to use various Extension Tubes or their combinations directly on the camera, without the use of the Sliding Focusing Attachment. This is quite practicable. The tube is simply screwed into the camera and the lens is screwed into the tube. Such an arrangement sometimes can be used in lieu of auxiliary front lenses. The focusing is then done to scale. Great accuracy is an absolute prerequisite of success.

The following table is given for this type of work.

It is based upon the diameter of Circle of Confusion of 0.03mm.

Since it is impossible to compose the picture on the film visually it is recommended to use a plumb weight whenever this method is employed. Special plumb-weights are available, but any plumb-weight will be found to work as long as it will be made so that it will drop in a line with the optical axis of the lens.

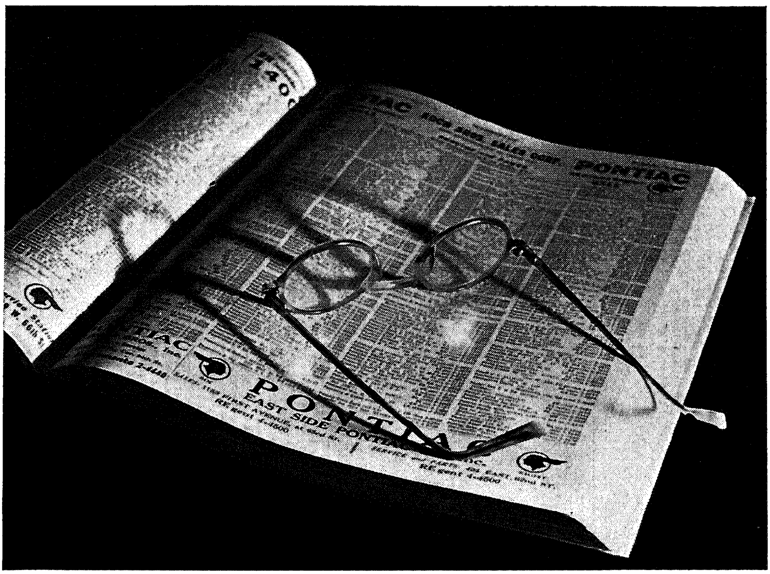


Fig. 151 "Small Print" Manuel Komroff
Elmar 50mm with "Nooky" 2 sec. f:12.5 Panatomic film—Harvey Developer

WORKING DISTANCE, RATIO OF MAGNIFICATION, DEPTH OF FOCUS, EXPOSURE FACTORS AND FIELD OF COVERAGE FOR EXTENSION TUBES USED DIRECTLY ON LEICA CAMERA (Without Sliding Focusing Attachment) with ALL 50mm Leica Lenses:

Elmar f:3.5 Hektor f:2.5 Summar f:2

Total Length in Millimeters	Extension Tubes MM	Working Distance (from object to Lens) in MM	Depth of Focus at f/12.5 Nearest points in Millimeters	Farthest in focus	Exposure Factor (Increase in exposure) (Times)	Approximate Field Covered in MM	Ratio of Reduction or Magnification
12	12	259	251	267	1.5x	96 ×144	4:1
22	22	164	161.5	167	2.0x	54 × 81	2.25:1
30	30	133	131.3	134.7	2.5x	38 × 58	1.6:1
42	12+30	109	108.2	110	3.4x	29 × 43	1.2:1
60	60	92	91.6	92.7	4.8x	20 × 30	1:1.2
72	60+12	85	84.6	85.5	6.0x	16 × 24	1:1.5
90	90	78	77.7	78.4	7.75x	13 × 20	1:1.8
102	90+12	74.5	74.3	74.8	9.25x	12 × 18	1:2
120	90+30	71	70.8	71.2	11.5x	10 × 15	1:2.4
142	90+30+12	69	68.8	69.2	14.75x	9 × 14	1:2.6
150	90+60	66.6	66.4	66.8	16.0x	8 × 12	1:3
162	90+60+12	65.5	65.4	65.7	18.0x	7.5 × 11	1:3.25
180	90+60+30	64.0	63.9	64.1	21.0x	6.7 × 10	1:3.6
192	90+60+30+12	63.0	62.9	63.1	23.5x	6.25 × 9.35	1:3.85

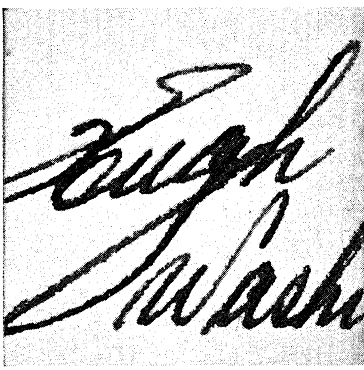


Fig. 152 Writing Showing Shading Variations in Pen Pressure and Grain of Paper. Elmar 50mm Lens with Focusing Copy Attachment

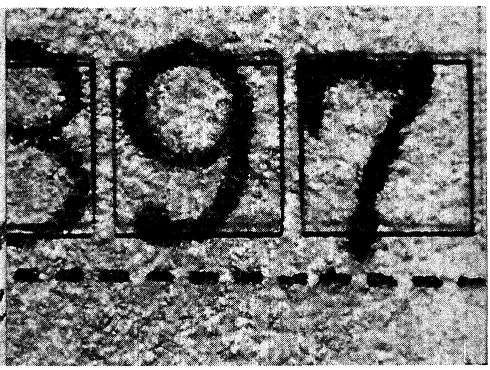


Fig. 153 Copy of Typewriting..by Ira Gullickson. Pica type. Ruled square on glass over typing. Fine detail shows type and kind of paper. Printer's ink in dotted line seen as being different from typing. Fuldy Copy Attachment with Elmar 50mm lens, 30 and 60mm tubes

Exposure Factors

For ALL Extension Tubes When Used With Various Leica Lenses and the Sliding Focusing Attachment

Tubes Lenses:	35mm	50mm	73mm	90mm	105mm	135mm
11mm	1.75x	1.5x	1.33x	1.26x	1.21x	1.08x
12mm	1.8x	1.54x	1.35x	1.28x	1.24x	1.09x
22mm	2.65x	2.1x	1.7x	1.5x	1.46x	1.35x
30mm	3.45x	2.55x	2.0x	1.78x	1.65x	1.5x
60mm	7.5x	4.8x	3.3x	2.75x	2.45x	2.1x
90mm	12.8x	7.8x	5.0x	4.0x	3.45x	2.75x

This table of Exposure Factors for all tubes and all Leica Lenses will be found useful for ascertaining the correct exposure factors:

1. when using extension tubes directly on the camera (without Sliding Focusing Attachment), interposing them between the camera and any lens.
2. when using various extension tubes or their combinations in connection with Sliding Focusing Attachments and any Leica Lenses.

For the purpose of exposure factors the Sliding Focusing Attachment is considered just as any other tube of 11mm length. Every tube, depending on its length, has its own exposure factor, which is constant for every lens.

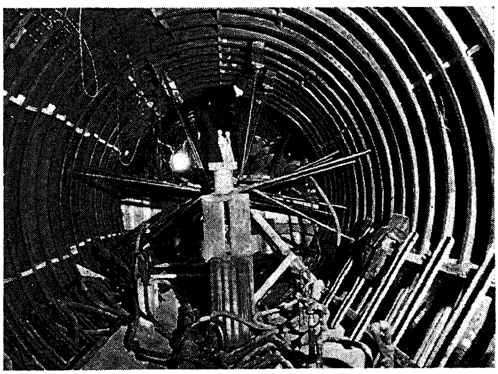


Fig. 154 Sewer Construction. Elmar 35mm at f:6.3, Super X Film. Photoflash used at the side and at the camera level. Photo by J. Winton Lemen.

TABLE OF DATA FOR COPYING OR REPRODUCTION WITH LEICA CAMERA, SLIDING FOCUSING ATTACHMENT AND EXTENSION TUBES FOR ALL 50MM LENSES: SUMMAR, HEKTOR OR ELMAR

Distance From Object to Lens	Distance From Lens to Film Plane	Ratio of Reduction or Magnification	Depth of Focus at F:6.3, Diam. Circle of Confusion .03mm: Nearest Point in Focus	Farthest Point in Focus	Exposure Factor (Increase of Exposure)	Approximate Field Covered	Auxiliary Reproduction or Copying Equipment S.F.A. = Sliding Focusing Attachment	Position of Lens
B	D	R. or M.	A	Z	T			
Formula 4B	Formula 4D	Formula 3	Formula 5Z	Formula 5A	Formula 2			
Millimeters	Millimeters	Ratio	Millimeters	Millimeters	Times	Millimeters		
1000	52.6	19 :1	928	1076	1.1x	456 ×684	None	Lens directly on camera Focusing set for nearest distance
800	53.3	15 :1	756	849	1.15x	360 ×540	S.F.A. No tubes	Lens barrel unlocked, moved in and out for focus
600	54.5	11 :1	576	626	1.18x	264 ×396	S.F.A. No tubes	Lens barrel unlocked, moved in and out for focus
500	55.5	9 :1	484	517	1.23x	216 ×324	S.F.A. No tubes	Lens barrel unlocked, moved in and out for focus
400	57.1	7 :1	389	412	1.3x	168 ×252	S.F.A. No tubes	Lens barrel unlocked, moved in and out for focus
350	58.3	6 :1	341.4	358	1.37x	144 ×216	S.F.A. No tubes	Lens barrel unlocked, moved in and out for focus
300	60.0	5 :1	294.5	305.5	1.45x	120 ×180	S.F.A. No tubes	Lens barrel unlocked, moved in and out for focus
277	61.0	4.5 :1	272.5	282	1.5x	108 ×162	S.F.A. No tubes	Lens mount set for ∞ lens barrel locked in mount
250	62.5	4 :1	245.6	254.2	1.56x	96 ×144	S.F.A. +12 mm tube	Focus with lens barrel

200	66.6	3 :1	197.5	202.5	1.76x	72 × 108	S.F.A.+ 12mm tube	Focus with lens barrel
175	70.0	2.5 :1	173.1	176.8	1.95x	60 × 90	S.F.A.+ 12mm tube	Focus with lens barrel
159	73.0	2.25:1	157.8	160.3	2.15x	54 × 81	S.F.A.+ 12mm tube	Lens mount set for ∞ lens barrel locked in mount
150	75.0	2 :1	148.7	151.2	2.25x	48 × 72	S.F.A.+ 22mm tube	Focus with lens barrel
125	83.3	1.5 :1	124.2	125.7	2.75x	36 × 54	S.F.A.+ 22mm tube	Lens locked in mount set for ∞
110	91.0	1.25:1	109.5	110.6	3.33x	30 × 45	S.F.A.+ 30mm tube	Lens locked in mount set for ∞
100	100.0	1 :1	99.5	100.4	4.00x	24 × 36	S.F.A.+ 12mm & 30mm tube	Focus with lens barrel
97	103.0	1 :1	96.7	97.4	4.25x	24 × 36	S.F.A.+ 12mm & 30mm tube	Lens locked in mount
85	121.0	1 :1.5	84.8	85.3	5.86x	16 × 24	S.F.A.+ 60mm tube	Lens locked in mount
80	133.0	1 :1.75	79.8	80.3	7.0x	13.5 × 20.5	S.F.A.+ 60 & 12 tube	Lens locked in mount
75	151.0	1 :2	74.83	75.25	9.0x	12 × 18	S.F.A.+ 90 tube	Lens locked in mount
72	163.0	1 :2.25	71.85	72.2	10x	10.5 × 16	S.F.A.+ 90 & 12 tube	Lens locked in mount
69	181.0	1 :2.5	68.86	69.10	13x	9.6 × 14.6	S.F.A.+ 90, 30 tube	Lens locked in mount
67	193.0	1 :3	66.88	67.15	15x	8 × 12	S.F.A.+ 90, 30 & 12 tube	Lens locked in mount
65	211.0	1 :3.25	64.88	65.10	18x	7.4 × 11.6	S.F.A.+ 90 & 60 tube	Lens locked in mount
64	223.0	1 :3.5	63.89	64.14	20x	6.9 × 10.3	S.F.A.+ 90, 60, 12 tube	Lens locked in mount
63	241.0	1 :3.75	62.9	63.12	23x	6.4 × 9.6	S.F.A.+ 90, 60, 30 tube	Lens locked in mount
62	253.0	1 :4	61.91	62.1	25x	6 × 9	S.F.A.+ 90, 60, 30, 12 tube	Lens locked in mount
61	275.0	1 :4.5	60.91	61.1	30x	5.35 × 8	S.F.A.+ 90, 60, 30, 22, 12 tube	Lens locked in mount
60	300	1 :5	59.92	60.09	36x	4.8 × 7.2	S.F.A.+ 90, 90 60 tubes	Lens locked in mount
58.3	350	1 :6	58.23	58.38	49x	4 × 6	S.F.A.+ 90, 90, 90, 30 tubes	Focus with lens barrel
57.1	400	1 :7	57.05	57.17	62x	3.44 × 5.15	S.F.A.+ 90, 90, 90, 60, 12 tubes	Focus with lens barrel
55.5	500	1 :9	55.46	55.55	100x	2.67 × 4	S.F.A.+ four 90s, 60, 22 tubes	Focus with lens barrel
52.6	1000	1 :19	52.57	52.64	400x	1.26 × 1.89	S.F.A.+ ten 90s, 30, 12 tubes	Focus with lens barrel

For lenses other than 50mm similar data are obtainable with the aid of respective simple formulas.
Intermediate values, not contained in table also may be obtained with these formulas marked at head of each column.

Formulas

1. $L = \dfrac{F}{f}$ = Diameter of lens

2. $T = \dfrac{D^2}{F^2}$ = Exposure factor (increase of exposure)

3. $\dfrac{O}{I} = \dfrac{B - F}{F}$ = Ratio of reduction (As a function of the object or magnification distance)

   $\dfrac{O}{I} = \dfrac{F}{F}$ = Ratio of reduction (As a function of the image or magnification distance)

4. $F^2 = (D - F) \ . \ (B - F)$ = (Relation between focal length, object and image distance)

   $B = \dfrac{D \ . \ F}{D - F}$ = Working distance of object to lens

   $D = \dfrac{B \ . \ F}{B - F}$ = Distance of image to lens

5. Depth of focus at a given diameter of Circle of Confusion:

   $A = \dfrac{L \ . \ B \ . \ F}{(L \ . \ F) + C(B - F)}$ = Nearest point in focus

   $Z = \dfrac{L \ . \ B \ . \ F}{(L \ . \ F) - C(B - F)}$ = Farthest point in focus

Explanation of Symbols

M — Ratio of Magnification
R — Ratio of Reduction
O — Size of Object (linear dimensions)
I — Size of Image on film (linear dimensions)
B*— Distance of Object to the Lens
D*— Distance of Image to Lens
F*— Focal Length of Lens
f — Stop of diaphragm
T — Exposure Factor (increase of exposure)
C*— Diameter of Circle of Confusion
L*— Diameter of Lens
A*— Nearest point in focus when lens is focused for B.
Z*— Farthest point in focus when lens is focused for B.
* It is important to express all units of length in the same system, either metric or linear (inches).

Practical Applications

1. Diameter of Lens:

$$L = \frac{F}{f} \text{ or } \frac{\text{(Focal Length)}}{\text{(Lens Stop(f))}}$$

Example:

What is the diameter of the aperture of a 50mm lens when it is stopped down to f:12.5?

$$L = \frac{50}{12.5} = 4\text{mm.}$$

2. **Exposure Factor:**

$$\text{Increase of Exposure } T = \frac{D^2}{F^2} \text{ or } \frac{(\text{Distance from lens to film plane})^2}{(\text{Focal length})^2}$$

Example:

What is the exposure factor for a 90mm tube when used directly on the camera in connection with a 90mm lens?

$$\text{Distance from lens to film plane } \frac{[90\text{mm (tube)} + 90\text{mm lens}]^2}{90^2}$$

$$= \frac{180^2}{90^2} = \frac{32.400}{81.00} = 4\text{x}$$

3. **Ratio of Reduction or Magnification:**

$$\frac{\text{Size of Object}}{\text{Size of Image}} = \frac{O}{I} = \frac{B-F}{F} = \frac{\text{Distance from Object to Lens less Focal length of Lens}}{\text{Focal length of Lens}}$$

Example:

Ratio of Reduction of an object 900mm from a 35mm lens:

$$\frac{900-35}{35} = \frac{865}{35} = 24.7 \div 1;$$

say 25 ÷ 1

or:

$$\frac{\text{Focal length of Lens}}{\text{Distance from Lens to Film Plane—minus focal length of lens}} = \frac{F}{D-F} = \frac{I}{O}$$

Example:

What is the ratio of Magnification obtained when using 60 and 90mm extension tubes in connection with a 73mm lens (tubes directly on the camera—no S. F. A.)?

$$[60 + 90 + 73 \text{ (lens)}] = D = 223$$

$$\frac{F}{D-F} = \frac{73}{223-73} = \frac{73}{150} = \frac{1}{2.06} \text{ or } 1 \div 2$$

Fig. 155 Latent Finger Print on Black Rubber Surface...... Gray Finger Print Powder. Photo by Ira Gullickson. Sliding Copy Attachment, used with 30mm tube

4. **Distance from Lens to Object or (B)**

" " **Lens to Film Plane (D)**

(knowing one how to find the other)

Basic Formula: F =(D—F) . (B—F)

$$B = \frac{D \times F}{D - F} \qquad D = \frac{B \times F}{B - F}$$

Examples:

What is the distance at which the object is to be placed when a 60mm tube and S.F.A. are used with a 135mm lens?

$$B = \frac{(135 + 60 + 11) \times 135}{(135 + 60 + 11) - 135} =$$

$$= \frac{206 \times 135}{206 - 135} = \frac{27810}{71} = 392\text{mm}$$

What extension tubes are to be used when a 50mm lens is available and the object is 97mm from the lens?

$$D = \frac{97 \times 50}{97 - 50} = \frac{4850}{47} = 103\text{mm} \qquad 103\text{mm} - 50\text{mm lens} = 53\text{mm}$$

or 53mm = 11mm (S. F. A.) + 12mm (tube) + 30mm (tube)

5. **Depth of Focus:**

The depth of focus for any lens at any opening or distance depends on the diameter of the Circle of Confusion. In all standard Leica formulas the diameter of the Circle of Confusion is taken to be

$$C = 0.03\text{mm}$$

$$\text{Nearest point in focus: } A = \frac{L \times B \times F}{(L \times F) + C\,(B - F)}$$

$$\text{Farthest point in focus } Z = \frac{L \times B \times F}{(L \times F) - C\,(B - F)}$$

Example:

What is the depth of focus of a 90mm lens at Stop f:9, focused upon an object 5 meters away, assuming the size of the C. of C. to be 0.01mm?

$$L = \frac{90}{9} = 10\text{mm};\ B = 5000\text{mm} \qquad C = 0.01$$

$$A = \frac{10 \times 5000 \times 90}{(10 \times 90) + .01\,(5000 - 90)} = \frac{4{,}500{,}000}{900 + 49.10} = 4750\text{mm}$$

$$Z = \frac{10 \times 5000 \times 90}{(10 \times 90) - .01\,(5000 - 90)} = \frac{4{,}500{,}000}{900 - 49.10} = 5300\text{mm}$$

Depth of focus will result in everything being in sharp focus at from 4.75 meters to 5.30 meters.

Avoiding Vibration During Copying

Usually most close-up copy work requires time exposures ranging from ¼ second up to 5 minutes or even more. During such exposures there must be no vibration in the equipment to cause a blurred image on the negative. In order to avoid vibrations the following points should be observed.

1. Use a rigid support for copying equipment.
2. Release shutter with a Wire Cable Release.
3. In case you are working in a building which transmits the annoying vibrations of passing trains, trucks, or a subway, a sponge rubber mat might be placed under the baseboard of the copying attachment in order to absorb the motion.
4. When all the extension tubes are in use have a support or clamp to hold the combination rigid.
5. When vibrations cannot be avoided use more illumination on the object, a larger diaphragm stop, fast film, and make fast exposures.

Focusing

As the camera lens is placed closer to the object the focusing becomes more critical. Naturally without perfect focus the object will be reproduced on the negative as a slight or even complete blur. With the Leica camera there are three methods of obtaining proper focus.

1. By actual focusing upon a ground glass in the Sliding Copy Attachments.
2. By measurement and the use of the printed tables supplied for the purpose.
3. By using the fixed focus attachments such as the Besum, Belun, Behoo, etc.

Ground glass focusing is recommended in the majority of cases because it is so easy to actually see the object projected upon the glass surface which is in the same plane as the film in the camera. Special 5x magnifiers (a regular and wide field magnifier) are available to help in determining exact focus with the Sliding Focusing Copy Attachment. In case there is too much stray light falling upon the ground glass, when the magnifier is not in use, take a piece of black paper about 4 x 6 inches in size and wrap this around the ground glass mount. Use a rubber band to hold the paper shade in position around the base. You will now have a paper tube which will keep out any stray light. When the magnifier is in position this paper tube is not required.

The ground glass of the Focusing Copy Attachment looks grainy when examined with the aid of a 5x magnifying glass. Considerable improvement of the clearness of the image is obtained by applying a drop of oil (cocoanut oil is very good) to the ground surface of the glass. Rub the oil in gently and evenly, moving the finger first in one direction, and then at right angles to it. This method will eliminate the graininess considerably and increase the luminosity of the image, permitting better focusing.

Critical Focusing and the Special 30x Magnifying Glass

A special 30x magnifier is available to secure critical focus for those who require the utmost precision and accuracy. This magnifier consists of a small eyepiece equipped with a tiny lens of the microscope ocular type and quality. The lens with its mount slides in a collar which fits into the half-rim clip on the ground glass of the Focusing Copy Attachment. This magnifier cannot be used with the regular ground glass supplied with the Fuldy Copy Attachment, be it ever so fine-grained. It would only magnify the grain 30 times, but would not resolve the details of the image focused upon the surface.

A special ground glass is available for use with this 30x magnifier. It has a narrow strip of clear glass running across the center of the disc. This clear strip is about 3mm wide. A millimeter scale is engraved in finest hairlines upon the ground side of the glass disc, which corresponds to the film plane in the Leica camera. The scale starts with 0 in the center of the disc and continues to the right and to the left of the 0 in millimeter markings.

The magnifier is placed upon the Copy Attachment just like a regular 5x magnifier. The eyepiece is then moved in or out until the scale engraved upon the glass appears in perfect focus, sharp and clear. Then the object or the camera is moved until the small portion of the object seen through the magnifier appears in sharp focus. It will be found that the image is clear and brilliant and permits the finest hairline adjustment.

This 30x magnifier works upon the principle of picking up the magnified image of the object from the air. The focal point of the lens of this magnifier is so critical, that if the image is not exactly in the film plane, it will appear unsharp until corrected. The focusing should be done with the lens of the camera open enough to permit sufficient illumination to enter for easy focusing. After correct focus has been secured, reduce the lens diaphragm to the desired stop.

Coarse focusing, or the preliminary work in bringing the object into fairly accurate focus upon the ground glass, is secured by placing the camera closer or farther away from the object. In doing this the Sliding Arm to which the camera and Copy Attachment are secured is raised or lowered on the metal upright bar which supports the equipment. In case the camera is in the horizontal position mounted on the Sliding Arm or on a tripod it is only necessary to move either the object or the camera closer or farther away until sharp focus is secured.

When using a 50mm lens, fine focusing can be secured by turning the lens mount or by slowly pushing the lens barrel in or out of the mount. If the 90mm or any other lens besides the 50mm lenses are used the fine focusing is easily secured by slowly turning the focusing mount on each lens until sharp focus is secured.

When working with small objects a convenient stage or mount can be made with an adjustable rack and pinion arrangement similar to the stage of a microscope. Sometimes such a stage can be picked up in a second hand store for only a few dollars; it makes a perfect platform for adjusting small objects. Such a stage is fully described in the chapter by J. M. Leonard on photographing insects.

Focusing by Measurement

When the Leica is to be used without the aid of additional copy attachments accurate focusing may be secured by referring to the special booklet of tables for the Front Lenses, which is available free for any Leica owners who use the Front Lenses in copying. This booklet of tables gives the exact distance between the object and the film of the camera (not the lens), the exact area covered by either one of the three supplementary Front Lenses used, and also the depth of focus at the various diaphragm stops.

When using the Leica with the Front Lenses it is necessary to have the camera secured to the Sliding Arm or to a tripod or any other fixed support, in order to keep the camera perfectly rigid.

Still another method of focusing by measurement is with the use of the various Extension Tubes directly on the camera. When these tubes are used singly or in combination it is not necessary to use the three Front Lenses already mentioned. The Extension Tubes will enable you to use the Leica at closer distances. For those who wish to use the Leica for copying without the use of any copy attachment, a measurement table for use with the Extension Tubes screwed directly into the camera has been prepared by Mr. Lester. The Single Exposure Leica, described in the first chapter, can be used very successfully for testing these fixed distances.

A special copying baseboard can easily be prepared to include the various areas given in the table by marking out the rectangular areas in ink or cut lines in the wood. Each rectangle should have figures giving the area and also the Extension Tube and lens setting required to secure perfect focus. Such a ruled board will be of great convenience for use where many pictures are to be made of objects which are uniform in size.

Stopping Down the Lens

All copying should be done with the lens stopped down to f:6.3 or smaller if possible. As the lens is stopped down the depth of focus increases, thus insuring perfect focus at all times even if a slight miscalculation has been made when securing the original focus. When working with high magnifications the lens should always be stopped down to f:12.5. A special diaphragm Attachment Ring is available for use with the Hektor and Elmar 50mm lenses, in order to adjust the diaphragm with side calibrations and thus avoid the necessity of standing on one's head to read the settings on the lens in case it is pointed down toward an object.

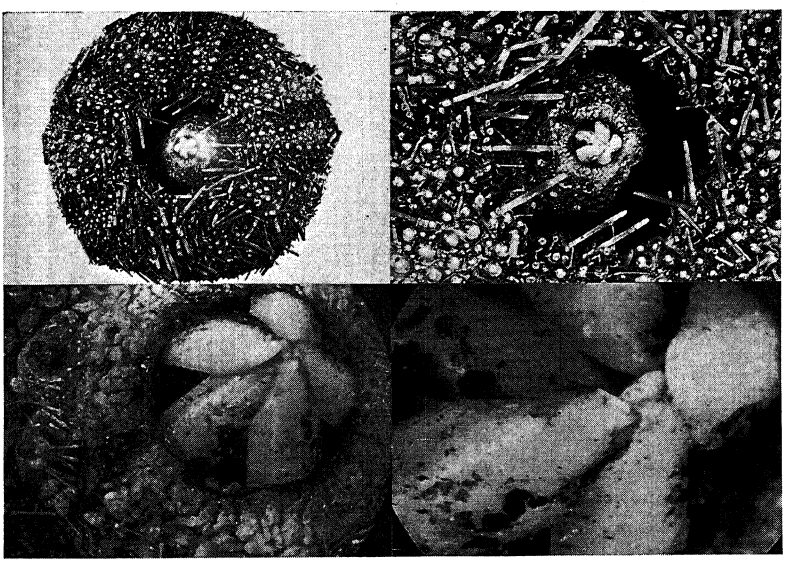


Fig. 156 Sea Urchin (Original Specimen 1½ inches diameter). Series of Four Pictures by Willard D. Morgan

Photographs made with Focusing Copy Attachment and various extension tubes to secure different magnifications. Highest magnification made with a 21cm tube extension.

Fixed Focusing

The various fixed focus attachments such as the Belun, Behoo, and Bazoo are of value for certain uses and when only a few areas are to be covered. The Belun attachment is permanently in focus for making pictures the exact size of the Leica negative or a 1:1 ratio. The Behoo and Bazoo have extension legs with markings for special settings and areas covered. Complete information about these attachments will be found in a special booklet from the Leitz Company.

Securing Proper Illumination

The importance of proper illumination of objects to be photographed at close range cannot be over-emphasized. Objects can be flooded with strong light until they become flat, lifeless, and washed-out reproductions on the negative. However with the proper type of lighting the very same objects will take on a richness of tone value which makes the final picture strong and at the same time a perfect reproduction of the original.

One of the first methods of checking proper lighting is by personal observation. Side, top, or back lights may be adjusted at various distances from the object, diffusion screens can be used to soften strong direct light rays, high or low power bulbs should be used when necessary. In some cases it may even be necessary to set up one or more flash bulbs for making the picture. In most cases the lights can be adjusted visually.

The best way to check the intensity of the illumination over an object such as a manuscript page, is by using an exposure meter. When in doubt about the proper balancing of the lights this meter provides a rapid means of checking.

For the majority of objects the ordinary side lighting with the lights set at a 45° angle is sufficient. One or two lights are placed on each side, depending upon the size of the object. When these lights are placed at a 45° angle the strong light rays illuminate the area to be photographed without causing back reflections which would ruin the picture, or at least make it fall short of becoming a perfectly illuminated reproduction.

A convenient lighting set-up consists of two ordinary desk lamps with reflectors. Two frosted 75-watt bulbs are sufficient for illuminating all areas up to 12 x 16 inches. Beyond this area use four or more lamps as required. Even such a rule may not hold for every set-up, because it is possible to use two photo-flood lamps or two 500-watt lamps in reflectors and evenly illuminate greater areas. If you have a Kodalite, Solite, or similar lighting outfits they can be used very successfully for copying. Usually the high power bulbs must be replaced with globes of lower light intensity in order to avoid over-illumination.

It is also possible to use normal daylight when convenient, although artificial lighting is more constant and easier to control. Sometimes when copying in libraries it is not possible to carry in extra equipment such as lights. Here is where it is necessary to use natural daylight. When photographing under such conditions the full illumination from a window is sufficient. Avoid any cross lighting from other windows which may cast shadows or otherwise cause uneven illumination.

Strong lights are useful when photographing moving subjects where short exposures are required. In some cases the strong lights may cause too much heat or otherwise disturb the subjects. To avoid this the focusing may be done with a small light, then when the exposure is to be made the full illumination is snapped on just before the shutter is released. It may also be advisable to use stronger lights when heavy color correction filters are used, thus reducing long exposures.

Making and Using Film Copies

The Clerical Side

A system of filing and identifying negatives is an important factor in putting a collection of film copies to the best account. Most of us follow the line of least resistance and if there is a good deal of bother about unwinding film and searching for the piece wanted we are inclined to neglect the film copies, no matter how excellent the photography may have been. The following plan fits my own needs and might be adapted to the use of others.

The film strips are numbered and filed under headings that parallel those in a general file of notes and documentary material. A record of the material copied is photographed in each case and becomes part of the negative, serving as a label.

The first exposure on each strip of film copies a large number that can be read on the negative without a lens, and a good deal of eye strain is avoided in identifying film strips by this large number at one end. The numbered series serves as a check against the loss of film in process or in use.

The second exposure copies a label, which contains the following information:

a. title of document
b. filing designation
c. photographic conditions
d. number of pages copied

It is not necessary to use an entire frame for this label, as it may be placed alongside a title page and photographed in that position. After the entire strip of film has been exposed, the number of pages copied may be noted on the original label, and if the document has not been completed the label may be carried forward to the next film strip. The original label is eventually filed in the general file, with other notes, and serves as a cross reference to the film. In special cases, as in copying a series of documents, it is convenient to keep a list of the contents of the film strips, taken from the labels before they are filed.

The most likely clerical errors are mislabeling of documents, or skipping pages. The following device serves as a check on missing pages, so that it is not ordinarily necessary to check them on the finished negative.

I count thirty pages in the document and place a marker at the end. If the camera counter, the frame numbers, and the marker in the document coincide at the end of the strip, it is reasonably certain that no pages were omitted. If an error has been made the best way to correct it usually is to retake the whole strip. This avoids isolated pages, taken at a later time, which must be spliced on to the film strip.

In copying material printed on thin paper it is necessary to interleave with white, to prevent the page underneath from showing through. Where the ink on one side of the page shows through on the reverse side I interleave with black, as this reduces the contrast and may eliminate the show-through on the negative.

Lighting Medical Specimens

Macro photography of gross specimens is a term often heard when referring to the copying of medical objects such as bone sections, animal or human organs, or sections of tissues. Here is where a knowledge of lighting is of special importance in order to obtain good detail in the objects and also avoid glistening high lights or bad reflections. In some cases the objects can be placed under water in a large glass specimen jar, with the light directed from the sides. Annoying reflections are thus avoided.

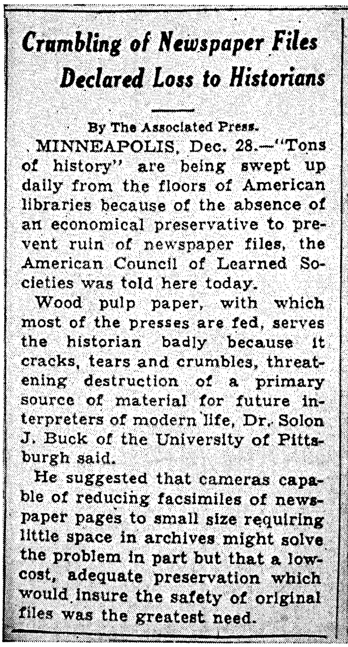
When a medical or any other subject is to be reproduced with a plain white background there are three ways to do this.

1. Make the photographs and then opaque the negative by painting around the object with opaque paint.
2. By using a white surface as a background for the object.
3. Produce a strong back lighting through an opal or ground glass. Such a backlight will overexpose the background around the ob-

ject. The specimen is illuminated from the top in the usual way. When the paper enlargement is made from this negative the background will reproduce perfectly white if the exposure is made for the object only.

One of the most useful accessories for copy work is an illuminated light box. With such a box the under or back lighting is easily controlled, because the lights may be switched on for only part of the time while the exposure is being made for the specimen mounted on top of the ground glass. Such a lighting also helps to eliminate unnecessary shadows when necessary. The top lights are used for illuminating the object.

When a jet black background is required for a light object it may be obtained by using a red glass, or celluloid, or paper, in the illuminated box providing positive or orthochromatic film is used in the camera. The red does not register on this film, therefore when the finished enlargement is made a rich black is secured for the background. Black paper or cloth may also be used for a similar purpose.



Crumbling of Newspaper Files Declared Loss to Historians

By The Associated Press.

MINNEAPOLIS, Dec. 28.—"Tons of history" are being swept up daily from the floors of American libraries because of the absence of an economical preservative to prevent ruin of newspaper files, the American Council of Learned Societies was told here today.

Wood pulp paper, with which most of the presses are fed, serves the historian badly because it cracks, tears and crumbles, threatening destruction of a primary source of material for future interpreters of modern life, Dr. Solon J. Buck of the University of Pittsburgh said.

He suggested that cameras capable of reducing facsimiles of newspaper pages to small size requiring little space in archives might solve the problem in part but that a low-cost, adequate preservation which would insure the safety of original files was the greatest need.

Fig. 157 Newspaper Clipping Warns Against the Loss of Valuable Records

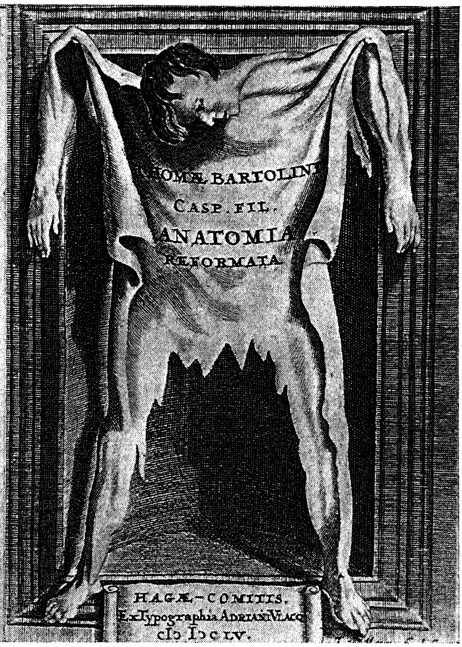


Fig. 158 Cover of an Early Medical Book Copied for Later Study

Still another lighting set-up which produces a white background without shadows can be prepared by mounting a clear pane of glass about six inches or more above a plain white surface which is strongly illuminated. By arranging the top lights at the proper angles the shadows are cast out of photographing range while the illuminated white surface produces an even background. This arrangement is of value for photographing many objects besides medical specimens.

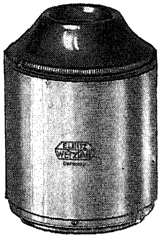


Fig. 159 Wide Field 5x Focusing Magnifier

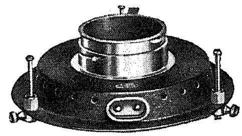


Fig. 160 Copying Ring Illuminator for Uniform Lighting of Small Objects

Exposure Time in Copying

As the camera is placed closer to objects and the lens is separated farther from the film plane, the relative exposure time increases. Consequently the values of the diaphragm stops vary according to the degree of reduction or magnification. For example, when photographing objects in actual size on the Leica negative the diaphragm of the 50mm lens will be 100mm from the film plane. In other words, when photographing objects actual size on the Leica negative the distance between the model plane of the lens and the film must be twice as great as the focal length of the lens. With such varying conditions the actual value of the stop changes, with the resulting changes in exposures. Once the correct exposure for a given distance has been determined the exact factors for exposures at different settings may easily be determined by referring to the tables.

The following six points must be observed before determining the exact exposure time:

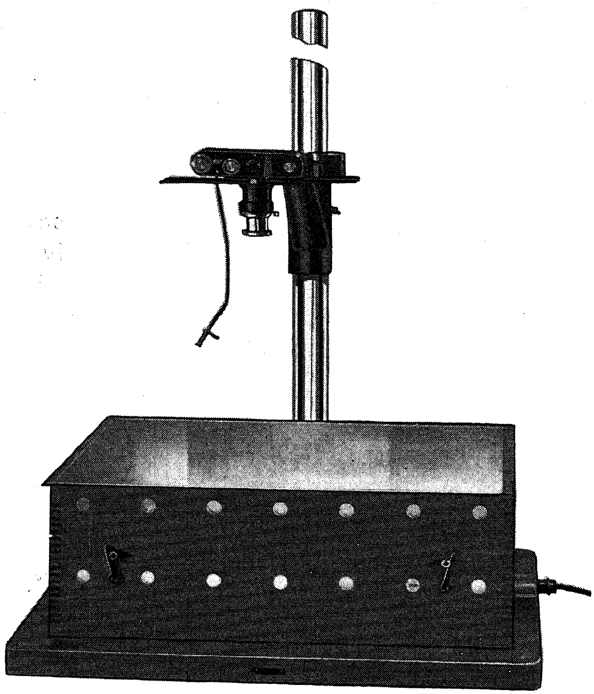
1. Intensity of the light used.
2. Diaphragm stop to be used.
3. Speed of the film.
4. Multiplying factors of any filters used.
5. Character of the object to be copied, which may be dark or light, rough or smooth.
6. The distance between the lens and the film, which determines the exposure factor for reduction or enlargement as given on page 232.

When photographing very small objects it will be found that it is difficult if not impossible to get a reading on the exposure meter which will be correct. This is due to the fact that the average meter usually covers a much greater field than that occupied by the object. It will be found helpful to get a piece of paper of about 5 x 7 inches or some other material of a brightness or color similar to that of the average color or brightness of the object and get a reading on that by placing it approximately in the plane of the object with relation to the light source. In the case of insects or similar small objects it will be found most expedient to color a piece of paper with water colors, giving it the average tint of the texture of the insect.

The most accurate method of determining exposures when copying is to make actual test pictures with different exposure times. A short length of film may be placed in the Leica magazine and exposed under varying, lighting, filter, diaphragm, and magnification or reduction conditions. Develop this film the proper time and then study the results and determine the exact exposures to be given on the next roll of film which will be exposed under the correct requirements.

Even a single exposure can be made on a short piece of film inserted directly into the Leica after the Film Magazine and Take-Up Spool have been removed. To do this, cut a piece of film approximately four inches in length and insert directly into the camera back of the shutter. Press one end down ahead of the other to avoid catching the film edge on the lower metal frame which determines the margin along one side of the negative. Try loading in daylight first; the exact position of the film will be quickly seen if the focal plane shutter is set at Time and held open. As 35mm film is inexpensive this method of testing exposures will be a real time saver and also help produce perfectly exposed negatives when the good roll of film is used.

Fig. 161 Focusing Copy Attachment Set-up with Illuminated Light Box for Copying X-rays, and Objects which Require an Illuminated Background



The Single Exposure Leica, described in the first chapter, can also be used for making single negative tests. In addition to this camera there is a convenient single exposure film holder for use directly in the regular Leica camera.

Always keep accurate written records of exposures and notes about filters, diaphragm stops, illumination, etc., when copying. After each roll of film is developed, mark the perfect exposures in your record. Then after a number of rolls have been exposed and recorded a final master exposure table should be made for future reference.

Films Used in Copying

When selecting a film for copy work it is very important to have a thorough understanding about the various film emulsions and just what to expect from each one used. You may have attempted to copy a book page or an article from your daily newspaper with one of the fast panchromatic films and then wondered why the finished negative looked flat without much contrast after development. Or you may have copied an original photograph with a slow positive film and wondered why some of the shadows disappeared and became black blotches in the negative or final enlargement.

Films for copy work may be roughly divided into four main classes as follows:

1. Slow positive films.
2. Slow panchromatic films such as Micropan, Panatomic, Finopan, Perpantic.
3. Orthochromatic films.
4. Fast Panchromatic films.

Positive film is contrasty and has an extremely fine grain emulsion. This film obtains its name from the fact that it is used in the motion picture industry for making positive prints from original negatives for projection. Likewise this film is best for making positive prints for projection in the Leica projectors. As positive film is not sensitive to any color except blue and violet, it should not be used when copying colored objects when correction filters are to be used. Use Dupont Micropan for this purpose.

Use postive film for copying . . . printed matter such as books, newspapers, charts, maps, line drawings, and objects which may require extreme contrast in the final negative and enlargement. As positive film is not sensitive to red this color will not register and thus there will be a clear portion on the negative which prints black when enlarged. This film characteristic can be put to excellent use when copying maps with red and black lines, stamps printed in various red shades, or any other subjects where the red lines should appear black in the finished paper reproduction. As a filter is not required for this type of work, just use the positive film for making the negatives in the Leica, and make the exposures in the usual way.

Use the slow panchromatic films such as Micropan for copying . . . multi-colored printed matter, blue prints, or whenever correction filters are to be used for obtaining special effects or more contrasty results. For example a snappy black and white reproduction may be required from an old newspaper yellowed with age. How can we obtain the proper results? To do this simply use Micropan film with a number II or III yellow filter. In case still more contrast is required use a Wratten G or even a light red (A) filter.

When copying a miscellaneous collection of subjects which may require some color correction along with others which do not require any, Micropan film is recommended as the most practical film for all around use. This film can be used without filters for the ordinary black and white copying.

Use the orthochromatic films for copying . . . original photographs and objects where a better gradation of values must be secured in the final reproduction. The orthochromatic films are fine grained and are not as contrasty as the positive emulsions. In case positive film is not available it is possible to use one of the orthochromatic films for copying printed matter and secure pretty good results, provided a contrast developer is used. The Perutz Fine Grain Film is very good for this type of work while the Agfa Plenachrome, Gevaert Superchrome, and others can also be used.

Use the fast panchromatic films for copying . . . paintings, moving objects which require fast films, and any subjects which require color correction filters and short exposures at the same time. This film gives more latitude, or in other words there is more gradation of values between the highlights and shadows. This is of special value when copying paintings which require faithful reproduction of the delicate color gradations.

Developing Films in Copy Work

Copy films are developed according to the results required just as the proper film is selected for obtaining definite results. The usual technique which is fully explained in the chapter on developing applies equally well to the processing of copy films. The only important variation comes when developing the positive or the Micropan films where greater contrast is required and development can be prolonged if necessary.

After printed matter or similar subjects have been copied on positive film one of the developers to use in finishing the negative is the Eastman D-11 solution which is mixed as follows:

Contrast Developer (D-11)

Water (about 125° F. or 52° C.)	16	ounces	500	cc
Metol	15	grains	1	gram
Sodium Sulphite (desiccated)	2½	ounces	75	grams
Hydroquinone	130	grains	9	grams
Sodium Carbonate (monohydrated)	420	grains	29	grams
Potassium Bromide	73	grains	5	grams
Cold water to make	32	ounces	1	liter.

This formula used at 65° will give very good contrast in five minutes. When less contrast is desired, the developer should be diluted with an equal volume of water.

Development of the positive film should be carried out for the full time. If the negative becomes too dense during this developing time it means that too much exposure has been given when copying the original subject. Only the finest negatives result from perfect exposures and complete development. Of course one can watch the development of positive film under a red safelight and slightly underdevelop the film if it is seen that the exposures were too heavy. However the finished enlargements from such negatives will not have the snappy quality which can be secured by full development of a perfectly exposed negative.

In case extremely contrasty results are required on positive film a caustic developer such as the Eastman D-9 will produce the correct results.

This developer oxidizes quite rapidly and cannot be used over again after the first developing. Therefore it is best to make several short test strips or even single negatives of the copy material and develop in a small tray in order to determine the exact exposures before putting through the full Leica film roll. Two rolls of positive film can be wound into the Correx developing tank back to back and developed at one time if necessary, if the operator has sufficient skill in handling film in this manner.

Filters Used in Copying

For most copy work only two or three filters will be required. Even then a considerable amount of copying may be done without filters. The chapter on filters will give complete information; however a few examples where filters may be used with panchromatic films in copying may be tabulated as follows:

1. Wratten G filter . . . used for copying printed matter on yellowed paper in order to produce a clear black and white reproduction.
2. Yellow number II or III filters . . . when copying paintings to secure proper balance of color values in the black and white reproduction. Colored maps may require one of these filters to bring out the proper legibility. For example the names of cities may be printed in black over a light red or orange background. With ordinary positive film the color would turn dark and the contrast would not be sufficient. However, by using the yellow filter the background is kept lighter so that the names are readable, and yet there is a suggestion of the shaded area. In case the red background is to be eliminated entirely use one of the red filters.
3. Wrattan A (red) or similar filters . . . excellent for use when copying blue prints to make the blue background reproduce black on the final enlargement. Blue or violet typewriting reproduces black when the red filter is used. This filter may be used in many ways for securing special results. For example the red design of a postage stamp will disappear entirely when this filter is used, thus leaving a black surcharge in bold relief for special study.

The tri-color set of filters, Wratten A (red), B (green), and C5 (blue), is very useful for securing over corrected negatives when certain results are to be obtained. When the colored object is viewed through a filter it is possible to obtain some idea about the final result. The eye looks upon objects and determines the differences either by contrast in colors or contrast in dark and light. Naturally the reproduction of dark and light on the photographic film creates new difficulties, and it is sometimes better to over correct one color to get the proper contrast.

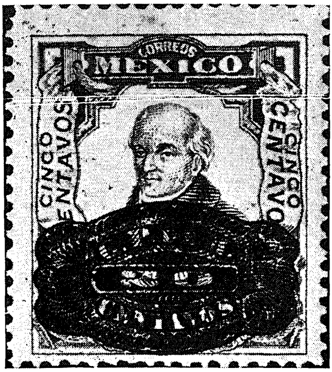


Fig. 162 Orange Stamp with Black Surcharge. . .Green Filter used to Give Better Black and White Contrast

Fig. 164 Genuine Stamp. Note the clear Design of this Stamp as Compared to the Forgery Shown in Fig. 167

Fig. 166 Detail of Forged Stamp. Note that the printing is not as Clear as the Genuine. The Second Ray to the Left of the Sprout Coming Out of the Ground is Farther Away from the Ground

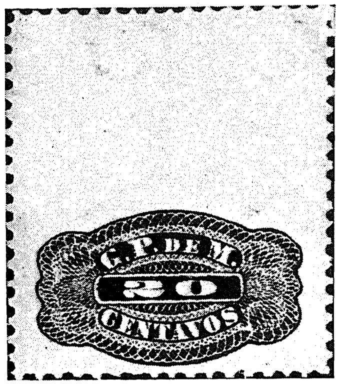


Fig. 163 Same Stamp as Fig. 162. Red (F) Filter Used to Absorb Orange Color of Original Stamp, Permitting only Black Surcharge to Register.

Fig. 165 Detail of Genuine Stamp. Note Clear Detail and Individual Parts which Differ From Forged Stamp Shown in Fig. 166. The Second Ray to the Left of the Sprout Almost Touches the Ground

Fig. 167 Forged Stamp. A recent attempt to copy original Latvia Stamp

Photographs made by Willard D. Morgan. . .using Focusing Copy Attachment with 3 cm Extension Tube for full size stamps and 9 cm tube for magnifications

A simple rule to follow when using the tri-color filters is to use the filter which absorbs the color which is to be reproduced as black. Thus if the green (B) filter is used for copying a map printed in red lines or red typewriting, the result will be black lines or typewritten letters on the white paper. In case a red filter was used the red typewriting would be entirely eliminated and only a white blank sheet of paper reproduced. There will be colored objects which require certain compromises when using filters to show contrast or gradation and detail as required.

The longer the focal length of the objective the more accurate the filter must be for copying. This is why the 50mm lens is excellent because of its short focal length.

While traveling or when working in libraries or similar places the complete equipment must be kept as light and portable as possible. For this use, the Collapsible Reproduction Stand is available. This apparatus consists of a number of tubes fitting into one another, two supporting base bars, and the extension arm for attaching the Leica or the Sliding Copy Attachment. As the upright is about 22 inches high the No. 2 and No. 3 supplementary front lenses can be used. The vertical and horizontal tubes have graduated scales in fractions of an inch.

When the Leica is used with the Front Lenses a plumb weight is used for determining the exact center of the object to be copied. Then by referring to the lens table booklet, which is supplied with the lenses, the exact focus and distance settings can be quickly made. A special light bracket containing two lights is also available for attaching to the extension arm of this outfit.

Fig. 168 Reproduction Stand Equipped with Sliding Arm, Illuminator, Leica with Wintu Angle View Finder, Measuring Tape, and Wire Cable Release. The Collapsible Stand is Smaller but a Similar Set-up can be made

Auxiliary Reproduction Devices

For certain types of close-up photography the Auxiliary Reproduction Attachments are of value. These attachments provide a fixed focusing arrangement which can be applied for special areas from 1 x 1½ inches up to 8½ x 12½ inches. **The Belun Device** is used with the Leica equipped with the Elmar 50mm lens for obtaining 1:1 or natural size copies. This same equipment is also available for the Summar 50mm lens and the Elmar 35mm lens. This equal-size reproduction device may be used for copying portions of maps, coins, postage stamps, finger prints, handwriting specimens, small insects, plants, seeds, and any other object which can be included in the 1 x 1½ inch area. The accompanying illustration will show how this attachment is set up.

The Behoo Device is used for obtaining reduction ratios of 1:1½, 1:2 and 1:3 with the Leica. The greatest sizes of the objects at the three different ratios are, 36 x 54mm, 48 x 72mm, and 72 x 108mm. As a complete direction booklet is available for this attachment as well as the other Auxiliary Copy Devices it will not be necessary to make a reprint. The Behoo Device uses three Extension Tubes for securing the three different fixed focusing positions. When the No. 2 and No. 3 Front Lenses are used there is an attachment known as the **Beooy** which covers areas from 3½ x 5 inches up to 8½ x 12½ inches. Still another similar attachment is known as the **Bazoo** which is a combination of the Behoo and the Beooy Devices. The accompanying illustrations will give a good idea about the way in which these copy attachments are set up.

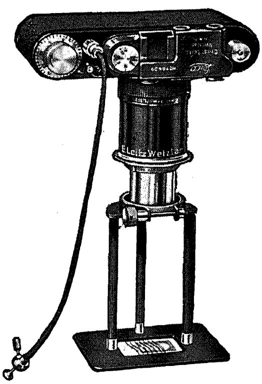


Fig. 169 The Belun 1:1 Copy Device used for Making Actual size Copies 1 x 1½ inches

Fig. 170 Auxiliary Reproduction Device for use with Extension Tubes and Front Lenses directly on camera

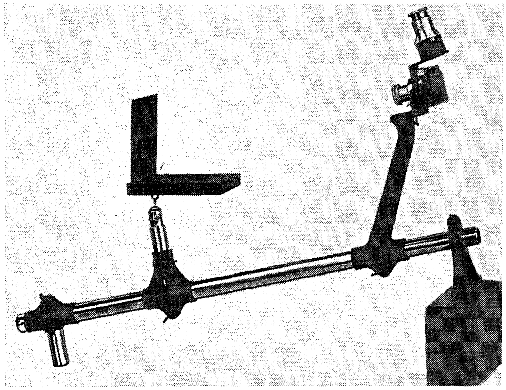


Fig. 171 The Shull Photo-Optical Bench Assembly. This optical bench is now available for small-object photography with miniature cameras. As the stage is mounted on a ball and socket joint the specimens to be copied can be adjusted for various positions. Manufactured by D. Paul Shull, Los Angeles, California

Special Rotating Copy Attachment

Still another type of copy attachment which has recently been made available is the Rotating Copy Attachment which serves the same purpose as the Sliding Focusing Copy Attachment already described. The Rotating Device, as shown in the illustrations, can be used for copying all areas similar to the Sliding Attachment. The booklet accompanying this Rotating Copy Device gives complete tables and directions for operation.

A very convenient attachment for the Rotating Copy Attachment is known as the Special Horseshoe Stand which can be used for photographing small objects such as minerals, medical specimens, art objects, photographs, or handwriting. This attachment (Fig. 172) has a magnification range from 1:1 to 1:4 and focusing may be secured by direct visual inspection of the ground glass or by using the calibrated upright. It will be noted that there are three engraved lines at the four different focusing positions on the upright. The top line in each case is for use with the Summar 50mm lens, the second line for the Elmar 50mm lens, and the bottom line for the Hektor 50mm lens. At the 1:1 position the picture area is the same size as the Leica negative or approximately 1 x 1½ inches, while at the 1:4 point the maximum area covered is 3 4/5 x 5 3/5 inches. When using the calibrate scale of the Special Horseshoe Stand it is necessary to use the intermediate rings recommended for this arrangement. Here again it is possible to obtain from the Leitz Company a complete

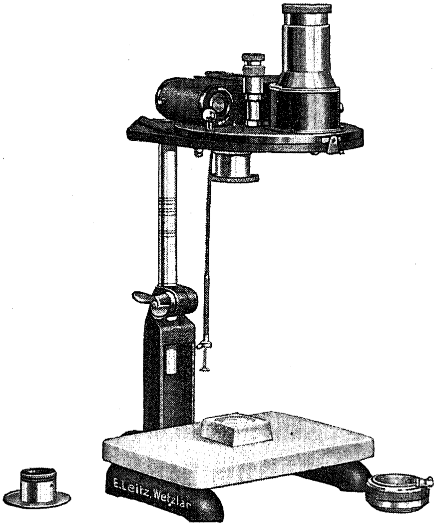


Fig. 172 Rotating Stage Copy Device. Note 5x Magnifier on Device and 30x Magnifier at Lower Left

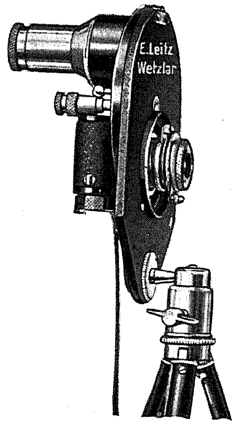


Fig. 173 Rotating Stage Copy Device as used in vertical position

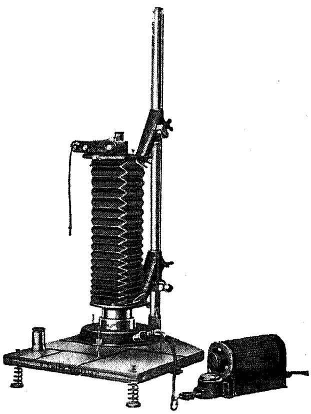


Fig. 174 Special Copy Device with bellows extension. Note Ring Illuminating Device used for Securing Proper Illumination of Specimens

direction booklet and also a special chart giving the exact areas covered with full information about intermediate tubes and the distances. There is a special Sliding Arm available enabling the Rotating Copy Attachment to be used in conjunction with the upright and baseboard of an enlarger, as in the case of the Fuldy Attachment.

When using the Special Rotating Copy Attachment it is possible to photograph objects 17 x 26 inches in size or minute objects only 1/10 x 3/20 inches in size. When a microscope is added as shown in Figure 176 one can obtain magnifications up to several thousand diameters. A brief summary of the basic equipment for the Special Rotating Attachment as shown in Figures 174 and 176 is listed as follows:

1. A 19 x 27 inch baseboard mounted on shock absorbing springs which can be clamped rigidly or left in free suspension.
2. An upper and lower copying arm which can be moved as required for focusing.
3. The upper arm is fitted with a clamping screw for holding the Rotating Copy Attachment while the lower arm holds the lens mount and the extension bellows.
4. A fine focusing ring is provided at the base of the lower arm.
5. The upright pillar is 4 feet high, and 1¼ inches thick.
6. A ring illuminator with rheostat provides the maximum of lighting efficiency.
7. The 5X and 30X magnifiers are used with this equipment in the same way as required for the Sliding Copy Attachment.

Fig. 175 Photo of Herbarium Sheet by Carl B. Wolf. An example to show the use of the Leica Copy Equipment in one particular photographic subject

250 Exposure Leica Model FF

When many photographs are to be made of book pages or other subjects the 250 exposure Leica is valuable as a time saver. This camera can be used on the regular Sliding Arm, on a tilting top tripod, or in connection with a special Sliding Copy Attachment. This camera can also be used conveniently with the microscope for making many photographs in rapid succession of still or moving objects.

Conclusion

As the subject of copying is such a broad one an entire book could easily be written in order to include the many interesting methods and applications. However this chapter will give the essentials from which the Leica user can select the information required for his own work.

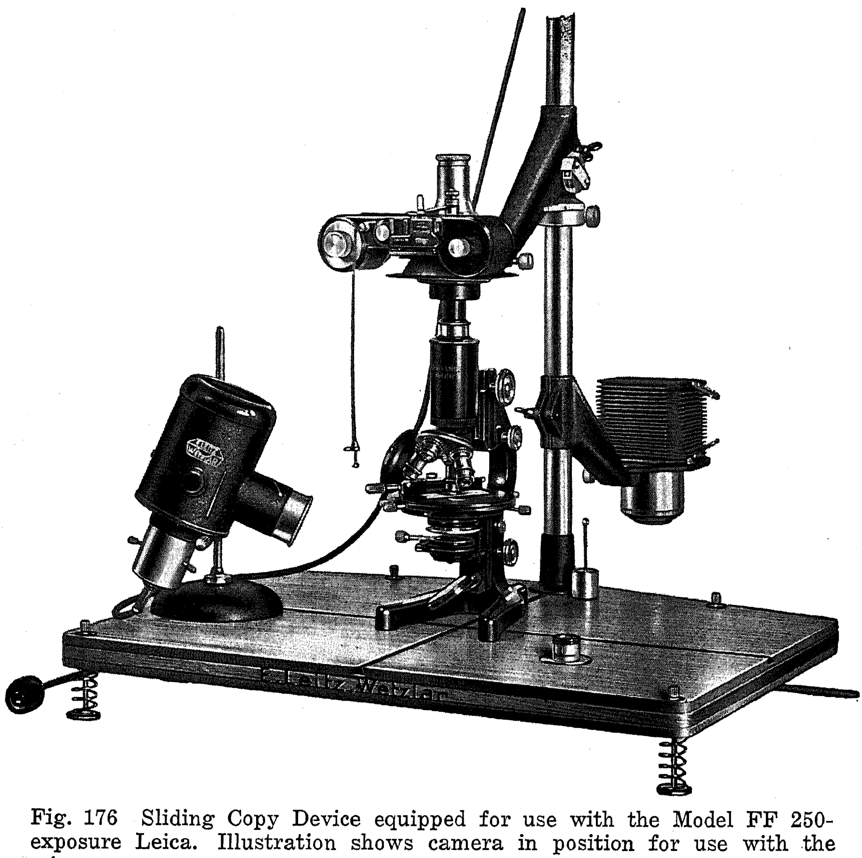
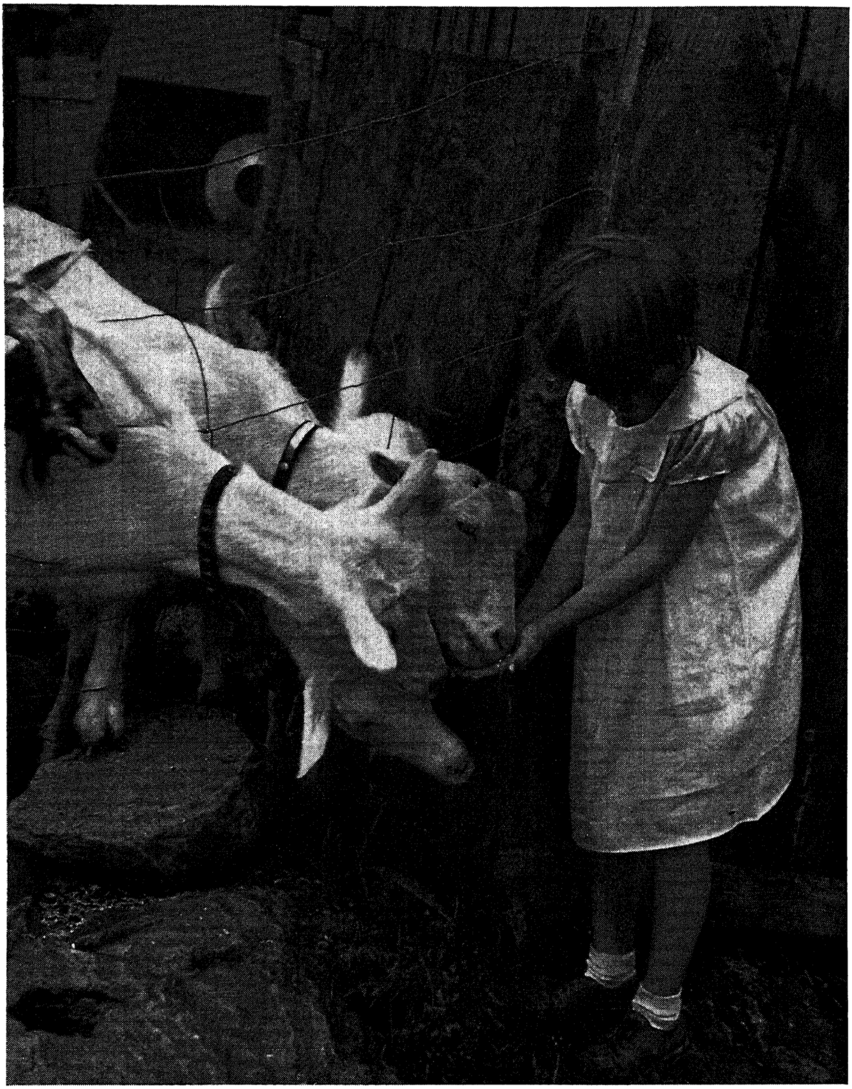


Fig. 176 Sliding Copy Device equipped for use with the Model FF 250-exposure Leica. Illustration shows camera in position for use with the microscope



Friends
Elmar 50mm lens, 1/40, f:9, Panatomic film

Rudolf Hoffmann

MAKING LEICA POSITIVES FOR PROJECTION

WILLARD D. MORGAN **CHAPTER 12**

Undoubtedly the best way in which to view Leica pictures is by projection upon a screen. In this way the projected image not only has a large area, but it also yields more of a plastic quality which closely resembles the original subject. Such pictures may be projected in full natural colors, in various tones, as well as the ordinary black and white film or glass slides. In these projected pictures, a large group of people may be able to enjoy the same picture at the same time. As most Leica pictures are made with shorter focal length lenses, the negatives produce positives which give an almost stereoscopic effect. This is due to the excellent depth of focus in the Leica lens. In contrast to the projected positive, the small 5 x 7 or 8 x 10 inch paper prints do not create the luminosity and brilliance which are to be found in the projected picture.

One reason why a greater use and appreciation of the projected image is not found is possibly because such pictures do not convey the full interpretation of the original negative. This may be due to the following:

1. The positive film or glass slide may lack contrast and brilliance.
2. The picture may not be composed properly on the slide or the original negative may not have a pleasing composition.
3. The positive may be overexposed and thus be too dark on the projected screen, or it may possibly be underprinted with the resulting loss of detail and depth.
4. The projected picture may have pin holes, dust spots, finger prints or other blemishes.
5. The center of interest may be lost in a maze of useless detail.
6. Possibly the positive may lack sharpness due to improper focusing or uneven pressure in the case of contact printing.

In many cases, an interesting Leica negative might be made into a slide for projection instead of viewing the same picture on an 8 x 10 inch enlargement. The projected picture presents a larger and more dramatic effect. At the same time, the film or glass positive emulsion has a greater latitude in the shadows and highlights of the image itself, as compared to the paper enlargement. This is due to the fact that there is a light illuminating the entire picture. In the projected image, even the blackest shadows have illuminated details, providing the positives have been properly made, while in the paper print there cannot be such transmitted luminosity.

What Makes Good Positives

Leica negatives can be prepared from many different subjects which later may be made up into film and glass slide sets. For example, these sets of positives may include pictures selected from your vacation, travels, photographs of children and pets, or, you may have sets illustrating your particular hobby by photographing the American scene, geological formations, architectural subjects, cartoons, wild-flowers, trees, insects and many other subjects which lend themselves readily to photographic interpretation. After illustrating such subjects, it is possible to use these pictures for lecture and visual education purposes, or for your own personal entertainment. In the case of film slides, these pictures may be printed in groups of twenty to forty on one strip of film. On the other hand, the 2 x 2 inch glass slides may be made individually and added to the sets at any time. There is something to be said for each method. The film slides are made more inexpensively while the glass slides are more permanent and may be re-arranged during projection. In addition to using the film and glass slides for general purposes, they are valuable in the commercial field for use in demonstrating sales methods, new products, as well as in training workers and salesmen.

The new Kodachrome film is excellent for commercial, educational, and for general subjects as well. This colorfilm produces a very satisfactory result when projected.

One of the most important advantages of making Leica pictures for projection is that these pictures require small storage space. For example, twenty-five rolls of positive film slides may easily be carried in a small container. These film rolls may include over 1,000 pictures. With positive film costing only two or three cents per foot, the film of 1,000 pictures would entail a cost of about $3.00, while 1,000 8 x 10 inch enlargements will probably come to over $60.00. A remarkable difference! Even the 2 x 2 inch glass slides are quite small and light in weight when compared to the standard 3¼ x 4 inch glass slides which are commonly used in the large projectors.

A thorough understanding of this chapter on the making of Leica positives, along with the contents of the chapter on Visual Education is essential. The two are closely related. In the same way, all the other chapters in this book are likewise allied, directly or indirectly, to the making of film positives. The making of the original Leica negative is just as important as the fine technique in the making of the final film or glass slide positive for projection. In other words, a poor Leica negative will not produce a superb Leica positive. On the other hand, an excellent Leica negative can very easily be made into a very poor positive unless proper steps in its preparation are carefully observed.

The Two Positive Printing Processes

There are two ways in which to make the Leica positive film or glass slides. The most common method is by actual contact printing which is accomplished by placing the Leica negative directly in contact with the unexposed positive film or glass plate. The other method is by placing the negative into one of the Leica enlargers and then printing directly by projection. Here again, there are advantages in both methods, the former possibly being completed a little more rapidly and at the same time requiring only a minimum amount of equipment, while in the case of projection, it is easier to omit portions of the image in case a negative must be balanced correctly in printing. The projection method helps in eliminating dust particles and also the best portions of the negatives may be utilized. Both of these methods will be described in detail later in the chapter.

Contact Positive Printers

The Eldia Film Printer represents one of the simplest arrangements for the contact printing of Leica negatives either upon paper or positive 35mm film strips. This printer will hold approximately eight feet of positive film. The raw stock is wound upon one spool and unwound upon another take-up spool after each contact print has been made. A ratchet clicks for each space of three-quarters of an inch which represents the single frame picture area. Two clicks of the ratchet represent the length of the Leica picture. The Eldia Printer is supplied with the standard frame size for the Leica negative. However, in case single frame negatives are to be printed, it is possible to secure a single frame window which is interchangeable on the Eldia Printer. The accompanying illustrations will give a more definite idea about the appearance of the printer.

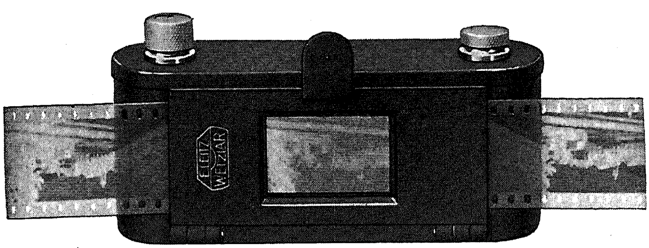


Fig. 178 Eldia Printer. For Making Contact prints on Positive Film or Paper

When using the Eldia Printer, it is possible to print each negative in its original sequence, or if necessary, important negatives only may be selected and printed upon the positive film stock, which is later developed and used in one of the projectors. In doing this, the negative is pulled past the window of the printer until the proper negative appears. The lid is then clamped into position and the exposure made. Do not wind the film when the top lid is closed or the film will become scratched.

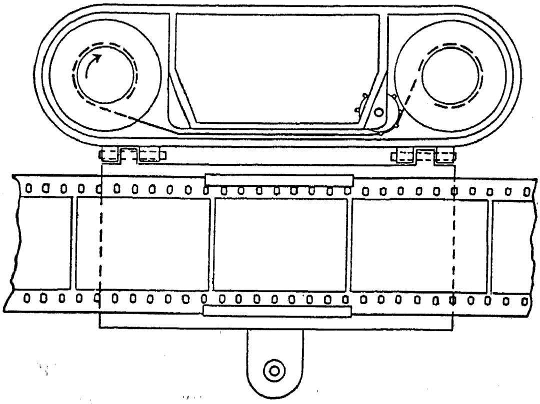


Fig. 179 Positive Film or Paper Passes over Ratchet Wheel and under Take-up Spool at Right. Negative Film Passes Through Channel of Hinged Cover

Mt. Hood, Oregon. (11225 feet)
Taken from 11,000 ft. elevation
E. D. Jorgensen

After a Day's Work.
A. Buchman

Fig. 180 Contact prints on paper are very attractive and should be prepared before making enlargements. Neatly arranged and numbered, they form an invaluable reference file and aid in subsequent composing of the picture, when enlarging.

Directions for Operating the Eldia Printer

Use standard safety base or non-inflammable positive film stock. This may be purchased in various lengths from any photographic dealer.

1. When loading the Eldia Printer cut off about five feet of positive film and wind it (emulsion side in) on the spool with the shorter knob.

The end of the film is tapered and inserted under the flat spring in the direction of the arrow, but the end of the tapered edge is not bent over.

2. After the film has been wound on the spool the end is tapered and inserted underneath the flat spring of the spool with the longer knob—emulsion side out. In this case the tapered end is bent over after being inserted under the spring. The two spools are now placed in the Eldia Printer as shown in the accompanying illustration (Fig. 179) the spool with the shorter knob in the chamber next to the ratchet wheel, and the take-up spool with the longer knob in the opposite chamber. The cover is then placed on the Eldia Printer and the film transported by turning the take-up spool in the direction of the arrow engraved on it.

3. Insert the Leica negative into the grooves which are to be found on each side of the glass plate in the cover of this printer, the emulsion side of the negative facing out. In other words, the emulsion side of the unexposed positive and the emulsion side of the Leica negative must come face to face in actual contact when the cover of the printer is closed.

4. After the printer has been closed, it is possible to judge the density of the negative by holding the printer over a small light box, or in case such a box is not available, hold the printer up in front of a low power light bulb for a few seconds in order to estimate the density of the negative through the red plate which is to be found at the base of the printer.

5. One of the easiest methods of exposing each successive negative when using this printer is by placing the apparatus under the Leica enlarger. In case the light in the Leica enlarger is too strong, one or two pieces of tissue paper may be placed in the position which would ordinarily be occupied by a negative for enlarging. This method provides better diffusion of the light. The projection lens in the enlarger should be thrown out of focus.

6. After one exposure has been made, unhook the cover of the Eldia Printer and pull the Leica negative to the next picture. At the same time turn the positive film until two clicks are heard in the case of Leica films.

7. Make the exposure, after the density of the negative has been determined by flashing on the small light under the printer. Proceed with this method until all the pictures have been printed.

8. **Make certain that the vertical and horizontal negatives are printed in the same way.** In other words, do not reverse the negatives so that the vertical or horizontal pictures show on the screen in different directions when projecting. Also, remember that if the first picture is to start at the beginning of the positive film, the print should be made in such a way as to show it at the beginning of the roll and not reversed, which may be the case if care is not utilized. Simply remember that the positive picture is placed into the projector upside-down with the emulsion side facing the projection lamp.

9. Before printing the full roll of Leica positives, it is best to make a few test exposures of various negatives with varying densities. To do this, cut up short two inch lengths of positive film and place directly into the printer so that the emulsion side will come into contact with the emulsion side of the negative when the cover of the printer is slipped shut. Develop each test film in exactly the same way the full length of positive film is to be developed. Three or four single exposure strips may be easily developed in a small tray for the full time required for the developer. After the test films have been cleared in the hypo, rinse for half a minute in water and then examine them by actual projection in the enlarger or, better yet, use one of the Leica projectors. The wet emulsion

will very quickly melt if exposed too long to the heat of the projector. Until you become an expert in judging the test exposures, it is always best to examine these test films by projection.

10. Make certain that the glass plate in the Eldia Printer is thoroughly cleaned and also keep the negative and positive film free from dust particles which may show on the finished positive film. Do not make more than 36 pictures on one length of film, if it is to be developed in a Reelo or Correx Tank.

11. After the completed strip of positive film has been exposed, development is carried out in the Correx or Reelo Tanks in a manner similar to that in which the Leica negative was developed. The only exception in the process is that the film is developed in a special developer which ordinarily takes about five minutes for complete development.

12. The Glass Developing Drum can also be used for developing the positive films. This drum is quite essential for developing the Leica Dufaycolor film also.

All positive films made for projection purposes should be thoroughly hardened after development. One of the simplest hardeners is Chrome Alum described in the Developing Chapter. After the film has been hardened, cleared in the acid fixing solution, washed, and then dried, it should be rolled up with the emulsion side out if it is to be used in the Umino or Umena projectors. If one of the Udimo projectors are to be used the film may be wound with the emulsion side in.

Making the Leica Glass Positive

Glass 2 x 2 inch positives may be made in the Eldur Glass Slide Printer very quickly by contact printing, as follows:

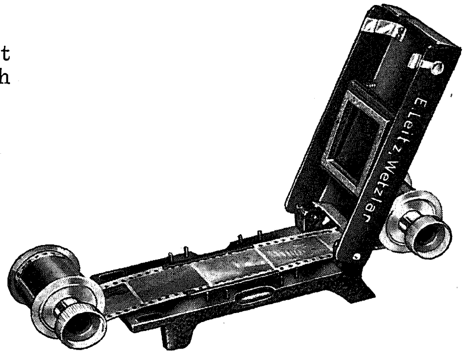
1. The method of inserting the Leica negative is shown in the accompanying illustration. The 2 x 2 inch glass plate is placed with the emulsion side down directly over the Leica negative. The top hinged pressure plate is then clamped down to hold the glass plate in contact during exposure.

2. The Eldur Printer is then placed under the enlarger and the exposure made by turning on the enlarger light for the correct exposure time, which may vary from 2 to 10 seconds, depending on the negative and the stop used in the enlarger lens. Always use the same illumination when making positives in order to help in making the exposure estimate more uniform. A test slide should be made first by turning on the enlarger light and then make four exposures of 2, 4, 6, and 8 seconds each on the same plate, by moving a card across at each step. When developed, the test slide may be projected and the best exposure quickly determined for the next slide. Sometimes it is more convenient and also less expensive to use a Bromide paper which has approximately the same speed as the plate for testing.

3. The glass slides are developed in the usual slide developer which is given in the same package in which the 2 x 2 inch glass slides come.

The Gevaert Company supplies the 2 x 2 inch glass slides in a medium as well as contrast grade. Barnet and Perutz slides may also be secured in the 2 x 2 inch size. When making glass slides, it is best to have both contrasts available, in order to obtain the best results from negatives which may be contrasty or flat. Usually, the contrast grade will be used. After exposing, developing and fixing the glass slide, it should be tested in the

Fig. 181 Special Eldur Contact Printer for Making 2 x 2 inch (50mm x 50mm) Glass Slides



projector for correct exposure and development. While still wet, it may safely be projected two or three seconds. After making thousands of glass slides, I still recommend that each slide be placed in the projector and flashed upon the screen for an instant since this is the only way in which the finest glass slides can be produced. If the light of the projector is flashed for only two or three seconds through the wet slide, there will be no effect upon the positive. However, if the wet plate is allowed to remain in the projector for a half minute or more, the emulsion will warm up and melt, thus ruining the slide. It is very easy to have the projector in the dark-room for this purpose. A small image projected upon a white cardboard is sufficient for determining the quality of the slide.

A good developer for use with the 2 x 2 inch glass slides is prepared as follows:

GEVAERT LANTERN SLIDE DEVELOPERS

	Soft working solution (for contrasty negatives)		Contrasty solution (for soft negatives)	
	Avoirdupois	Metric	Avoirdupois	Metric
Water (warm) ..	24 oz.	750.0 cc	24 oz.	750.0 cc
Metol	44 grains	3.0 grams	22 grains	1.5 grams
Hydroquinone ..	15 grains	1.0 gram	88 grains	6.0 grams
Sodium Sulphite (desiccated)...	292 grains	20.0 grams	366 grains	25.0 grams
Sodium Carbonate (monohydrated)	310 grains	21.0 grams	628 grains	43.0 grams
Potassium Bromide	15 grains	1.0 gram	15 grains	1.0 grams

All chemicals must be dissolved in the order named.

Lantern Slides should be developed for 1½ to 2½ minutes at 65°F. or 18°C.

Make certain that the exposure is such that the positive plate will remain in the developer for at least two and a half to three minutes without becoming overdeveloped. In case the image flashes up too soon and the plate is removed at the same time from the developer, the resulting positive will not have the rich transparency and brilliance which occurs when the plate is properly exposed and fully developed. **This is where many workers make a mistake.** Never underdevelop a positive but on the contrary, carry the development to the recommended length of time. Even a minute over this time will be better than a minute under. The Universal Developer described in the chapter on Enlarging Papers may also be used for positive films or glass slides.

Whenever more contrasting results are required on positive glass plates, it is necessary to use a contrast developer. The Eastman D-11 Developer produces good contrast, while the Eastman D-9 Caustic Developer produces extreme contrast. The D-9 Developer is particularly well suited for line work, where extreme contrast is desired.

Hydroquinone-Caustic D-9 Developer
For Process and Panchromatic Process Films and Glass Slides
For Tray Development

	Avoirdupois	Metric
Stock Solution A		
Water (about 125° F.) (52° C.)	**16 ounces**	**500.0 cc.**
Sodium Bisulphite	**¾ ounce**	**22.5 grams**
Hydroquinone	**¾ ounce**	**22.5 grams**
Potassium Bromide	**¾ ounce**	**22.5 grams**
Cold water to make	**32 ounces**	**1.0 liter**
Stock Solution B		
Cold water	**32 ounces**	**1.0 liter**
Sodium Hydroxide (Caustic Soda)	**1¾ ounces**	**52.5 grams**

Dissolve chemicals in order given.

Use equal parts of A and B and develop for not more than two minutes at 65° F. (18° C.).

Cold water should always be used when dissolving sodium hydroxide (caustic soda) as considerable heat is evolved. If hot water is used, the solution will spatter with violence and may cause serious burns if the alkali spatters on the hands or face. Solution A should be stirred thoroughly when the caustic alkali is added; otherwise the heavy caustic solution will sink to the bottom.

Wash thoroughly after development and before fixing to prevent stains and dichoric fog.

When using the D-9 Caustic Developer, mix a small amount in a small tray or dish which is only a little larger than the 2 x 2 inch glass plate. Use developer only sufficient to cover the plate. Upon mixing the two solutions, the developer oxidizes quite rapidly and after eight or ten minutes, at the most, the developer should be discarded. In the meantime, the slides may be developed. As this is a strong and rapidly working developer, make certain that the positive plates are not overexposed, since fine details in a line drawing or a printed page will not show distinctly unless correct exposure has been made. However, with the correct exposure and the caustic developer, a brilliant contrast negative will result.

Using Projection Paper for Testing

When making film or glass slides, it is possible to use a bromide projection paper cut into small sizes and used in place of the film or glass plate for testing the exposures. A paper, such as the Agfa Brovira medium, or contrast has a printing time very similar to positive film or glass plate emulsions. With a little experience, the proper ratio between the paper and the positive emulsions may be easily determined for this paper, as well as any other make of Bromide papers. Such a method of making tests is economical because a full glass plate does not have to be exposed in order to find out the correct exposure time. At the same time these contact paper prints may be used for indexing purposes or for cross references after the slides have been made. It is a good plan, in fact, to make a paper contact print of every negative which is made into a positive for projection. These paper prints are useful for classifying the pictures later. There is a special metal pressure plate which may be placed over the square rubber plate which is used in the Eldur Printer. This metal pressure plate permits the making of paper contact prints in the Eldur Printer. It is quickly removed when glass plates are to be made.

After each positive glass plate has been developed, it should be rinsed for a few seconds in fresh water and then placed in the hypo clearing solution for about eight to ten minutes. After clearing, the slide is then placed in running water and washed for one-half hour. When washing has been completed, wet a piece of cotton or use a wet

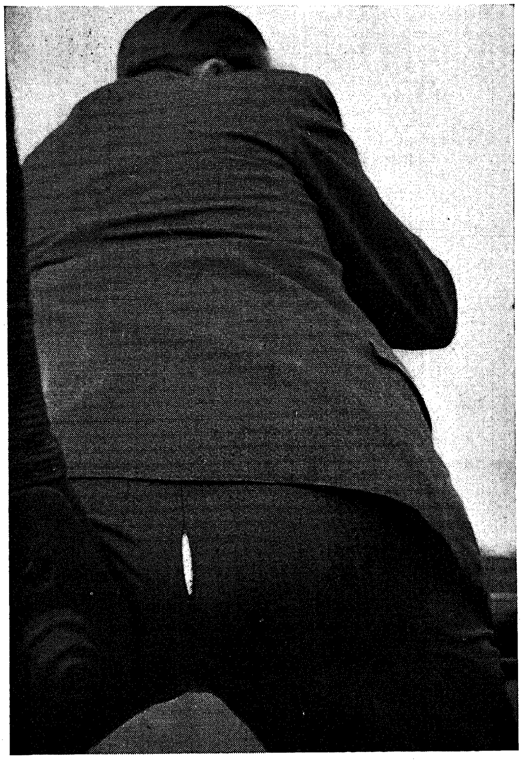


Fig. 182 Candid Photo of a Candid Camera Man by Willard D. Morgan
Summar 50mm, 1/60, f:9, Agfa Superpan

viscose sponge for swabbing off both sides of the plate which is then placed in a drying rack in a location free from dust. A close-meshed linen cloth may be laid over the drying rack in order to keep out dust particles which may settle on the wet emulsion of the plate and later show up on the projection screen.

When all the slides are dry, they should be projected before binding in order to check on the quality. In case there are scratches, pin holes or other defects, the slide must either be touched up or discarded. Small pin holes and breaks in the emulsion can usually be eliminated by spotting with a fine brush and black spotting ink. The Chinese Ink stick, which may be purchased at most photographic dealers, is very handy for this purpose. Some slides may require opaquing around the principal object. This is easily done by painting with a good opaque solution which dries quickly. Slides showing machinery parts, and copies of irregular subjects which are to be shown without a background, will require this method of opaquing before binding.

Mounting the Finished Glass Slide

After the glass slide is dry, secure a clear cover plate together with a cut out mask and a package of lantern slide binding tape. The binding tape can be cut into four lengths of two inches each, or if preferred, one full length about eight and one-half inches long may be cut. Place the cut out paper mask over the emulsion side of the positive in such a way that the clear portions of the positive surrounding the picture are covered. Next, place the clear cover glass, which has previously been washed and polished dry, over the mat and the positive plate. Hold both plates together and paste the paper binding tape around the edges. **Make sure that the emulsion side of the positive plate is always covered by the glass plate.** If the emulsion side is on the outside, it will quickly be damaged.

Film positives may be cut with scissors and bound between glass plates if desired. Some Leica users prefer this method since the pictures may be made at smaller expense. Two or three positives may be made of the same negative in case there is any doubt about the exposure. The best positive is then selected for binding between the two clear glass plates with the paper mask between. The film positive should be attached to the paper mask by one or two small pieces of the paper binding tape in order to keep the picture centered while binding. This method is especially recommended for the natural color films, such as the Agfacolor, Dufaycolor and Kodachrome.

After the glass slide is bound, it should be spotted by placing a small white square of gummed paper or photo cloth in the upper right corner of the slide when it is in its correct position for projecting. In other words, hold the slide before you so that it looks correct. That is, the slide should appear in the same orientation as the original subject. Then, turn the slide so that the subject is up-side-down with the emulsion side facing toward you. Place white spot on the upper right corner of the slide. When the slides are being projected, it is very easy to place them in the projector in their proper position without difficulty, simply by watching the reference spot.

All glass slides spoiled by wrong exposure, developing, or any other cause, should be saved and used for cover glasses later. These discarded slides may be soaked in hot water and strong soap in order to soften and remove the emulsion. A razor blade is good for scraping off the emulsion. Give the glasses a final wash in another soap and water bath and then wipe thoroughly dry with a clean linen cloth. The glasses are now ready for use in binding the good lantern slides.

Still another method of preparing film positives for projection is by mounting three positive films between two clear glass plates which measure 35 x 120mm. These plates are matted and bound, similar to the 2 x 2 inch glass plates. The Udimo Projectors have a special slide holder for accommodating this longer sized plate. In the case of stereo positives, this method of binding is excellent as the Stereo Viewer accommodates the 35 x 120mm slide.

Making Film or Glass Slides by Projection

My favorite method of making film or glass slides is by using one of the Leica enlargers. The negative is placed in the enlarger with the emulsion side facing down as usual, while the unexposed film or glass plate is placed on the baseboard after exact focus has been obtained on another focusing plate. When unexposed positive film is used in the Eldia Printer, the top plate of the printer is clamped shut as usual. However, the picture is projected through the glass plate upon the positive film. Before making the exposure, focus the negative upon

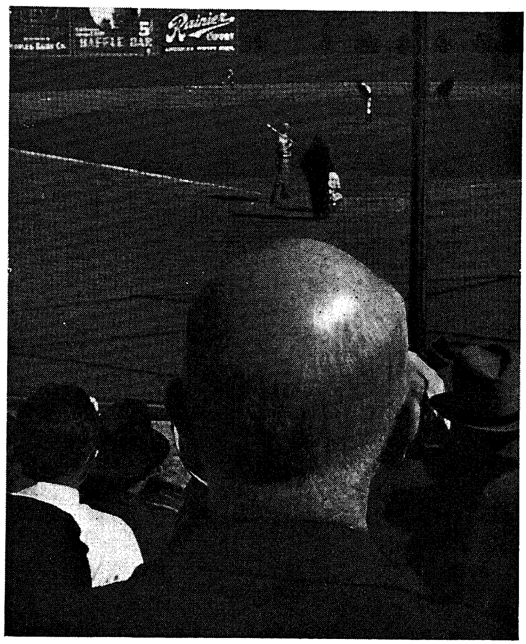


Fig. 183 Baseball Fan
John Shortridge
Elmar 50mm, 1/40, f:18, Super-X

a white area the exact size of the Leica negative and also in the exact plane of the film in the printer. A block of wood may be cut for this purpose or two printers may be used.

Film positives may also be made by using the Leica camera loaded with positive film without a lens. The picture is focused from the enlarger directly into the camera after the focal plane shutter has been set at time exposure. Once the correct focus and position have been determined, the entire strip of film may be exposed. A thin block of wood 3½mm thick (the exact thickness between the back of the Leica and the face of the pressure plate) may be used for focusing the image before the camera is placed into position. The face of the wood should be painted white and the exact frame size of the picture ruled off in black crayon for a guide when focusing.

A single frame 18 x 24mm film positive may be made by reduction from the Leica size 24 x 36mm negative. The Eldia Printer equipped with a single masking window may be used for this purpose. The Leica Enlarger is equipped with a 6cm extension tube between the 50mm lens and the focusing mount. In this way, it is easy to reduce the Leica negative to single frame size. All Leica projectors can be equipped for single frame as well as double frame projection. As there are many projectors available for single frame pictures only, this method of making positives will naturally be of great value for such projectors.

When using the 2 x 2 inch glass plates, it is simpler to place one of the undeveloped plates on the paper easel of the enlarger. The plate may be pushed into the corner of the easel in such a way that a second plate may be replaced after the image has been centered on the focusing plate which contains a penciled outline 1 x 1½ inches in size, representing the size of the Leica negative. If preferred, the picture area may be made 3 x 4cm in size and later the picture masked off by using the short strips of lantern slide binding tape. This 3 x 4cm size can be projected only in the Udimo projectors.

An orange filter is convenient to use while making glass slides. Such a filter may be thrown across the projected negative image in order to make certain that the unexposed glass plate is properly centered before the exposure is made.

The important part of the Leica negative is easily centered upon the glass plate. All unessential parts of the negative are eliminated because the projected picture may be made larger or smaller in order to eliminate certain parts of the negative. At the same time, it is not difficult to shade part of the picture during exposure in order to bring out certain parts of the positive, such as, a dense sky, or possibly some other portion of the negative may have a strong highlight which should be printed longer. In fact the projection method of making glass slide positives is the ideal way in order to insure the best results.

In some cases it is necessary to make 3¼ x 4 inch standard lantern slides for use in the larger projectors. Such slides are made by using the Leica enlarger and following similar methods which apply to the smaller 2 x 2 inch glass slides. If the original Leica negative is developed properly, it is possible to make 3¼ x 4 inch glass slides which will produce beauty and brilliance equal to slides made from larger negatives when projected.

When using the Valoy or Focomat enlargers for making film or glass positives, it is necessary to use either a 3cm or 6cm extension tube between the 50mm lens and the focusing mount of the enlarger. When the 3cm tube is used, keep the lens barrel pulled out and locked in position. However, in case the 6cm tube is used the lens barrel may be pushed in as far as it will go. The correct focus is obtained by turning the focusing mount of the enlarger. Naturally, other extension tubes or any combination of tubes may be used depending upon the results required. In case a longer working distance is required between the lens and the positive, a 6cm tube and the 90mm Elmar lens may be used very successfully.

Fig. 184 Kopat Combination Printer. A complete Unit Easily Convertible for Contact Printing on Paper, Paper Strips, Film or Glass Slides

Operating the Combination Professional Printer

When a more universal positive printing outfit is required, the Kopat Combination Printer is recommended. The important features of this printer are listed as follows:

1. Single frame and double frame film slides may be made.

2. Single frame, Leica size double frame, 3 x 4cm and 4 x 4cm glass plate positives may be made by using a supplementary plate printing attachment.
3. All metal construction, with enclosed lamp housing, containing a 15-watt bulb for making the exposures.
4. Rheostat control for varying light intensity.
5. A small red light burns continually in the lamp housing in order to show the proper exposure, or density of each negative.
6. Contact button for turning on the white light for making the exposure.
7. Slots on each side of the printer permit the insertion of a thin piece of cardboard for use in shading parts of negatives during the exposure.
8. Film housing will hold up to 35 feet of positive film. The exposed film may be cut off and developed as used.
9. On each side of the glass plate, under the negative, there is a small line drawing, showing which way the negatives should be printed in order to appear in the finished positive film roll in the proper upright or horizontal positions.
10. When the positive film chamber is moved out of position, a metal plate automatically covers the exposed portion of the positive film. **Naturally the printing should be done under a red safety light in the darkroom.**

The positive film is loaded into the Kopat Printer by removing the top portion of the film housing and rolling the film directly upon the spool opposite to the ratchet spool, similar to the one in the Eldia

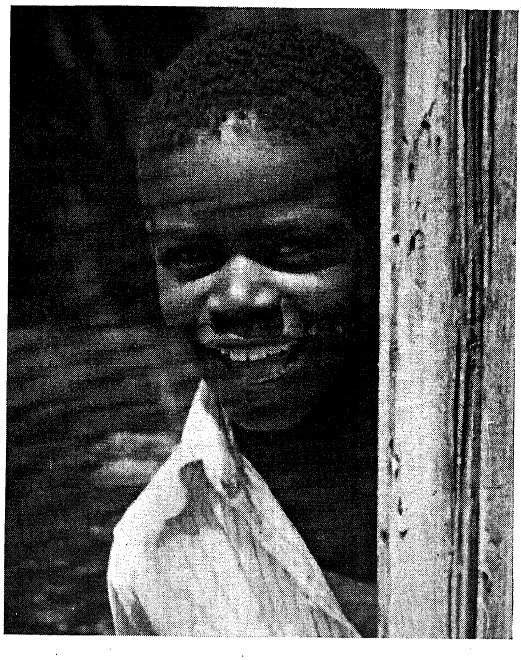


Fig. 185 Hello
Herbert H. Schoenlank
Summar 50mm, 1/60, f:9,
Agfa Superpan Film

Printer. Make certain that the film is wound with the emulsion side out when loading and attach the free end to the take-up spool which is wound in such a way that the film emulsion will be on the inside. In other words, the film passes over the ratchet wheel and down under the take-up spool. As the film is advanced, a distinct click will be heard for each single frame space. Two of these clicks represent the length of a Leica negative. After the film has been inserted, place the upper part of the housing back into position.

The making of film and glass slides by contact printing is carried out by methods similar to those previously explained.

In using either the film slide attachment or the glass slide attachment on the Kopat Printer, it is possible to see picture numbers or special marks which may be made on the film margins for reference when selecting the proper negative for making the positive printing.

Using the Belun Attachment

Still another method of making positives is by using the Belun 1:1 copy attachment. For this set-up secure a light box for illuminating the negative which is to be copied directly upon the positive film which has been loaded into the Leica camera. A 15-watt bulb will be sufficient for illumination. Set the Belun copy attachment over each negative to be copied and make the exposures. A few test exposures should be made before running through the entire film. A short length of positive film may be loaded into the camera for making the test shots. By using the Belun attachment sections of larger negatives can be copied and made into positive film slides for projection also. Then by using the Sliding Focusing Copy Attachment any sized negative can be copied for positive film slides.

Fig. 186 Indian Children

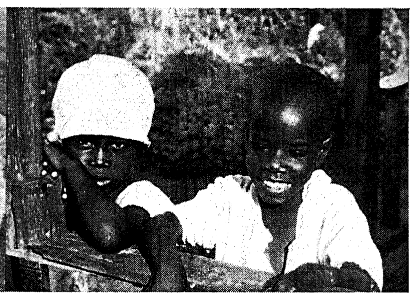
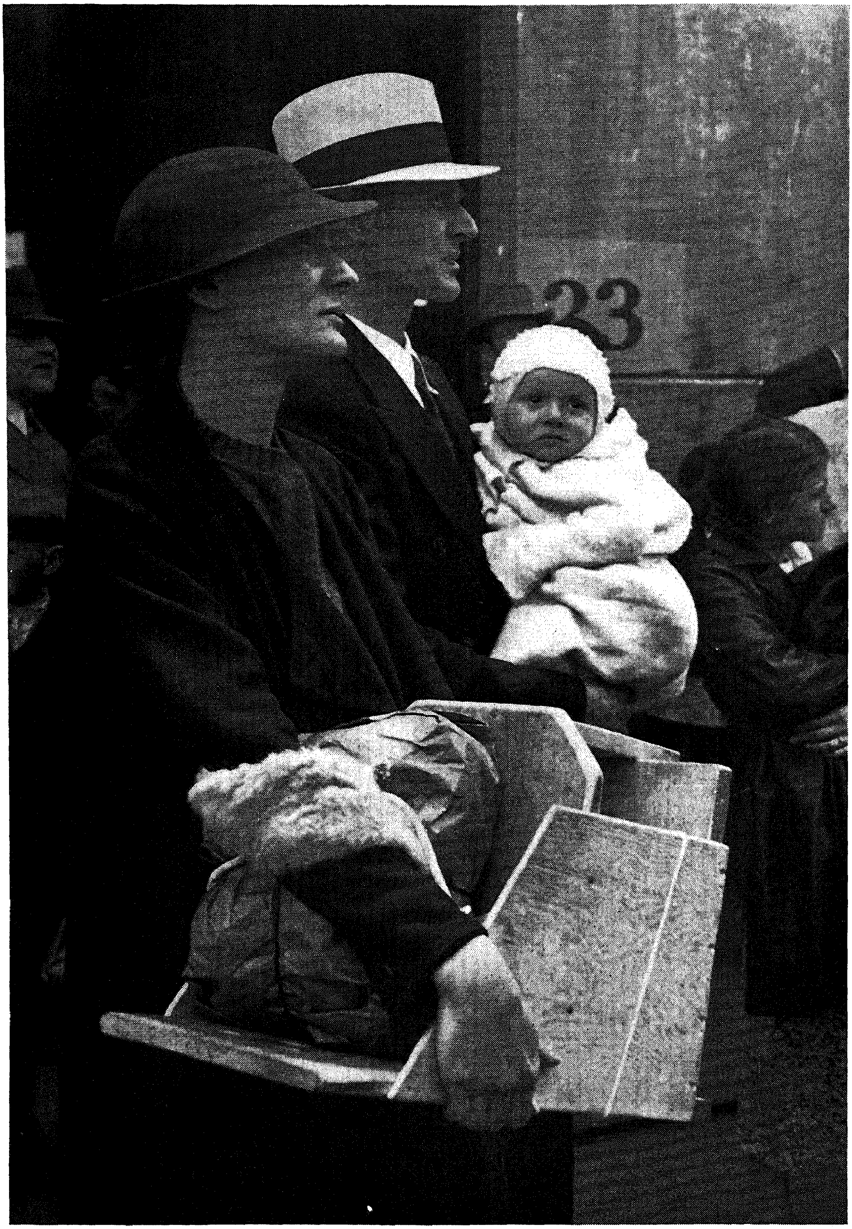


Fig. 187 Negro Children



Resettled to Alaska — Peter Stackpole

Elmar 50mm, 1/60, f:6.3, Panatomic Film

PROJECTING LEICA PICTURES

WILLARD D. MORGAN

CHAPTER 13

After the positive film or glass slide has been made, the next step is to show the finished pictures on a projection screen. In doing this, it is necessary to select one of the projectors described later in this chapter.

By projecting Leica pictures you have an opportunity to show one picture to a group of friends who may be assembled for the occasion. In this way, all can be united in viewing one picture at a time and also in talking about each picture as it is shown. Thus, a very profitable half hour or an entire evening may be spent. Each picture is thus presented in its fullest advantages of large size and with its three dimensional effects which come nearest to interpreting the original scene.

In the field of visual education and industrial selling, the use of positive pictures for projection is of immense value. In the industrial sales field, for example, it is possible to use the Leica Camera to photograph actual manufacturing processes and later arrange these pictures in slide form for projection. For example, there is a large industrial firm which uses the Leica Camera very successfully by collecting the latest developments and uses for their product from different state managers. These pictures are then assembled and printed along with appropriate titles on film strips. The duplicate strips are later mailed out to the various branches for the regular sales meeting of the district salesmen. Thus each district is kept in constant touch with all the developments throughout the country.

The Various Projectors Available

There are seven different Leica projectors available for showing Leica positives. These projectors range from the small Umino projector to the large 750-watt Udimo projector. In selecting the proper equipment for your purpose, it is important to consider the various specifications of each projector. Two of the most generally used projectors are, the small miniature Umena Projector, and the Udimo-100 Projector. The VIII-S (250-watt), Udimo-400, and the Udimo-

750 projectors are of special value for use in projecting natural color pictures and also for use in larger rooms where a longer projection distance is required.

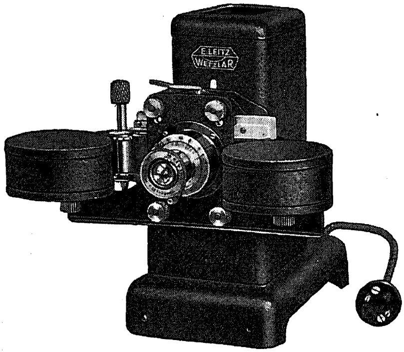


Fig. 189 Udimo—100 Projector, Shown Complete with Camera Lens, Film Magazines and Transport Gate

The Udimo 100 Projector

The Udimo-100 Projector is considered to be the standard model projector which is used by many Leica owners. The specifications and directions for using this projector are given as follows:

1. Height, 9½ inches, width of base, 5 inches, length of base, 7½ inches.
2. Bayonet socket for holding 100-watt prefocused projection bulb.
3. Detachable heat absorption screen. When glass slides are being projected, this heat filter may be removed, thus slightly increasing the brightness of the screen picture.
4. The condenser of this projector is made up of three elements, the front element being interchangeable for use with lenses of various focal lengths. This system insures the full illumination of every picture projected with the various lenses providing the proper front condenser is in position. Complete information about the interchangeable condensers is given later.
5. The top cover plate of the projector housing may be removed when the tubular projection lamp is to be changed. When removing the lamp, simply pull directly out of the socket. When placing a new lamp in position, make certain that the filaments are parallel with the condenser system.
6. The entire lamp mounting may be removed by turning the projector up-side-down and removing the three large screws which hold the bottom plate in position. In case the central lamp housing is out of alignment, proper centering may be done by adjusting the set screws on the base plate.
7. The intensity of the projected positive is increased by means of a mirror reflector mounted at the rear of the projection lamp.
8. The film slide attachment which is mounted on the front part of the projector may be rotated in order to show horizontal and vertical pictures in their proper orientation. There is a small spring catch mounted just above the revolving attachment. This catch may be re-

leased when the attachment is changed to a vertical or horizontal position.

9. The various slide masks may be used for showing film or glass slide positives in various sizes, from single frames up to 4 x 4cm. All these masks and slides are quickly interchangeable in the film or glass slide attachment which is mounted in front of the projector and secured into position with four knurled knobs.

10. All the Leica lenses with the exception of the 28mm and 35mm wide angle lenses may be used with the projector as well as the VIII-S, Udimo-400, and Udimo-750 projectors. There are also two special 80mm and 120mm projection lenses available for the Udimo-100 projector. A special base tube or receiving socket is used with the 80mm and 120mm projection lenses for attaching to the projector. All the Leica lenses are screwed into the film or glass slide attachment directly without the use of any intermediate tubes.

11. When loading the positive film slide into the Udimo film slide attachment, proceed as follows:
    a. While facing the projector from the front, remove the left film drum and draw out the film transporting gate. Make certain that this gate is thoroughly cleaned. The front plate may be removed by lifting out from under the two springs which hold it into place. At the same time, the lower glass plate may be slid to one side and removed by slightly raising the spring band which will be seen along the top side of the film gate. This plate may be replaced by a plate with single frame window in case single frame slides are to be used. Otherwise, clean the original plate and place it back in position along with the film transport gate.
    b. When replacing the film transport gate, push it into its slideway as far as it will go. While facing projector, this gate is pushed into position from the left side, the same side through which the positive film strips are started.
    c. Replace the left film housing and insert the positive film roll into this housing with the beginning of the roll projecting through the guide which opens directly into the film sliding gate and is transported through this gate by turning the ratchet wheel.
    d. The turning knob of this ratchet wheel must be pressed down each time the film is transported, otherwise, the film will not turn. After the film has been transported, raise the turning knob. In doing this, the glass pressure plate automatically presses against the film and holds it in a perfect plane during the projecting. When the turning knob is depressed, this glass plate automatically separates at the same time the film is being transported. This precaution prevents any possible scratching of the film.
    e. As the film is turned through the transport gate, it automatically enters the opposite film chamber on the right and winds into this chamber.
    f. Start the positive film through the transporting device with the emulsion side facing the projection bulb, being sure that the horizontal images of the film are inverted or upside down.

12. The Glass Slide Changer as illustrated is excellent for use when showing the 2 x 2 inch glass slides in the Udimo Projectors. This Slide Changer may be used in the special glass slide holder, or it may be used in the Film Slide Attachment after the two film drums and film gate have been removed.

Interchangeable Condensers for Udimo Projectors

a. **Interchangeable Condenser** marked "5" for use with Summar, Hektor and Elmar 50mm lenses for use with Udimo-100 projector only.

b. **Interchangeable Condenser** marked 5cm VIII K for use with Summar, Hektor and Elmar 50mm lenses for use with Udimo-400 and 750 projectors only.

c. **Interchangeable Condenser** marked "7.3-8-9" for use with Leica lenses Hektor 73mm, Elmar 90mm and projection lens Milar 80mm.

d. **Interchangeable Condenser** marked "10.5-12-13.5-15" for use with Leica lenses Elmar 105mm, Elmar and Hektor 135mm and projection lenses Dimax 120mm and 150mm.

e. **Interchangeable Condenser** marked "20-25" for use with projection lenses Dimax 200mm and 250mm.

Projection Lenses for Udimo Projectors

Milar 80mm, can be used with all Udimo projectors and must be used in conjunction with a special Base Tube.

Dimax 120mm, can be used with all Udimo projectors and must be used in conjunction with a special Base Tube.

Dimax 150mm, made for use with the Udimo-400 in conjunction with regular film and glass slide attachments.

Dimax 150mm, (special type) made for use with the Udimo-400 and 750 projectors in conjunction with special film and glass slide attachments which have attached base tube.

Dimax 200mm, for use with the Udimo-400 and 750 projectors in conjunction with the special film and glass slide attachments.

Dimax 250mm, for use with the Udimo-750 in conjunction with the special film and glass slide attachments.

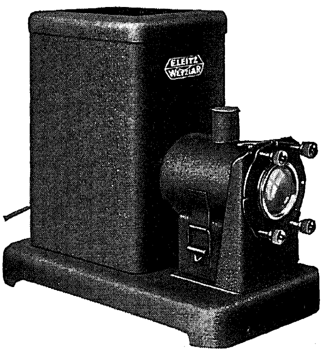


Fig. 190 Udimo - 400 Projector. Illustration Shows Lamp Housing Only

All the film and glass slide attachments are interchangeable for use on the Udimo-100, Udimo-400 and Udimo-750 projectors. There are special film and glass slide attachments, provided with a base tube, which are used in conjunction with the special Dimax 150mm and the Dimax 200mm and 250mm projection lenses. The main differences in these projectors are in the lamp housing. 100, 400 and 750-watt projection bulbs are used respectively in each Udimo Projector. The height of the Udimo-400 Projector is 12½ inches, while the width of the base is 7½ inches and the length 13½ inches. The Udimo-400 as well as Udimo-750 Projectors are equipped with a special water cooling jacket which should be filled with distilled water or glycerine before using.

A special Elevator Plate may be attached to any of the Udimo Projectors. There are two small threaded holes in the base at the front of each projector for attaching the Elevator Plate. This Elevator Plate may be attached to the base of either projector and set at the proper position so that the projected picture is perfectly centered on the projection screen . The film and glass slide attachments are all interchangeable for the various projectors.

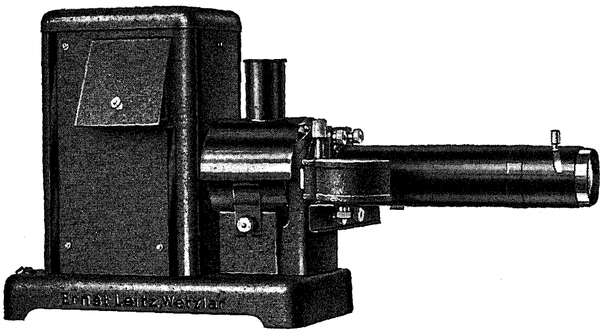


Fig. 191 Udimo-750 Projector complete with 250mm projection lens and special film transporting device which accommodates film lengths up to 50 feet

The Udimo-750 Projector

The Udimo-750 Projector is really a universal projector which can be used for screen distances between 10 and 100 feet or more. All the Leica lenses with the exception of the 28mm and the 35mm can be used with this 750-watt projector. In addition, there are the 80, 120, 150, 200, and 250mm projection lenses to select from. The high light intensity makes it possible to project color pictures upon a large screen and still retain the brilliance required.

The Udimo-750 has a special heat filter and water jacket cooling chamber to prevent the overheating of positive films during projection. All the interchangeable accessories used with the other Udimo projectors may also be used with the Udimo-750. A special film attachment may be used which accommodates all film lengths up to 50 feet.

Table showing screen areas for various projection lenses.

Lens	Screen Distance and Screen Areas in Feet: 6 ft.	9 ft.	12 ft.	15 ft.	18 ft.	21 ft.	24 ft.
Elmar f:3.5 50m ...... / Summar f:2 50mm..... / Hektor f:2.5 50m	2.7×3.9	3.9×6	5.4×8.1				
Hektor f:1.9 73m......		3×4.5	3.9×5.7	4.8×7.2	6×9		
Elmar f:4 90mm		2.4×3.6	3×4.5	3.9×5.7	4.5×6.6	5.4×8.1	
Elmar f:6.3 105mm....			2.7×3.9	3.3×5.1	4.2×6.3	4.8×7.2	5.4×8.1
Elmar f:4.5 135mm....			2×3	2.4×3.6	3×4.5	3.6×5.4	4.2×6.3
Milar 80mm		2.7×3.9	3.6×5.4	4.2×6.3	5.4×8.1	6.3×9.5	7.2×10.8
Dimax 120mm			2.4×3.6	3.7×4.2	3.6×5.4	4.2×6.3	4.8×7.2

	35 ft	60 ft.	80 ft.	100 ft.
Dimax 150mm	6×9	10 ×14½		
Dimax 200mm		7½×11¼	10×14½	
Dimax 250mm		6 × 9	8×12	10×14½

The VIII-S Projector

This projector replaces the Udimo-250. It is also a 250-watt model. In general construction it resembles the Udimo projectors but embodies many new features, which are as follows:

1. There are external adjustments enabling the lamp to be moved from side to side or forward and backward so that it can be placed in correct optical alignment.
2. To further insure maximum illumination, the lens carrier (which also supports the film or glass slide gates) can be changed in its position relative to the lamphouse, and is adjusted according to the focal length of the lens employed.

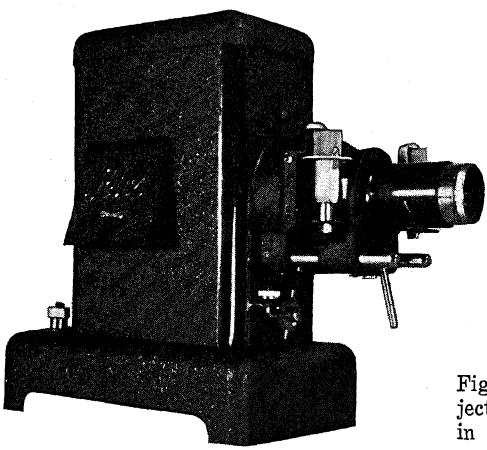


Fig. 192 The VIII-S Projector with Film Attachment in Place

3. There are three internal condensers (Nos. 1, 2 and 3) which are mounted separately and are removable, providing more efficient ventilation. Condensers Nos. 2 and 3 are used with 50mm lenses and condensers Nos. 1 and 2 are employed for lenses of greater focal length. As with the Udimo projectors, various external Interchangeable Condensers are supplied for use with lenses of different focal length.
4. It contains a built-in tilting device. Turning a screw to the left or right raises or lowers the projector housing.
5. A new type of film gate is employed. The film is clipped to spools. When the entire roll has been projected it is merely slipped off the take-up spool. The pressure plates open by pulling back a bar on top of the gate. The film is slipped on and the gate closed. The film is transported by turning the spools. Over the latter lay bars which are pressed forward when turning the spool. This action causes the pressure plates to separate, preventing scratching.

Fig. 193 The VIII-S 250-Watt Projector with Glass Slide Attachment in Place

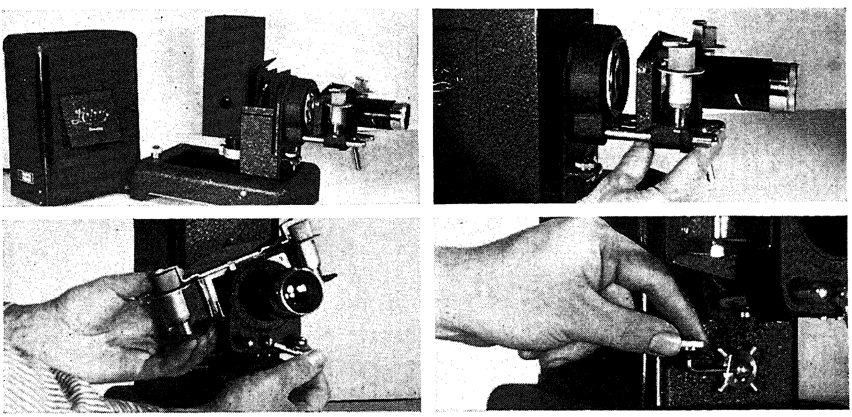


Fig. 194 Photos showing the various parts and adjustments of the VIII-S Projector as described in text

6. To interchange gates it is but necessary to turn a lever, enabling the gate on the projector to be lifted off and another gate put in its place.

The VIII-S projector can be used with Leica lenses, and the following projection lenses are supplied for it:

Hektor	f:2.5,	85mm
Epis	f:3.6,	80mm
Dimax	f:4.5,	120mm
Dimar	f:3.5,	150mm
Dimar	f:4,	200mm

Another new projector is the **Standard Projector,** which is basically a Udimo-100 but is provided with a built-in gate for 50 x 50mm glass slides and therefore can only be used for the latter. It has a non-interchangeable condenser front and can be used only with 50mm Leica lenses.

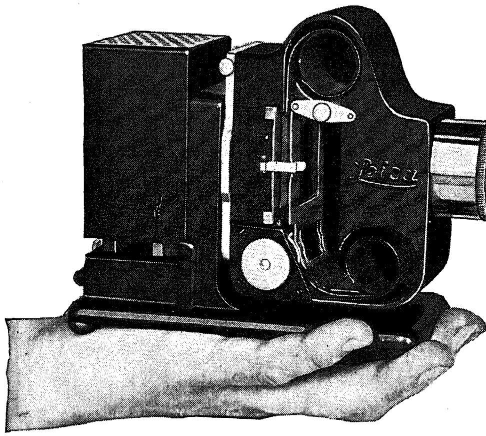


Fig. 195 The Umino (50 watt) or Umena (100 watt) Miniature Projector for Single and Double Frame Film Slides as Glass Lantern Slides

The Umino and Umena Miniature Projector

One of the simplest and most compact projectors available for showing Leica film or glass positives is known as the Umino Projector which contains a 50-watt projection bulb. This projector is so small that it can easily be carried in a brief case along with a supply of positive film or slides.

Titles for Film

Whenever possible, try to include printed titles in your film strips. A few titles scattered through a film strip will give added interest as well as information to the people who are viewing pictures. The strip can start with a special title and short description about what the pictures will cover. Titles are easily made by using one of the copy attachments referred to in the chapter on Copying with the Leica Camera. Boards containing movable letters are available for setting up titles.

UMINO AND UMENA PROJECTION TABLE

Distance in feet between Umino or Umena and projection screen	Screen Image Leica size	Screen Image single frame size
6	2 ft. 5 in. x 1 ft. 7 in.	1 ft. 7 in. x 1 ft. 3 in.
9	3 ft. 7 in. x 2 ft. 3 in.	2 ft. 3 in. x 1 ft. 8 in.
12	4 ft. 10 in. x 3 ft. 2 in.	3 ft. 2 in. x 2 ft. 5 in.
15	6 ft. x 3 ft. 10 in.	3 ft. 10 in. x 3 ft.
18	7 ft. 2 in. x 4 ft. 8 in.	4 ft. 8 in. x 3 ft. 6 in.
21	8 ft. 4 in. x 5 ft. 6 in.	5 ft. 6 in. x 4 ft. 2 in.
24	9 ft. 6 in. x 6 ft. 3 in.	6 ft. 3 in. x 4 ft. 8 in.

If a title board cannot be secured, simply use a black slate and letter the wording with chalk. Make the photograph and then erase the lettering for the next sub title. In fact, titles might even be lettered across actual Leica enlargements which may present an interesting background. With a lettering board many interesting titles may be worked up for use with your film slides.

Storing Positive Pictures

All film slides and glass slides should be kept in containers free from dust. Such containers may be secured from the regular photographic dealers, or, if preferred, special containers can be made to cover any individual requirements. The small metal cans with covers, on which the titles of the film slides may be written, are excellent. These tins may be purchased on the market. Another way to keep film slides is by using the regular film storage boxes which contain cross-sections with spaces for about 25 rolls of film. The glass slides are easily kept in small boxes with hinged lids.

As your film and glass slide library grows, it will be necessary for you to develop a special indexing system so that any picture may be located instantly when desired. In the case of film slides, it is convenient to make paper contact prints of every picture on a single strip of film. These contact pictures are then mounted onto an index card which contains titles, numbers and complete information about that particular film roll. Contact prints of the individual glass slides may also be made and mounted on individual indexing cards, along with the proper title and descriptions. In the case of the glass slides, it is very easy to group the subjects under various classifications, such as buildings, street scenes, birds, boats, portraits, flowers, or any other subject. As the glass and slide collection grows, a valuable index and cross reference system may be built up. The slides are then available for instant use for showing in the home or in preparing special lectures or demonstrations.

Four Mugs
Summar 50mm, 1/100, f:9, Super-X Film

Mark Palmer

STEREOSCOPIC PHOTOGRAPHY

AUGUSTUS WOLFMAN **CHAPTER 14**

Our keen appreciation of realism in photography finds its fullest expression in our fondness for color pictures and stereoscopic views. The latter, known among graphic arts as three dimensional photography, is, for the time being the only method of rendering pictures so that the subject looks round and plastic. It is unfortunate that at present we are unable to lend this plasticity to single picture views obtained by ordinary, two dimensional photography, which always has, and still is endeavoring to assist our imagination to see things in pictures as we are accustomed to see them in life. By means of lighting, suitable backgrounds and skillful placement of the object within its environment, photographers are trying more or less successfully to give their pictures the effect of roundness and depth. But so far, photography has not been able to find a substitute for that lifelike rendering of depth in anything but the double image secured by viewing the subject from two points.

There is nothing new about a stereo camera. But the manner in which stereo views are obtained with a Leica camera is a decided departure from the old-fashioned methods of stereo photography. Before the Leica made its entrance into this field, a stereo camera had to have two lenses. In better cameras of this type these lenses had to be of the **matched** type, synchronized as to lens aperture and shutter action. The stereo feature introduced by the Leica consists of taking stereo pictures with one lens only.

The problem was solved with remarkable simplicity. Two prisms, placed about 70mm apart along a horizontal axis are made to act as small periscopes, bringing the two respective images together in front of the regular Leica lens. Each of these two images enters the camera and reaches the film plane through its respective half of the lens. Thus two separate images are formed upon the film, each measuring half of the Leica frame: 18x24mm. There is no dividing line between these two images: they merely join each other, forming a narrow *fade* into one another, thus using the maximum space available.

A negative thus formed is made into a positive transparency by contact printing upon 35mm positive film without any of the customary reversal of images. The positive is then viewed through a slightly modified form of the same periscopic double prism, where the process is reversed. Here the images are picked up from the double frame separately, and carried to two eyepieces, thus giving full stereo effect. Of course, if paper prints are preferred, they may be made just as easily by enlargement to the size desired, and viewed with a stereoscope.

The Stereo Equipment

The Stereo equipment consists of two units: the photographing unit, which is placed over the standard 50mm lens, and held in place by means of a small arm fitting into the camera clip; and the viewing unit, which has adjustable eyepieces and a slotted channel for the film. The viewing unit can be held in hand or attached to a convenient stand. The Stereoly taking unit has its own view finder, which replaces that of the camera. Since each of the two pictures obtained is only half as large as the regular Leica frame, only half the area covered by the 50mm lens is available. The Leica must always be held horizontally when used with the Stereoly, which will result in two vertical images. The camera should not be used vertically.

Taking Stereo pictures with the Leica is no more complicated than taking ordinary pictures. The Stereoly is placed before the lens, given a simple adjustment described in the instructions accompanying each instrument, and one is ready to take pictures. The exposure variation of the

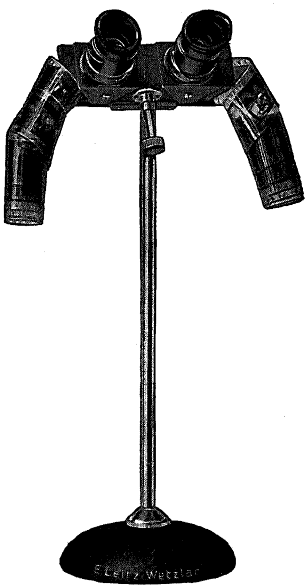


Fig. 198 Stereo Viewer, on Stand, for 35mm Leica Stereo Positives

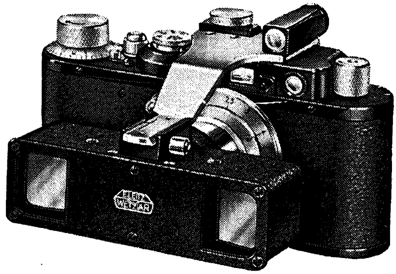


Fig. 197 Stereoly Photographing Unit for Stereoscopic Photography with Hektor, Elmar, and Summar 50mm Lenses only

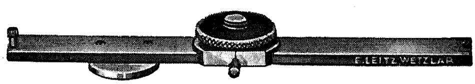


Fig. 199 Stereo Slide Bar, for Stereoscopic Photography when making two separate negatives

Stereoly is almost negligible, if one considers the latitude of modern film emulsions. To be sure, the exposure factor is not constant. It varies from the requirement of an exposure fifty per cent longer with the lens set at f:3.5 to an increase of some ten per cent only, when the lens is stopped down to f:12.5. As a matter of general practice, it is recommended to take stereo pictures with the lens stopped down to f:6.3 or f:9. Lens openings larger than these do not yield sufficient depth of focus for stereo pictures, while those smaller than f:9 are apt to cause vignetting of images under certain conditions. The Stereoly unit does not by itself cause any unsharpness of picture, but to avoid pictures lacking definition and detail, so important in stereos, all exterior glass surfaces should be kept scrupulously clean at all times, and free from finger marks above all.

Filters for Stereo Photography

Filters may be used in connection with the Stereoly attachment if they are in the standard Leica slip-on mount. They are simply placed over the lens, and the Stereoly is attached over the filter. Since the aperture of the lens cannot be changed nor can the filters be removed without first removing the Stereoly from the camera, it is suggested that the lens be operated always at the same stop when used for stereo pictures.

In certain instances where special filters used for definite effects are not available in Leica mounts, and cannot be made to fit on account of their excessive thickness, they may be used (if available in pairs) by being fastened to the front part of the Stereoly taking unit in such a way that they completely cover the two front apertures. It may not be amiss to say that when this is resorted to, both filters must be identical.

Sunshades and Film

Experiments have shown conclusively that stereo pictures secured with the aid of sunshades were quite superior to those obtained without them. They seem to be sharper, clearer and more brilliant and have a better definition throughout. The proverbial ingenuity of Leica users should find here another field of application. The writers have used successfully two standard Leica sunshades of the inexpensive kind fastened to each end of the Stereoly unit by means of scotch tape. On another occasion, a 10 inch length of 1½ inch black scotch tape wound all around the front edge of the Stereoly, protruding about an inch, served the purpose admirably.

Stereoscopic photography with the Leica is so simple that it may be said that there is actually no difference between this form of photography and any other form of Leica photography, except for the accessories required. For this reason the selection of film, developer, filters, and other factors should be made exactly as one would for any other form of work.

It is quite feasible to produce direct stereo transparencies on negative stock by reversal. For this purpose, the newest Agfa film, the Reversible Superpan is very much to be recommended. Generally, regular negative materials of the modern type cannot be used for reversal on account of their gray nonhalation backing. However, it should be realized that although reversal is one of the simplest ways for securing transparencies, it is by no means the most practical procedure: through reversal one loses the negative, and with it the only way for making additional prints. All positive transparencies should receive an adequate hardening treatment by any of the methods described in the chapter dealing with this subject.

Stereo Color Pictures

As far as black-and-white photography goes stereo transparencies represent probably the most realistic form of reproduction. But natural color transparencies for stereoscopic viewing mark the goal (at least at present) of realism. With the advent of KODACHROME, the new natural color film recently made available for the Leica camera by Eastman Kodak Company direct color stereoscopic photography with the Stereoly Attachment is not only practical but extremely simple and easy. No color filters being required for use with Kodachrome film, there being one type of film for daylight and another for work in artificial light—there is no longer any impediment to simply attaching the Stereoly to one's Leica, stopping down the lens and proceeding to photograph in natural color as one would to make black-and-white pictures. Kodachrome Haze filters, if one wishes to use them for distant views, should be used according to suggestions made on the preceding page. The handling of Kodachrome films is described in a special chapter of this volume.

Protecting the Stereos

Stereo transparencies of any intrinsic value that cannot be duplicated should be handled with particular care. Any stereo transparency may be bound between two thin plates of cover glass and thus assured comparative permanence and security from scratches, abrasion marks and finger marks. This precaution would apply particularly to color transparencies, where negatives are not available, since they are obtained by means of reversal. For this reason, color transparencies should be bound in glass as soon as they are dry and ready for viewing. One has the choice of binding them into individual frames, or, better still, into strips of three frames each. Special cover glass plates are available for this purpose, measuring 35mm x 120mm, and their use cannot be too strongly recommended, not only for color transparencies, but also for any black and white pictures which are worth having. In such bound form they become comparatively permanent and most convenient to handle and to file.

The Stereo Slide Bar

While the Stereoly may be used for all forms of stereo photography, both indoors and outdoors, it is primarily intended for work without a tripod, for action pictures, landscape work, and all such subjects as require rather short exposures. A somewhat simpler accessory is available for stereo photography of still life, table top photography, three color separation work, etc. This accessory is known as the Stereo Slide Bar: a metal bar about 6 inches long with an engraved scale and slide mounted upon it. By means of a set screw the slide may be placed anywhere along the bar. The Stereo Slide Bar is firmly secured to a rigid tripod either of the field or table top variety. The camera is fastened to the slide and one exposure is made with the camera at one end of the bar. Then the camera is quickly moved to a predetermined position at the other end of the bar, and the second exposure made. Thus, the set of stereo pictures is secured upon two full frame negatives, which may be made either into transparencies or prints. This method, while not as universal in its application as the Stereoly, has certain advantages over the other. The separation of the two shots may be adjusted to suit any special requirements, a separation up to 6 inches being available for special effects. Any lens and any filter may be used for this type of work. The two resulting pictures are larger than those available with the Stereoly, but they cannot be viewed through the regular stereo viewing unit.

The Stereoly unit should not be used for photographing objects less than 5 to 7 feet from the camera. Close range photography introduces complications of parallax adjustment, since the optical axes

Fig. 200 Advertisement Rudolf Hoffmann

of the two prisms of the Stereoly are theoretically parallel, intersecting one another at infinity. For this reason, photography of near objects may better be accomplished with the aid of the Stereo Slide Bar, into which the parallax adjustment may be introduced by careful manipulation.

Making of Stereo Prints

Regardless of whether the Stereoly attachment or the Stereo Slide Bar, or the two-camera method has been used to make stereo negatives, paper prints may easily be produced from any of them. The prints may be of the contact type, but a much better job will be secured by making enlargements.

Enlargements or negatives produced with the Stereoly attachment are made on one sheet of paper, for greater brilliance and better detail. Before a print is made, the available stereo viewing equipment should be examined to determine the correct size of the finished print. It will be found to be most practical and then trimmed to the required size of the stereo viewing apparatus. Since there is no sharp line of demarcation between the two halves of the print, they should be cut in half carefully, or better still, left together unseparated, and thus mounted on a piece of cardboard of a size conveniently accommodated by the stereopticon.

In the case of two separate negatives obtained by the other two methods, separate enlargements will be made. It is important that both negatives be enlarged to identical size, with the enlarger in the same position, using the same paper, developer and exposures. Fin-

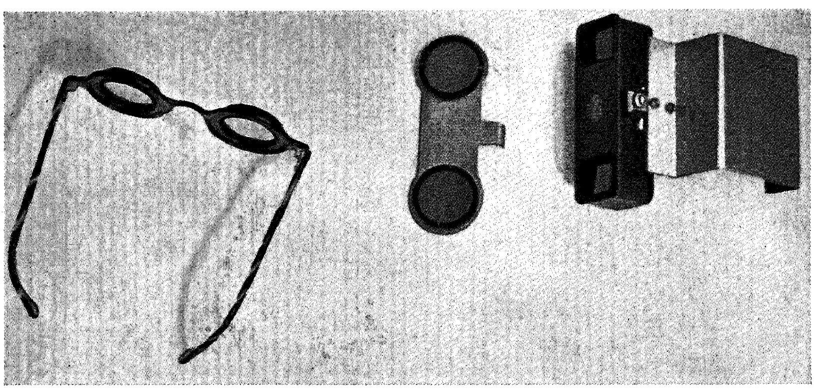


Fig. 201 Accessories for Projecting and Viewing Stereoscopic Pictures

ished prints should be trimmed only after careful examination and tests made in the stereopticon.

Stereo Projection

Printing stereo negatives on positive film and viewing them with the aid of the Stereo Viewer is an excellent method. The transparencies provide greater luminosity, brilliance and plasticity than paper prints. It would, however, be more advantageous if the positive transparencies could be projected so that the stereo picture could, first of all, be viewed in an enlarged size and, secondly, a few individuals could see the picture at the same time.

Stereo projection has now become possible through the use of the recently introduced polarizing filter, or pola screen. In order to understand the workings of this method, it will be necessary to have some idea of the characteristics of plane polarized light, which is employed in stereo projection.

Theoretically, light consists of waves in a substance called "ether" which, it is supposed, is spread through all space and matter. The vibration of a light wave is not along the direction of the ray but at right angles to it and in all possible directions; that is, up and down, sidewise, etc. If a mechanical medium is placed in the path of the light ray, which changes it so that it vibrates in one direction only, the light ray is said to be plane polarized. This action is performed by the polarizing filter.

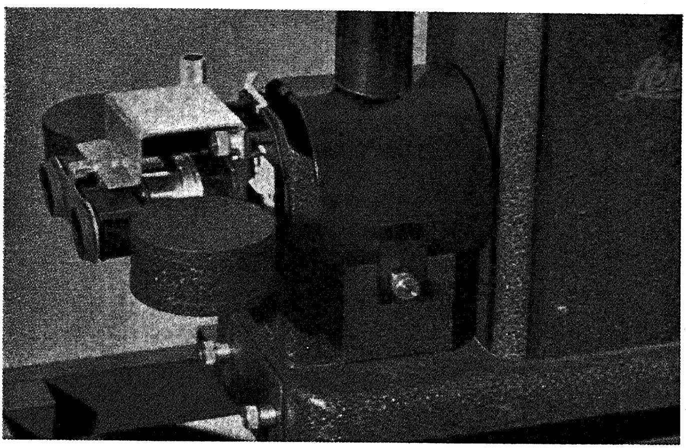


Fig. 202 Stereoscopic Attachment with Polarizing Filters Mounted over 50mm Summar Lens on Udimo Projector

To visualize this let us imagine that we have a string stretched tightly between two points, the string representing a ray of light. Then consider that this string is vibrating in all directions, which are at right angles to the length of the string. If the string were passed through a vertical slit in a piece of cardboard, then the string would vibrate vertically, and when passed through a horizonal slit it would vibrate horizontally. In either case, the string would vibrate in one direction only. This is analogous to the manner in which a pola screen plane polarizes light rays.

The pola screen contains myriads of small rod-like crystals which are all parallel to each other. These crystals act in a similar manner to the slits in the cardboard.

In stereo projection a 50mm lens is placed on the projector and then a Stereoly Attachment is fitted over the lens, in a similar manner as when it is used on a camera. It will be necessary to construct a special bracket that will hold the Stereoly Attachment in place. Polarizing filters are now fitted over the windows of the Stereoly Attachment and again, in this case, a special holder will have to be made for the filters. 30mm diameter filters are sufficient for this purpose.

When these screens are fitted into the special mount, it will be necessary to so orient them that one filter polarizes the light in one direction and the other filter polarizes it in another direction—vertically and horizontally. The observer wears a pair of spectacles containing pola screens which have been oriented in the same manner as the filters over the windows of the Stereoly Attachment. In this way one eye can only see one image and

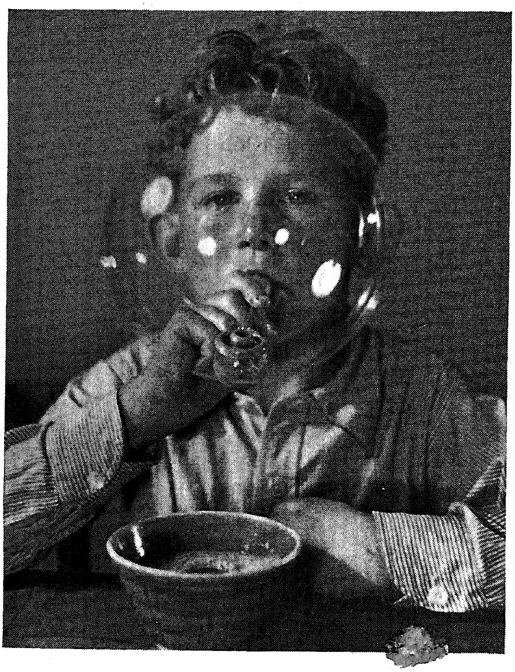


Fig. 203
Blowing Bubbles
John B. Titcomb
Elmar 50mm, 1/60, f:3.5,
Agfa Superpan

the other eye sees the second image so that the full stereoscopic effect is had. The beauty and realistic quality possessed by these third dimension projected pictures is beyond description, especially when color stereoscopic pictures are projected.

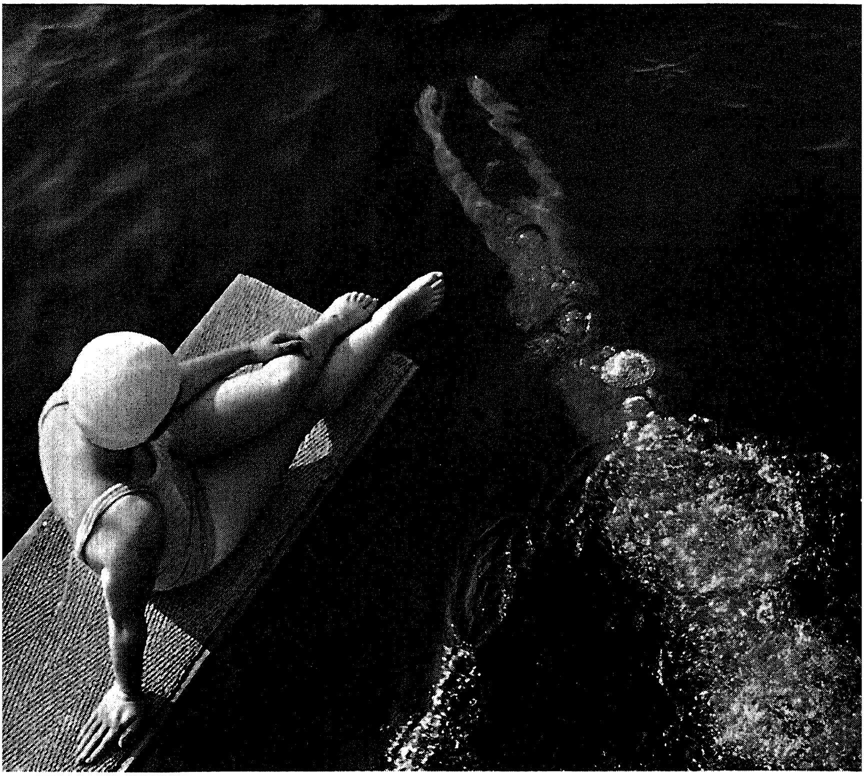
In order to make proper allowance for the changed condition of the projector system, it is advisable to use an Interchangeable Condenser for an 80mm lens. At that, there is considerable loss of light through absorption by the various accessories employed. The Stereoly Attachment absorbs about 25% to 40% of the light coming from the lens and the pola screens absorb about two-thirds of the light striking them, so that the final amount of light reaching the screen is about 20 to 25% of that originally leaving the lens. Therefore, a 750-watt projector is in effect similar to a 90-100-watt projector used in normal projection. The loss in light is, however, more than compensated for by the beauty of the stereoscopic effect.

In the matter of screens, it has been found that they must be made of a material which will not de-polarize the light. Ordinary white (so-called "half-tone") screens are not satisfactory for stereo projection but translucent and metallic surface screens, such as "silvered" screens will serve the purpose. The beaded screen, though it enables the viewing of the projected image at a greater angle—depolarizes the light somewhat. As this printing goes to press experiments are being conducted on a more suitable screen material for stereo projection. This material will be announced in the near future.

If a pseudoscopical effect is obtained—the opposite of the stereoscopic effect, what is nearest appearing farthest—a turn of 90 degrees of the polarizing filters of the viewing glasses or on the projector will correct it.

Fig. 204 Tell Asmar, Iraq — James H. Breasted, Jr.
Courtesy of Oriental Institute

Pay Day for the Iraq Expedition's Native Workmen, Refer to Chapter 19, Archeology and Exploration



The Dive

Eric Schaal

Summar 50mm, 1/100, f:6.3, Super-X Film

NATURAL COLOR PHOTOGRAPHY WITH KODACHROME FILM AND WASH-OFF RELIEF PRINTS

HENRY M. LESTER **CHAPTER 15**

Probably every user of the Leica Camera has made or seen Kodachrome pictures. This marvelous color process, which has swept over the entire world, provides Leica workers everywhere with the simplest and least expensive method of making the best color transparencies possible today.

Since its announcement, many improvements have been made, both in the film and in processing. Likewise most of the users of Kodachrome have learned much about color photography and the color characteristics of light and lighting conditions, all of which tends toward improvements in results.

The most significant news to Leica workers is the reduction in price (in U. S. A.) of the 18 exposure Kodachrome Films for Leica Cameras from \$3.50 to \$2.50 per roll, which includes processing at the Kodak Laboratories. This applies to both the daylight film K135 and artificial light film K135A. This means that natural color pictures can be made for about fourteen cents each, possibly no more than the cost of black-and-white enlargements.

For film speed and color rendition, no more could be desired. The knack of obtaining the best results, however, lies in estimating the *exposure correctly,* but this will be discussed at length further on.

Kodachrome is free from all grain, color fringing, and has no screen pattern, all three of which tend to ruin true color rendition and picture quality. The silver grains, after serving their purpose of recording the original photographic image in the film, are removed in the final stage of the process. The final color images are made up of dyed gelatin so no grain remains in the final picture. The color separations are all made on one film within the depth of the emulsion, so the images are all automatically registered one over the other. Thus, there is no color fringing, common in processes that are dependent upon mechanical, optical, or manual methods of registration. This method of separating the colors of the original subject does not require a color screen pattern or lenticular surface on the film. This provides sharp images of fine detail, lost in other color processes.

No filters are required for the separations because the film emulsion is coated in three separate layers, each layer is sensitive to a different portion of the spectrum. Each layer is separated by a thin coating of gelatin. An enlarged cross-section of the film would resemble a layer cake with the frosting left off the top layer. See figure 206. Next to the film base is coated a red sensitive emulsion, then, on top of that, a very thin layer of gelatin, next, on top of that, a green sensitive emulsion, then another layer of gelatin, and finally, on top, a blue sensitive emulsion. The gelatin on top of the bottom or red sensitive layer contains some red dye so that nothing but red light or light from red colored objects reaches the bottom or red sensitive layer. With all five coatings the film is no thicker than ordinary film used for black-and-white photography.

The two gelatin coatings provide two other important uses. First, in coating the film they prevent the film sensitizing dyes from wandering out of their proper layers. Secondly, in processing they provide the safety factor necessary for the penetration of each dye to its proper layer.

Additive and Subtractive Principle

There are two general types of processes of color photography: namely, additive and subtractive. In additive color processes, three pictures are made through three filters, red, green, and blue-violet, and after the negatives are developed and printed, the positive transparencies are projected through three filters, red, green, and blue, very similar to the taking filters. The three pictures, when superimposed in register on the screen, render a satisfactory color picture of the original subject. In the subtractive processes, the separation negatives are made the same as in additive processes but the positives are dyed with colored dyes of the complementary colors to the taking filters. The red filter image is dyed blue-green. The green filter image is dyed magenta, and the blue filter image is dyed yellow. When all three images are superimposed and either projected or viewed as a transparency, the result is a color picture.

Kodachrome is a subtractive color process. After development, the bottom or red sensitive, or red filter image is dyed blue-green; the middle or green sensitive layer is dyed magenta, and the top, or

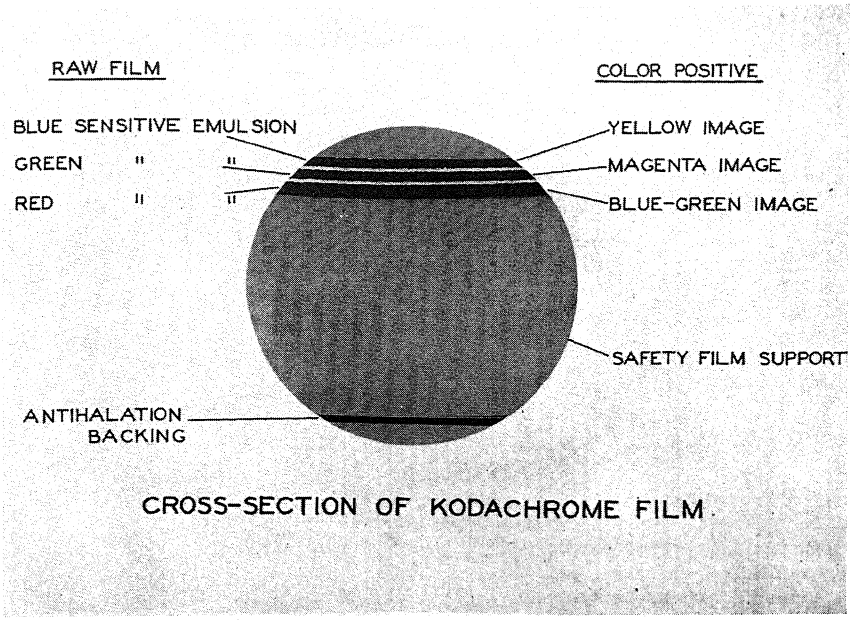


Fig. 206 Cross-Section of Kodachrome Film Greatly Magnified Showing Alternating Layers of Gelatin and Emulsion

blue sensitive layer, is dyed yellow. This remarkable feat is accomplished in Kodachrome by the use of a series of dye-coupler developers in the various stages of processing.

Daylight or Artificial Light

Since any color film must be color balanced to the type of light in which it is to be used, Kodachrome is no exception. When we make pictures in sunlight, we have the various qualities of sunlight to consider. If there were no such things as atmosphere, clouds, haze, etc., it would be a simple matter to always obtain good color results out-of-doors. All of these things, however, do change the color, intensity, and color quality of light from the sun. **Kodachrome Daylight Film is color balanced to noon-day sunlight.** This same type of light prevails from about 9:00 to 4:00 o'clock in summer, and from 10:00 to 3:00 o'clock in winter. Before and after these hours, the sun's rays are redder because of the greater amount of atmosphere they travel through during these earlier and later hours of the day. Therefore, pictures made early and late in the day will have a yellowish to reddish cast to them. The light from a clouded overcast sky or from a north sky when the sun is shining, is quite blue when compared to sunlight and pictures made under these conditions will have a bluish cast. These colors may be more apparent in the Kodachrome picture on projection if the previous slide viewed was made with light of correct color balance. Human beings as a rule subjectively make some compensation for the effect of light on colors in nature, whereas pictures thrown on the screen in rapid succession do not allow sufficient time for the subjection processes to make these corrections. A picture that may be quite badly off color, due to the conditions under which it was made, will appear quite satisfactory if it is viewed for two or three minutes, for the longer we view it the better it looks, due to the subjective compensations made by our mental processes. Similarly artificial tungsten light at night appears white but when compared to daylight it is distinctly yellowish.

Type A Film

Because of the necessity of balancing Kodachrome Film to the type of light used, it can be readily seen that for use with artificial light, an entirely different type of Kodachrome Film would be required. Since there are many types of artificial light, each would require its own particular type of Kodachrome Film. Since Photoflood lamps are highly efficient, inexpensive, and universally available, their color quality of light was chosen as the type of artificial light to balance to the Type "A" or artificial light Kodachrome Film. Photoflood lamps are an over-volted type of tungsten light, radiating considerably more blue light than ordinary tungsten. So with artificial light, the best color results will be obtained when Photofloods are used with the Type "A" Kodachrome. However, ordinary tungsten lamps of the 500-watt projection type, while emitting less blue light, will render quite satisfactory results. However by using 500-watt 100 to 105-volt lamps a closer match for Type "A" Kodachrome can be obtained.

With arc lamps using white flame carbons, regular daylight Kodachrome Film should be used because white flame arcs are very similar to sunlight in their color characteristics.

Exposures in Artificial Light

With four No. 1 or two No. 2 Photofloods in Kodaflectors at a distance of four feet from the subject, excellent snapshots can be made at 1/30 of a second at f:4.5. 50% or ½ stop more exposures should be given to dark colored subjects and 50% or ½ stop less to light colored subjects. The light should be distributed evenly over the entire subject and careful attention paid to the *distance* of the light from the subject. Since the Photoflood operates most efficiently on 112 to 115-volts, additional exposure should be given if the line voltage is down to 100 or 108-volts.

The following exposure guide may prove useful, or one may reliably follow the guide packed with the film.

KODACHROME FILM TYPE A K135A

Artificial Light Exposure Guide for Photoflood in Kodaflectors

	f:6.3	f:4.5	f:3.5	f:2
1/30 sec.	4 lamps at 2¾ feet	4 lamps at 4 feet	4 lamps at 6 feet	4 lamps at 9 feet
1/20 sec.	4 lamps at 3½ feet	2 lamps at 3½ feet 4 lamps at 5½ feet	2 lamps at 5½ feet 4 lamps at 8 feet	2 lamps at 8 feet 4 lamps at 12 feet

With No. 2 Photoflood lamps in Kodaflector use half as many of them as in table. If same number of No. 2 lamps are available use next smaller stop, or next faster shutter speed.

It is advisable when possible to stop the lens diaphragm down one or two stops and give a longer exposure accordingly. This will improve scenics, still life studies and other subjects where there is no action or motion.

EXPOSURE TABLE FOR PHOTOFLASH LAMPS
Using Kodachrome Film (Regular) (K 135) with Kodachrome Filter for Photoflood.

Adjust the Shutter for a Time Exposure

Distance of lamp from subject	No. 10 lamp with Kodak handy reflector	No. 20 lamp with Kodak handy reflector
12 feet	f:2	f:2.8
9 feet	f:2.8	f:3.5
6 feet	f:3.5	f:4.5
4 feet	f:4.5	f:6.3

EXPOSURE TABLE FOR PHOTOFLASH LAMPS USING KODACHROME FILM TYPE A (K135A)

Adjust the Shutter for a Time Exposure

Distance of lamp to subject	No. 10 lamp with Kodak handy reflector	Distance of lamp to subject	No. 20 lamp with Kodak handy reflector
18 feet	f:2.8	24 feet	f:2.8
15 feet	f:3.5	19 feet	f:3.5
12 feet		16 feet	f:4.5
11 feet	f:4.5	12 feet	f:5.6
10 feet		9 feet	f:8
8 feet		6 feet	f:11

If the Flashlamp is used without a reflector double the above indicated exposure should be given.

NOTE:

It will be noted that the exposure table for Photoflash lamps, using Kodachrome Film Type A presumes the use of a camera without a Photoflash Synchronizer. If a synchronizing device is used with a Photoflash, the fundamentals of the exposure table given above should be kept in mind in making any adjustment for higher shutter speeds than those recommended in the table. To assure getting the most of illumination out of the brief peak of maximum light intensity of a Photoflash bulb, it is suggested that shutters be set for an exposure of not more than 1/20th of a second nor less than 1/100th of a second.

Photoflash Lamps

There are many occasions where it is not only desirable but convenient to use the photoflash lamp for Kodachrome snaps with the Leica. In general the photoflash is not productive of the very best pictures because large apertures must be used and the light is from one source and is contrasty. The preceding table indicates the limits of flexibility of the photoflash for general work.

Medical Photography

The Photoflash lamp is probably better suited to medical photography than most other types of light sources.

While the photoflood type of lamp is ideal for most all Kodachrome subjects and can be used satisfactorily for medical work, there are times in recording clinical subjects where the subjects become impatient and difficult, this is particularly true with children. Here the photoflash plays an important part, the subject can be framed and focused in weak subdued light, the camera shutter opened and the bulb flashed. The flash which takes place in 1/70 to 1/75 of a second stops all average motion or slight movements.

For eye photography the flash bulb can be brought within 8 inches of the eye and the camera lens stopped down to f:16 with the No. 10 flashbulb and f:22 with the No. 20.

For medical pictures of this type the flashbulb should be placed in a safelight fitted with a piece of clear glass instead of the regular red or green safelight filter. This clear glass does not obstruct any light and acts as a safety window in case the glass of the flash bulb should shatter.

In making medical pictures every precaution should be observed to insure the safety of the subject.

Film Latitudes

Kodachrome Film, like all other color films, does not have the long exposure range or film latitude common to black-and-white films. In other words, with black-and-white film, if 1/30 of a second at f:6.3 were the correct exposure, one could make the same picture 1/30 at f:4.5, 1/30 at f:3.5, or 1/30 at f:8, or 1/30 at f:11, and obtain satisfactory prints from each of the negatives. With Kodachrome this is not possible, assuming the correct exposure is 1/30 at f:6.3, a 1/30 at f:4.5 or f:8 will be passable, the former a shade light and the latter a shade dark but 1/30 at f:3.5 will be too light or over-exposed, and 1/30 at f:11 will be too dark or under-exposed. However, many times the pictures purposely under-exposed render a most pleasing picture from the artistic point of view.

The above is equally true for either the Daylight or the Type "A" Kodachrome Film.

Daylight Exposures

If an exposure meter is used, it should be calibrated to the equipment and conditions under which the pictures will usually be made. If no exposure meter is used, the comprehensive DAYLIGHT EXPOSURE GUIDE on pages 300, 301 will furnish the most dependable information, which, if followed intelligently will yield most satisfactory results under all conditions.

Exposure Meters

If an exposure meter is used, the proper rating should be obtained from the meter manufacturer. The speed of film may be changed from time to time and there is a difference between models of meters of the same manufacture. So to insure the best results the correct rating for any photo-electric type of meter should be obtained from the manufacturer. For general guidance the following table is approximate.

Scheiner°	Din°	H & D	Weston
14	7/10	159	3
15	8/10	200	4
16	9/10	252	5
17	10/10	318	6
18	11/10	400	8
19	12/10	504	10
20	13/10	635	12
21	14/10	800	16
22	15/10	1000	20
23	16/10	1270	24
24	17/10	1600	32
25	18/10	2020	40
26	19/10	2540	50
27	20/10	3200	64

Filters

While excellent Kodachrome pictures can be made without ever using a filter, there are occasions where a filter will improve results. There are three filters for use with Kodachrome Film . . . an ultra-violet light absorbing filter, a blue filter, and an orange filter.

In some localities, and under some conditions, a considerable amount of ultra-violet light is present. This affects the top layer of the film and reproduces as blue light in the finished picture. To absorb this, **the ultra-violet light absorbing filter** should be used. Since we cannot see ultra-violet light, it is difficult to tell when to use it. However, it improves pictures made on dull or cloudy days or in the shade, winter scenes when snow is on the ground with a bright sun and blue sky also scenes in the tropics or in high altitudes, or aerial views made from the air. Many Leica workers leave this filter on for all exterior pictures. It does no harm, but is not essential for all scenes.

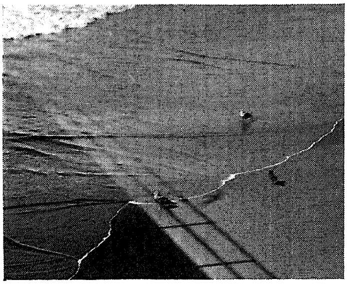
The blue filter is for use with regular daylight film when used for interior color photography with artificial light. Artificial light, photoflood or regular tungsten, are both much redder than sunlight, therefore, the blue filter absorbs some of the red light, thus giving a balance between daylight Kodachrome Film and tungsten illumination.

The orange filter is for use with the artificial light Type "A" film when it is to be used for daylight or out-door sunlight photography. The Type "A" film is made extremely blue sensitive to color balance with Photofloods, and, therefore, the orange filter is used to make daylight look like artificial light to Kodachrome film.

Many Leica workers use only the Type "A" film. Thus they are always prepared for an interior picture, and by merely slipping on the orange filter, the Type "A" becomes balanced for daylight with no increase in exposure.

DAYLIGHT KODACHROME

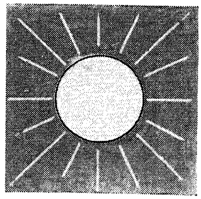
"Basic" Exposure for Average Subjects



Bright Sun

Strong Shadows; clear blue sky; Direct Sunlight.

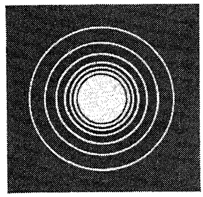
1/60. . .f:6.3



Weak, Hazy Sun

No Distinct Shadows cast; Hazy skies.

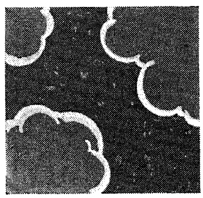
1/60 . . . f:4.5



Cloudy but Bright

Overcast Skies; No Direct Sunlight.

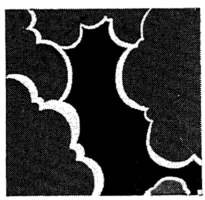
1/40 . . . f:3.5



Cloudy and Dull

Heavily overcast skies—no sun; Medium to dark clouds.

1/20. . .f:3.5



Figures 207—214 Four Types of Light Conditions

EXPOSURE GUIDE

This guide should be used for both kinds of Kodachrome Film, Regular and Type A. With the Kodachrome Film, Type A, be sure to use a "Type A Kodachrome Filter for Daylight" in front of the lens.

This guide is for the hours from two hours after sunrise until two hours before sunset; earlier or later, use a larger opening. Do not make Kodachrome pictures before one hour after sunrise and after one hour before sunset, except when making pictures of the sunrise or sunset.

In direct sunlight, a flat lighting (light falling directly on front of subject) is best.

Dark-colored subjects include dark foliage, deep-colored flowers, dark animals, buildings, and similar subjects.

Light-colored subjects include snow and **beach** scenes, light-colored flowers, subjects with blonde complexions, light-colored buildings, and other subjects of a similar character.

Average subjects combine dark and light objects in approximately equal proportions.

Landscapes are best if taken in direct sunlight.

The above guide should be followed for both close-ups and distant views; special attention, however, should be given as to whether the subjects are of average brightness, or dark-or light-colored.

When in doubt, use basic exposure (see guide).

This guide is for both temperate and tropical zones.

Do not hold the camera in the hands for exposures longer than 1/20 second.

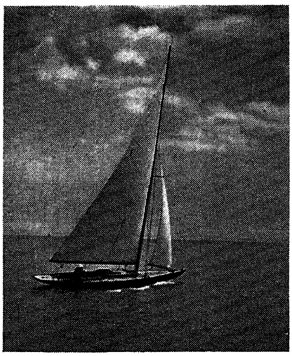
Before 9 or 10 a.m., or after 3 or 4 p.m.—½ stop larger.

Winter months in north—½ to 1 stop more.

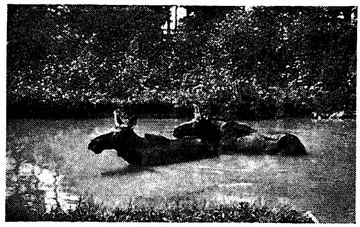
Winter months in north, with snow—no allowance.

Winter in tropics—no allowance but remember that a majority of scenes in the tropics are of light colors and should have ½ stop smaller.

Light colored subjects—
½ stop smaller



Dark colored subjects—
½ stop larger



Side lighted subjects—
1 stop larger

Back lighted subjects—
2 stops larger

Figures 215—218 Four Types of subjects

In other words, the Type "A" Kodachrome Film with the orange filter is the same speed to daylight as the Daylight Kodachrome Film. On the other hand, when the daylight film is used with artificial light with the blue filter, two diaphragm stops larger must be used. The filter has a factor of about 4x with tungsten.

Projection

The finished pictures should be suitably mounted in the 2 x 2 inch glass slides. This protects the film from surface scratches, saves ever having to clean the film, and lengthens the life of the film indefinitely.

The dyes in the film are balanced to regular tungsten projection lamps burning at rated voltage and so can be projected to a size relatively proportional to the wattage of the projection lamp. The only hazard comes from leaving slides in the heat of the lamp for too long a period of time. This is apt to cause fading or melting due to overheating. A 500-watt projector can be used if the lamp rays are passed through a water cell, but even with this, slides should not be left in for over a minute or two at a time.

If too large a picture is projected for the wattage of the lamp, the picture will lack brilliancy and appear yellowish on the screen. If too small a picture is projected, it will appear too light or washed out.

The projection screen should be absolutely colorless. Old screens have a tendency to turn brownish or yellowish with age. Often this will bleach out if the screen is placed in the sun for a day or two. If a screen is yellowish, the projected pictures will take on a yellowish cast. Blues will appear greenish, flesh tints yellowish, etc.

All daylight or artificial light should be excluded from the projection room. Stray light may dilute the projected colors of the slides.

Fig. 219 Japanese Puppet Theater — Julien Bryan
Summar 50mm, 1/8 sec., f:2, Super-X Film

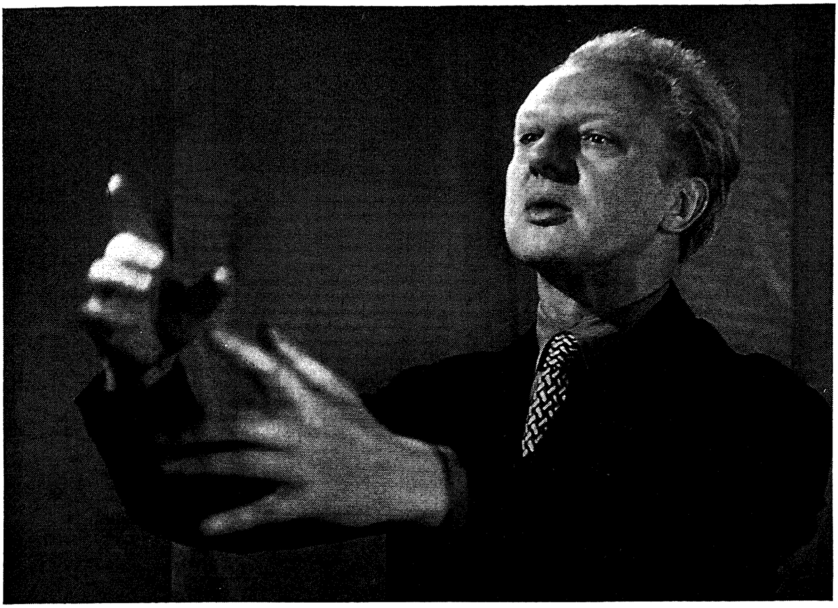


Fig. 220 Leopold Stokowski Conducting Rudolf H. Hoffmann
Black and White Enlargement from a Kodachrome Color Transparency
Courtesy Lord & Thomas for RCA Mfg. Co., Inc.

If the projection lamp is burning below its rated voltage, due to an over-loaded line, the pictures will appear dim and yellowish. If this condition is usual, a lower voltage projection lamp should be used, or a smaller picture projected.

Black-and-White Pictures from Kodachrome Film

Probably one of the most interesting things about Kodachrome is the fact that the candid camera fan can snap a color picture and virtually bring all of the great out-doors into his darkroom for further experimentation.

Many times it is necessary when making black-and-white negatives to try and obtain a certain effect with filters. Often it is not practical nor will time permit the making of several negatives with several filters to produce the desired result. Also many times after we've made a black-and-white with no filter we wished later that an A, F, or G filter had been used. Kodachrome Film offers a complete solution to all of these problems. Make all Leica originals on Kodachrome film. Then take the finished Kodachrome pictures into your darkroom, enlarge them up to 4 x 6, 5 x 7 or even 8 x 10 on to Panchromatic negative material. Make one enlargement with the A filter, one with the B or one with the G until you obtain the desired effect. The possibilities do not stop here for four or five enlarged negatives can be made, and each one developed with a different fine grain developer. There is plenty of fun to be had at night enlarging Kodachrome to black-and-white. Regular enlargements made without filters will produce excellent negatives, sharp, and free from any grain (because the silver grains are all removed from Kodachrome).

With good Kodachrome originals and enlarging and filtering facilities, it is only a step to making Wash-Off Relief color enlargement prints from Kodachrome originals.

Wash-Off Relief

To make Eastman wash-off relief color prints, three color separation negatives are required. These can be made by contact or enlargement.

The negatives are next printed onto wash-off relief film either by contact or enlargement. In either method of printing, the exposure is made through the base or support of the wash-off relief film and with the light of a Photoflood and a number 35, violet filter. The films are developed to positive silver images, the image, of course, being near

Fig. 221 Advertisement — Rudolf H. Hoffmann
Black and White Enlargement from a Kodachrome Color Transparency
Courtesy Buchanan & Co., Inc., for Cafe Rico

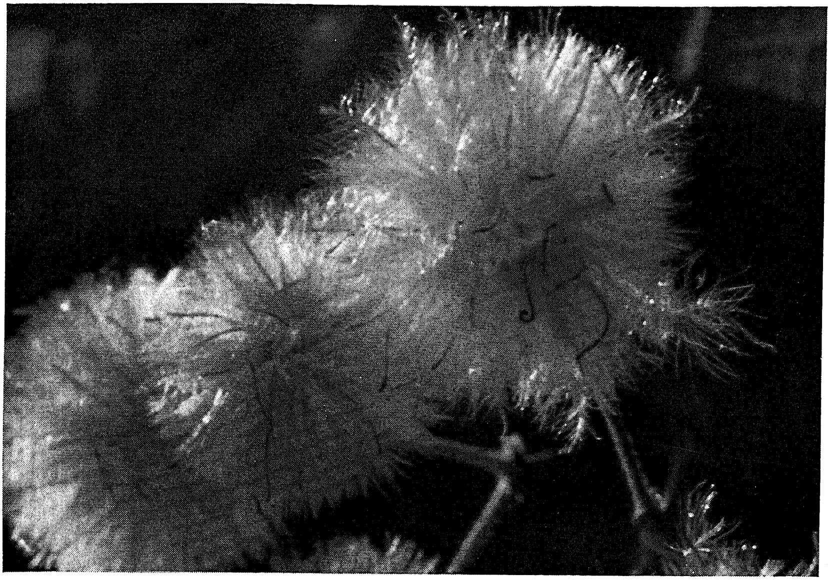


Fig. 222 Clematis Seed J. M. Leonard
Summar 50mm, 1/20, f:12.5, Sliding Copy Attachment, Sunlight, DuPont Superior

the film base rather than on the surface. The films are next bleached in a bichromate bleach solution. This bleach hardens the gelatin wherever there was a developed silver image and renders the gelatin insoluble. Now, if the films are washed in warm water, 125° F., all of the soft gelatin is washed away, leaving only a relief image composed of hardened gelatin, firmly adhering to the film support. The films are now fixed in hypo and then washed and dried. The three wash-off relief films called matrices are now dyed in the Eastman three-color printing dyes, A, B, and C: blue-green, magenta, and yellow or, since this is a subtractive process, the films are dyed the same as outlined earlier in this article, viz., the red filter image is dyed blue-green, etc. When these dyed positives are dry, they can be superimposed in register to form a three-color transparency, or the dye in the matrices can be transferred to paper by imbibition transfer. To transfer these to paper, a wetted paper coated with gelatin containing a dye mordant is prepared. The transparencies or matrices are squeegeed on and transferred one at a time, to the paper; each is left until there has been a complete transfer of dye from the film to the paper the total time for transfer is usually about 25 minutes. As the dye transfers it is precipitated by the mordant in the gelatin so that finally the dyes from the original are not in layers but all mixed with each other. The resulting print in color is permanent.

Any good Kodachrome slide of good color quality, sharp, and of not too high a contrast, will reproduce well. Contrasty originals have a tendency to show color distortion in either the highlight or shadow tones. The soft color picture made with a flat, even lighting produces the best results.

For making the enlarged three color separation negatives from Kodachrome originals, the miniature type of enlarger is satisfactory. A light tight box should be built over the bed of the enlarger to prevent stray light from affecting the Panchromatic Film. This should be provided with a small hole on the top for the insertion of the lens or the light beam. If the enlarger can be mounted in a horizontal position, a 5 x 7 or 8 x 10 camera can be used. The lens board is removed from the front of the camera and the color picture focused directly on to the ground glass of the camera. In this way the negative Panchromatic material, 5 x 7 or 8 x 10, can be loaded into film holders placed in the camera. A piece of rubber focusing cloth can be fastened from the front of the camera to the lens of the enlarger, thus providing a light-tight chamber for making the separations.

As a light source, a 250-watt G 30 Mazda lamp with clear spherical bulb, operated at or slightly below its rated voltage, will greatly outlast a Photoflood lamp and provide constant illumination for a long time.

In placing the Kodachrome frame in the enlarger, a small strip of film with a number of neutral density steps should be included along the edge of the film. This strip should have steps of density about 3/16 of an inch wide, eight steps ranging from 0 density to 1.5. This gray scale aids in obtaining the proper balance of exposure, development time, and in color balancing the transparencies.

Wratten Copy Board Chart

An almost indispensable accessory for color photography is a Wratten Copy Board Chart, a very inexpensive but highly efficient aid procurable through any dealer of the Eastman Kodak Company. It is available in a variety of sizes and should be used either for the actual Kodachrome photographs or for making of three color separation negatives.

The chart consists of four easily separable portions and is intended to assist the photographer when making negatives for three or four color printing:

1. To be sure that the exposure ratio is correct for each filter.
2. To identify easily the respective negatives.
3. To have plain register marks on each.

The graded steps of the neutral density scale in the center of the chart is used as a check of correct exposure of the original subject. This scale may be reproduced thin or dense, depending on the exposure required by the subject, **but it should be the same in all three negatives.**

Three colors: Yellow, Magenta and Blue-Green are printed upon the upper portion of the chart. Their purpose is to assist in identifying each of the three negatives with respect to the filter through which each was made. Each color is identified by its name appearing upon it in white letters. Above each name appears in brackets the name of its complementary color (of which it is the *minus* color). As the chart is photographed successively through the three color separation filters: Blue-Violet (C-5), Red (A), and Green (B) each inscription will appear best and most contrasty as it is photographed through the filter of a complementary color. Thus the yellow color will show its name best when photographed through the Blue-Violet (C-5) filter, the magenta—when photographed through the Green (B) filter, and the blue-green—through the Red (A) filter. In this manner the white inscriptions will act as self-identification marks upon the negatives and positives: the colors in brackets indicating the color of filter employed to produce the negative, while the capitalized words indicate the color of the dye to be used for making the positive.

Thick and thin register marks available on the two halves of the lower portion of the chart are given so that they may be used for large or small reproductions. They should be placed at opposite ends of the original as far apart as possible.

If this chart can be used in the actual photograph, the largest available size of it should be used and two or more placed next to the subject matter, in the plane of the sharpest focus but outside of the area required for the finished photograph, however within the field covered by the camera. Thus while they will appear on the original film they can be omitted from the finished print.

For the making of three color separation negatives in the Valoy or Focomat Enlarger it should be remembered that either of these enlargers will accommodate a negative area up to 4 x 4 centimeters. For this purpose a hinged, double glass negative carrier should be used (code word VOONR). The following procedure is recommended as preparatory to the making of three color separation negatives.

1. Separate the four parts of the smallest size of the Wratten Card Board Chart (3¼ x 4¾) along their perforations.
2. With the Leica camera and any of the copying attachments (see chapter on Copying) copy the strip containing the three color ink patches: yellow, magenta, blue-green without filter, using photoflood lights for illumination. The length of this strip, about four inches, should be accommodated within the long dimensions of the Leica negative which will reduce it on the negative to about 1¼ inch. A number of exposures should be made and after development that frame should be chosen which renders the colors best.
3. On the same supersensitive Panchromatic emulsion copy the central portion of the same chart accommodating the netural density grada-

tion strip within the long dimension of the negative. This strip also should be reduced to about 1¼ inch length.

4. A number of exposures should be made and after development that frame should be chosen which contains definite gradations of each of the eight steps of gray. Over and under exposed frames should be discarded.
5. Separately copy the lowest portion of the chart containing the registration marks. Similar procedures of several exposures should be followed but it is suggested that these registration marks be copied upon positive film and developed for maximum contrast.

As these "accessory copies" can be used repeatedly, their making in the most careful manner will be worth while, and their preserving in separate envelopes for repeated use will repay the trouble in results and economy of time.

As soon as these copies are available one may proceed with the making of three color separation negatives by placing the Kodachrome transparency and the various pieces of film containing the copies of portions of the Wratten Copy Board Chart within the hinged glass negative carrier in the manner shown in figure 223.

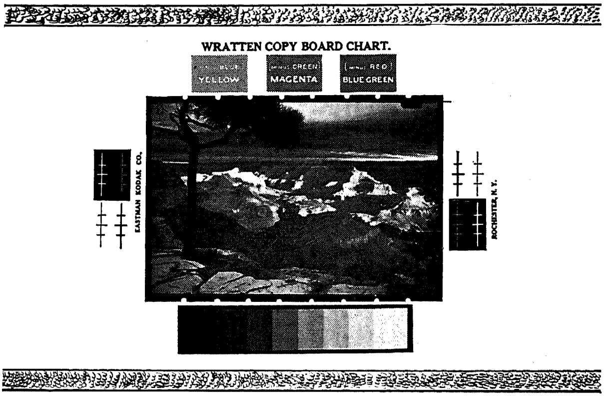


Fig. 223 Wratten Copy Board Chart

Arrangement of material within the Hinged Plate Glass (code word VOONR) Negative Carrier as required for making of three color separation negative.

Center—original Kodachrome transparency (emulsion side away from enlarger lens) with perforations on both sides trimmed off;

Bottom—Negative copy of neutral density steps;

Top—Negative copy of color ink patches;

Right and Left—Negative copies of registration marks.

It is suggested for making three color separation negatives that the next larger size of negative film be used for the three color separation negatives than the size of the finished negatives. Thus if 3¼ x 4¼ enlargement is contemplated a 4 x 5 or 5 x 7 negative be used to accommodate the auxiliary data furnished by the Wratten Copy Board Chart. The importance of having these marks cannot be over emphasized and will be realized by the worker only while he actually carries out the job to completion.

Color Separation Filters

Satisfactory filters for the color separations are Wratten No. 29 red, No. 61 green, and No. 49 blue. These are placed successively between the slide and film in making the three exposures. As a negative material, Eastman Safety Super Sensitive Panchromatic Cut Film is recommended. However Eastman Portrait Panchromatic will produce satisfactory results. In either case, film with the antihalation backing should be used.

For development of the negatives, Eastman DK-50 is recommended, about five minutes for the red and green filter negatives, and seven and a half minutes for the blue filter negatives.

Trial exposures can be made through the red filter and sufficient time given to produce a veiling over of the shadow tones.

With the 250-watt, 115-volt G 30 Mazda, used with a heat absorbing glass, the filter factors are as follows:

TABLE I

Filter	Relative Exposure	Filter Factors
29 Red	1.0	5.3
61 Green	1.5	8.0
49 Blue	4.0	21.0

By way of example a Kodachrome Leica picture of average density and contrast enlarged 6½ times at a lens aperture of f:8 will require approximately the following exposures:

29 Red	4½ seconds
61 Green	7 seconds
49 Blue	18 seconds

The ratio of exposures and development for any light source, developer, type of material or set of filters can be established using Table 1 as a guide.

A new method has been recently developed for making the wash-off relief positives, called the Automatic Masking Method. The reason for this new method is to provide the proper amount of color correction to each relief print. The necessity of this correction arises from the fact that up to the present time, no perfect set of three color printing dyes, pigments, or inks have been invented. It is well known that each subtractive printing colored substance should absorb one of the three primary colors of white light and transmit or reflect the other two. This ideal condition does not exist, so the masking method was designed to correct for some of the inefficiency of the dyes.

With the automatic masking method, the red filter negative is printed on to wash-off relief film in the usual way. This is developed, carried through the bleach wash-off, fixed, and dyed blue-green. After the blue-green transparency is dry, it is superimposed in register over the green filter negative. Another print is made onto wash-off relief film of the green negative and the blue-green positive. This print is carried through the process and dyed magenta. When this is dry, both the blue-green positive and the magenta positive are superimposed in register over the blue filter negative and the final print made on wash-off relief film carried through the process dyed by a new dye, CK yellow. When the yellow is dry, the three positives can be bound together as a transparency or all three wetted and the dye images transferred to the prepared paper. When making the positives by this method the violet 35 filter is not used.

A new paper is available, called Trade 867, which is gelatin-coated and only needs to be bathed for 5 minutes in a solution of aluminum sulphate, washed for 5 minutes in running water, then bathed for 5 minutes in a buffer solution of 5 per cent sodium acetate.

The paper can be used immediately or dried for later use. It must always be wetted and stretched before the transfers are made.

The color relief prints are now transferred to the paper, yellow, magenta, and blue-green; the time required is about 5 minutes for the yellow, 10 minutes for magenta, and 8 minutes for the blue-green.

Complete instructions can be obtained from the Eastman Kodak Company. However, to show the steps necessary the following outline may provide a clear picture of the procedure:

SUMMARY OF PROCEDURE

Three Color Separation Negatives

1. Enlarge Kodachrome picture on Eastman Safety Supersensitive Panchromatic Cut Film, Antihalation, through Wratten Filters No. 29, 61, 49. The exposure should be such that when properly developed it will produce a density of about gamma 1.8 on each negative for a diffuse white highlight under this developing condition.
2. Develop the red and green filter negatives in a tank of DK-50 developer for about 5 minutes at 65° F. (18° C.) or sufficient time to attain a gamma of about 0.8. (See page 138 about gamma.) Develop the blue filter negative for about 7½ minutes, or sufficient time to attain the same gamma.

KODALK DEVELOPER (Formula DK-50)

	Avoirdupois	Metric
Water (about 125° F. or 52° C.)	16 ounces	500.0 cc
Metol	36 grains	2.5 grams
Sodium Sulphite, desiccated	1 ounce	30.0 grams
Hydroquinone	36 grains	2.5 grams
Kodalk	145 grains	10.0 grams
Potassium Bromide	7 grains	0.5 gram
Cold Water to make	32 ounces	1000.0 cc

Dissolve the chemicals in the order given.
Use at 65° F. or 18° C.

3. Fix, wash and dry negatives in the usual manner.

OUTLINE OF THE PRINTING PROCESS

Making the Relief Positives

A. Blue-Green.

1. Make a contact print **by white light** (the violet filter, Wratten No. 35 is not used over the light source in this method, which is known as

the semi-automatic masking) onto Wash-Off Relief Film. Expose through relief-film support.

2. Process completely the print from the red filter negative:
   a. Develop 5 minutes in Formula D-11 at 65° F. (18° C.)

DEVELOPER (Formula D-11)

	Avoirdupois	Metric
Water (about 125° F. or 52° C.)	64 ounces	2.0 liters
Metol	60 grains	4.0 grams
Sodium Sulphite, desiccated	10 ounces	300.0 grams
Hydroquinone	1 ounce 85 grains	36.0 grams
Sodium Carbonate, desiccated	3 ounces 145 grains	100.0 grams
Potassium Bromide	290 grains	20.0 grams
Water to make	1 gallon	4.0 liters

Use without dilution.

   b. Wash 10 minutes in running water at no more than 70° F. (21° C.)
   c. Bleach completely (about 2 minutes) in Solution R-10a, at 65° F. (18° C.)

(Formula R - 10a)
WASH-OFF RELIEF BLEACHING SOLUTION

Stock Solution A

	Avoirdupois	Metric
Water	16 ounces	500.0 cc
Ammonium Bichromate	290 grains	20.0 grams
Sulphuric Acid C. P.	1 dram	4.0 cc
Water to make	32 ounces	1.0 liter

Stock Solution B

	Avoirdupois	Metric
Sodium Chloride (table salt)	1½ ounces	45.0 grams
Water to make	32 ounces	1.0 liter

For use, take 1 part of A, 1 part of B, and 6 parts of water.

   d. "Develop" relief for 4 minutes in water at 125° F. (52° C.)
   e. Fix 1 minute in Bath F-24.

NON-HARDENING FIXING BATH (Formula F-24)

	Avoirdupois	Metric
Water (about 125° F. or 52° C.)	16 ounces	500.0 cc
Hypo	8 ounces	240.0 grams
Sodium Sulphite, desiccated	145 grains	10.0 grams
Sodium Bisulphite	365 grains	25.0 grams
Water to make	32 ounces	1.0 liter

   f. Wash 5 minutes in running water.
   g. (Optional) If necessary bleach brown stain by bathing 1 minute in Permanganate Reducer R-2.

PERMANGANATE REDUCER (Formula R - 2)

Stock Solution A

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Permanganate	1⅝ ounces	52.5 grams
Stock Solution B		
Water	32 ounces	1.0 liter
Sulphuric Acid, C. P.	1 fluid ounce	32.0 cc

For use, take 1 part of stock solution A, 2 parts of stock solution B, and 64 parts of water.

Important: When preparing stock solution **B,** always add the acid slowly to the water while stirring the water rapidly. **Never add the water to the acid,** or the solution may boil over and spatter on the hands or face, causing serious burns.

h. (Optional) If above treatment was resorted to, finish up by washing for three minutes in running water, clearing by replacing in Bath F-24 for 1 minute, then washing it for 5 minutes in running water. Drying it is not necessary, though advisable to avoid too high contrasts.

3. Dyeing the Relief.
   Dye the Relief from the red filter negative in the BLUE-GREEN A dye solution containing about 2.0 cc of 5% Acetic Acid in 500.0 cc of dye solution, or sufficient acid to make the blue-green image appear by reflected light almost as high in contrast as the Kodachrome appears by transmitted light, when both are viewed through a No. 29 Wratten Filter.

4. Rinse the blue-green relief positive in 1/10 per cent (0.1%) of Acetic Acid—and **dry.**

B. Magenta.

1. Register the BLUE-GREEN Relief Positive with the green filter negative.
2. Make a contact print **by white light** from the masked green filter negative onto Wash-Off Relief Film, giving it about 1½ times the exposure that would be given if no mask were present.
3. Process completely the print from the masked green filter negative. (Steps as for Blue-Green Relief Positive: 2a - 2h before).
4. Dye the relief from the masked green filter negative in the Magenta B dye solution containing about 6.0 cc of 5% Acetic Acid to give good reproduction of the Kodachrome when the wet blue-green and magenta reliefs are superimposed on a white tray bottom and both the Kodachrome and the reliefs are viewed through a yellow filter, Wratten No. 12.
5. Rinse the magenta relief Positive in 1/10 per cent (0.1%) Acetic Acid solution and **dry.**

C. Yellow.

1. Register both the BLUE-GREEN and MAGENTA Relief Positives with the blue Filter Negative.
2. Make a contact print **by white light** from the doubly masked blue filter negative onto Wash-Off Relief Film, giving about 2 times the exposure required without the masks.

3. Process completely the print from the masked blue filter negative (Steps as for Blue-Green Relief Positive: 2a - 2h).
4. Dye the positive relief from the masked blue filter negative in the new CK dye solution so as to obtain a good reproduction of the Kodachrome by light of daylight quality in the three wet superimposed dyed reliefs. Add a small amount of 5% Acetic Acid to the dye solution, only if necessary.
5. Rinse the yellow relief positive in 1/10 per cent (0.1%) solution of Acetic Acid and dry.

Corrective Measures.

If necessary to increase contrast of Reliefs Dyed for transfer—all three negatives should be intensified by identical treament with Chromium Intensifier In-4.

CHROMIUM INTENSIFIER (Formula In - 4)

Stock Solution

	Avoirdupois	Metric
Potassium Bichromate	3 ounces	90.0 grams
Hydrochloric Acid C. P.	2 fluid ounces	64.0 cc
Water to make	32 ounces	1.0 liter

For use, take 1 part of stock solution to 10 parts of water. Bleach thoroughly, then wash for five minutes and redevelop fully (5 to 10 minutes) in artificial light or daylight in any quick-acting, non-staining delevoper containing the normal proportion of bromide, such as Formula D-11, diluted 1:3. Then wash thoroughly and dry. Greater intensification can be obtained by repeating the process. The degree of intensification can be controlled by varying the time of redevelopment.

If the picture should appear too contrasty, the dyes should similarly be removed from the reliefs by washing first in a 1% solution of strong aqueous ammonia, and then in plain water.

1% Ammonia Solution

Add one part by volume of strong ammonia water to 100 parts of water.

Making Imbibition Transfers to Paper.

1. Prepare paper in advance, or during dyeing of reliefs.
   a. Bathe the gelatin-coated paper, known as Trade 867 for 5 minutes in the following Paper-Mordanting Solution.

Aluminum Sulphate Solution for Mordanting Paper (Formula M - 1)

	Avoirdupois	Metric
(A) Aluminum Sulphate	6¾ ounces	200 grams
Water to make	32 ounces	1 liter
(B) Sodium Carbonate, des.	1 ounce 145 grains	40 grams
Water to make	16 ounces	500 cc

Add **B** slowly to **A**, stirring well during the addition. A white precipitate is at first formed, but this dissolves upon stirring. If a trace should remain, it can be filtered out with a rapid filter paper.

   b. Wash for 5 minutes in running water.

c. Bathe for 5 minutes in the following buffer solution:

5% Sodium Acetate Solution

Dissolve Sodium Acetate, Anhydrous, 50 grams in 950 cc. water, or dissolve Sodium Acetate, Anhydrous, 1 2/3 ounces in 32 ounces water.

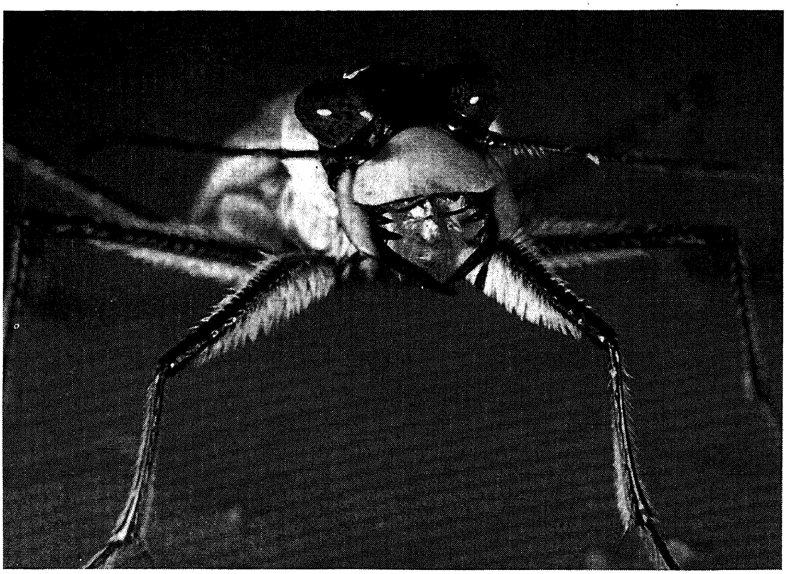
d. Wash for 5 minutes in running water and use wet.

2. Soak the dyed relief positives thoroughly in 1/10 per cent acetic acid.
3. Rinse the yellow relief positive for 1 minute in distilled water and then immediately squeegee it onto wet mordanted paper, known as Trade 867, and allow to remain until the transfer of the dye is uniform and substantially complete.
4. Squeegee the magenta relief positive onto the same sheet of paper and allow to remain until the transfer of the dye is uniform and substantially complete.
5. Squeegee the blue-green relief positive onto the same sheet of paper and allow to remain until the transfer of the dye is uniform and substantially complete.
6. Dry and mount prints as desired. Dry mounting is very satisfactory.

Transparencies

A set of reliefs can be used for a transparency, for which purpose a slight difference in dyeing is required. When the three dyed reliefs are dry they are registered and bound between two pieces of glass. For projection in a lantern they should be varnished before

Fig. 224 Tiger Beetle J. M. Leonard
See Chapter 20 for method of photography



registering and binding them. Varnish Formula 1 will produce the most satisfactory results.

Varnish Formula for Color-Film Transparencies (Formula V-1)

	Avoirdupois	Metric
Gum Sandarac	365 grains	25 grams
N-Butyl Alcohol	6½ fluid ounces	200 cc
Castor Oil	1¼ fluid drams	5 cc
Oil of Lavender	¼ fluid dram	1 cc

Warm the gum sandarac and butyl alcohol together until the sandarac has been entirely dissolved. **(Caution: Butyl alcohol is inflammable, and should not be heated over an open flame.)** Then filter the solution through a fine, lintless cloth, add the castor oil and the oil of lavender, mix thoroughly and cool before using. The oil of lavender may be omitted if the odor of the castor oil is not objectionable.

For convenience the following table of Dilutions of Acetic Acid is offered, these various concentrations being required for the different parts of the procedure.

Table of Dilutions of Acetic Acid

Concentration in %	Amount of Acetic Acid: Glacial Acetic Acid	28% Commercial Acetic Acid
1/10%	1 cc diluted to 1 liter, or ¼ fluid dram diluted to 32 ounces	3.6 cc diluted to 1 liter, or 1 fluid dram diluted to 32 ounces
½%	5 cc diluted to 1 liter, or 1¼ fluid drams diluted to 32 ounces	18 cc diluted to 1 liter, or 5 fluid drams diluted to 32 ounces
5%	50 cc diluted to 1 liter, or 13 fluid drams diluted to 32 ounces	180 cc diluted to 1 liter, or 5¾ fluid ounces diluted to 32 ounces

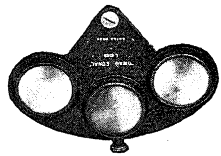
For those interested in making Wash-Off Relief prints it might be pointed out that little or no difficulty is ever experienced in making the three color separation negatives or the dye positive matrices.

Most of the errors are made in dying the matrices to correct color balance. Particular attention should be paid to following detailed instructions on this subject available from the Eastman Kodak Company. It is therefore suggested that before attempting above procedure the following two booklets be secured from the Graphic Arts Department, Eastman Kodak Company, Rochester, N. Y.:

1. "Making Color Prints on Paper from Kodachrome Films."
2. "Color Printing with Eastman Wash-Off Relief Film."

Making Separation Negatives in the Camera

The Kodachrome film is undoubtedly the quickest and simplest method of obtaining the original color positive. Requiring no accessories "in the field" it can be broadly applied to action photography, and photography of living and moving objects. At times, however, it may be desirable and possible to make three separate negatives of the same object. This is done simply by making three exposures on the same Panchromatic film, one exposure through each of the standard Wratten three color separation filters A, B and C-5. A set of these three filters mounted in a rotating segment is produced and distributed by the Chess United Co. of New York. This combination set is known as the "Trichromatic Separation Filter," is mounted directly over the lens and each of its three filters moved into taking position as required. (The same filter can also be used in connection with making three color separation negatives by projection in the enlarger.)



Trichromatic Separation filter for use on Camera or Enlarger Lens.

The exposure factors of the three color separation filters vary depending on the negative material used. They will be found in the filter factor table on page 111. As a matter of convenience the following filter factors for DuPont Superior Film are given:

	Daylight	Photoflood	Mazda
A	9	5	4
B	5	6	6
C-5	6	10	13

It seems almost superfluous to point out that the camera must be rigidly supported for the making of three color separation negatives. A neutral density scale consisting of step gradations of white, grey and black, sharply outlined, should always be placed in a corner of the picture (so as not to appear later in the finished print but to appear on every negative). The scale must be illuminated in the same manner as the subject and should be sharply in focus to serve not only as a means of comparing the density of the negative but also as a means for registering the three prints in superimposing them. When the negatives are developed and dried they should be marked along the edge with good water proof India ink as follows: B for the negative taken through Red filter for blue color; R for the negative taken through green (to be colored red); Y for the negative taken through blue filter (to be colored yellow).

The color balance of the final prints will depend upon the care and relative correctness of exposure used in making the original black and white negative in the camera, or of the separations made from the Kodachrome positive. If correct exposure has been given the neutral density scale referred to will have the identical tone value in each negative. If the original negatives are not correctly exposed, it may some times be possible to make a slight compensation by varying the exposure during subsequent manipulations, but the results will not be as satisfactory as those originating from correctly balanced negatives.

The problem of securing proper balance of densities in the three-color separation negatives requires considerable experience before satisfactory results are obtained and a good deal of experimental work will have to be done before the proper technique is acquired. However, once a set of satisfactory three-color separation negatives is available, one may proceed to make color prints either by the Eastman Kodak Wash-off Relief Method or by the Defender Chromatone Process.

DEFENDER CHROMATONE COLOR PRINTING PROCESS

ROWLAND S. POTTER **CHAPTER 16**

All manipulations involved in the Defender Chromatone Process are very simple, and little difficulty should be experienced by the Leica worker who is already familiar with the developing and toning technique. The process is based upon the principles of three-color photography of the subtractive type. Briefly, the process involves the superimposition of three transparent positive prints: one toned yellow, another magenta, and the third blue-green—all mounted upon a white background, the finished product resulting in a picture in natural colors. The original photograph may be taken either by direct color film, such as Kodachrome or three separate negatives can be made by direct photography through green, red and blue filters. When the original color photograph has been made on Kodachrome, it will be necessary to make three color separation negatives as described above from which subsequently Chromatone color positives are made.

White light is a mixture of all known colors. White is not an absence of color, but on the contrary it is the sum total resulting from the presence of all colors. To show the presence of the components of light we can pass a beam of this white light through a glass prism with the result that the colors are separated into the spectrum: violet, blue, bluish-green, green, yellow, orange and red. Each of these spectral colors is a true color which cannot be broken down or separated into other colors by any known methods.

For practical purposes, the spectrum may be considered divided as shown in the following diagram:

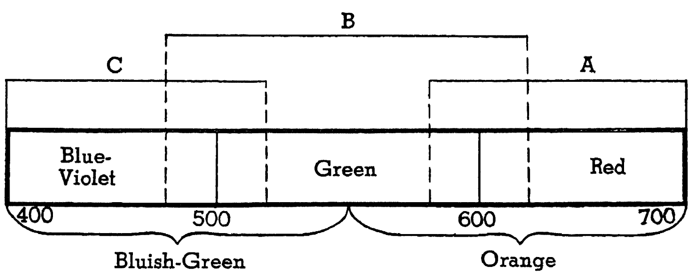


Fig. 226 A Photographic Division of the Spectrum

The color of any object is due to the color of that portion of the incident light which is reflected from its surface. The other colors of the incident light that are not reflected are absorbed by the object.

It is commonly known that any color can be reproduced by mixing varying quantities of blue-violet, green and red colors. Therefore all three-color processes are based on photographing separately the primary colors: red, green and blue. In the case of Kodachrome this is accomplished within the body of one composite emulsion while in three color separation negatives made in the camera, or by projection, this is done by three separate exposures made through red, green and blue light filters respectively.

Making the Actual Color Prints

The principle of color prints is based upon considering the white paper stock upon which the print is being built up as the light source. This white paper stock reflects all colors of the spectrum. From each of the three separation negatives secured either directly through the camera, or by projection from a color transparency like the Kodachrome, positive prints are made upon a special stripping film (Chromatone Print paper) which is exposed and handled similarly to projection paper. The collodion emulsions of the Chromatone Print Paper are stripped off their base, toned to the proper color, which is complementary to the color of the filter through which its respective negative had been made, and superimposed over each other upon the white paper backing. The complementary color of red is blue-green; it transmits both blue and green, absorbing red, being therefore *white minus red.* The complementary color of green is blue red or magenta; it transmits both the blue and red, and is therefore *white minus green.* The complementary color of blue is red, green or yellow; it transmits both red and green, and is *white minus blue.* When all color prints are superimposed upon the white mounting paper, each print will thus subtract from the white of the paper all the portions of the original which were not blue, green or red, according to the respective light filters through which its negatives were taken. Such superimposed prints if correctly registered will give a print in natural color.

The black and white Chromatone prints are thoroughly fixed and washed for at least 15 minutes in running water. In the fixing bath the gelatin emulsion can be stripped or separated from the paper backing. The stripped emulsions should be handled with reasonable care to avoid formation of kinks. The next step is to tone each film in its respective Chromatone toning solution.

Toning the Separation Positive

The stripped off black and white positive films which are intended for the Red and Blue images are placed together in one tray and the Red and Blue toner-A made up according to the formula sheet accompanying the materials is poured over. They should remain in the A solution for at least 15 minutes thoroughly agitated until all of the black silver is removed. When these prints are thoroughly toned they will appear as a light greenish blue image. They are then placed in running water and thoroughly washed for about 10 minutes. It is essential that hands be kept clean at all times to avoid contamination of various solutions.

After this washing, the film to be toned is placed in the Red toner B, and allowed to tone for about 10 minutes. The solution is then poured off for use a second time, and the print is immersed for three minutes in a 15% hypo solution (granular or rice hypo: 2¼ oz.) (70 grams)—distilled water 32 oz.—(1000 cc.) (Do not use acid fixing hypo). It is then washed for about 15 minutes in running water.

Similarly, the film to be toned Blue-green is placed in the Blue toner B and allowed to remain for about 10 minutes, after which the toner is poured off for use a second time, and the print immersed in a tray of weak Hydrochloric Acid solution for about one minute. Use one part of diluted solution Hydrochloric Acid CP: 16 oz. (500 cc.)—distilled water 48 oz., (1500 cc) with one part of water. The print is then thoroughly washed in running water for about 10 minutes after which it is placed in a tray containing standard hypo solution (see above) until greenish tones have changed to blue. It is then washed for 20 minutes in running water.

The Yellow toning solution (Yellow Toner A) is supplied in two solutions, equal parts of which are mixed for one. The print to be toned yellow is immersed in this solution for about 15 minutes. This work may be carried on simultaneously with the blue and red toning operations, separate trays being used. At the end of about 15 minutes the solution is poured off into a graduate and 10cc (3 drams) of standard hypo solution is added to every 50cc (2 oz.) of working solution, and thoroughly mixed. Next wash the print for 2 or 3 minutes in running water, or in one complete change of water, return it to the tray and pour the solution back on the print. This operation should be done quickly, and the tray should be vigorously rocked for about 1 minute to prevent any streaking of the yellow image. The print is now allowed to remain in the solution for about 3 minutes, after which the solution is discarded, the print washed for a minute or two in clear water, and then immersed for about 1 minute in a solution made up of standard hypo solution—one part, water three parts. Do not keep the print longer than one minute in this solution as the image at this stage is slightly soluble in hypo and highlight detail may be lost thereby. Wash the film immediately for not less than 20 minutes in running water. The yellow image, after thorough washing, is immersed for about 2 minutes in Yellow toner B, and then washed in running water for about 20 minutes. It is then ready for assembling.

The three-color images are now registered on a gelatin coated paper (Chromatone Backing Paper) which has been previously soaked thoroughly in water. Lay the backing paper gelatin side up, on a clean ferrotype tin, clean glass or Masonite tempered hard board, or on any flat waterproof surface. The Yellow image is placed first on the paper and squeegeed firmly into place, emulsion side down, and allowed to remain for a few minutes. The Red image is then placed on top of the Yellow, pushed carefully into register, squeegeed lightly, the register checked, and adjusted if necessary, and the Red image squeegeed firmly into place. If at this point the two images do not appear exactly in register, the Red sheet may be peeled off carefully, re-moistened and registered again. It will be found easier to register the Red and Yellow images if they are viewed through a light blue filter.

The Blue image is then superimposed upon the other two, precisely as described above, completing the color print; all prints emulsion side down.

The print is now allowed to remain in the air for about 10 minutes until the surface dries to some extent. Next, the damp print should be trimmed so that the edges of the collodion layers are flush. It is then placed on a piece of rigid, hard waterproof material. Masonite Tempered Hard Board is admirably suited for this purpose.

Ordinary Kraft gummed tape is moistened and the damp print fastened to the board with this tape overlapping the print about 3/16" on all four edges. Do not have the gummed tape too wet or the gum will ooze between the print and the board, making it difficult to remove the print.

The print will dry rapidly, stretched absolutely flat. It can be loosened from the board when dry by carefully inserting a sharp knife through the tape under the edge of the print and running it around the print.

Chromatone prints, ordinarily processed, dry with a high gloss and great color brilliancy, which is considered desirable for illustrative and commercial work.

A MATT finish can be obtained by rubbing over the glossy surface with fine dry pumice powder. If the finished print is given a coat of good matt lacquer applied with an air brush, varying degrees of matt finish can be secured.

To obtain rougher surfaces, any of the regular rough textured papers, such as Defender Veltura Q, can be used instead of the glossy base paper when assembling the print. Simply fix the paper, without exposure and thoroughly wash it.

The above described Chromatone Process of making color photographic prints is one in which color images are formed on three transparent media which are permanently superimposed upon paper, forming a print consisting of a number of layers.

Condensed Routine for Producing a Chromatone Print

An organized method for producing a Chromatone print is specially detailed below. There are no lost motions. A finished print will be obtained in less than one hour.

The set of three black and white Chromatone prints, having been thoroughly fixed (see page 318), are taken directly from the fixing bath, the paper backing discarded and the stripped films placed in a clean tray (No. 1) filled with water in the order—Yellow, Blue and Red. They are then immediately transferred, one at a time, to another tray (No. 2) of clean water.

The first tray is then emptied, filled again with clean water, and the films transferred back to it. This accomplishes the third change of water. In like manner, two more transfers of the films are made through trays filled with clean water. When this is done, all three films are in tray No. 1. the yellow at the bottom and red on top.

Condensed Routine for Toning Chromatone Prints

1. WASH set of three developed Prints—after fixing and stripping from backing paper—through FIVE changes of water in trays 1 and 2—finish with prints in Tray 1 in this order: YELLOW bottom—RED—BLUE top.
2. Place RED and BLUE prints in Tray 2, cover with Red-Blue A working solution. Bleach 15 minutes.
3. Drain water from YELLOW print in Tray 1, cover with Yellow Toner A Working solution. Bleach 15 minutes.
4. Place BLUE print in Tray 3—wash five or six changes of water —cover with Blue Toner B.
5. Drain Red-Blue Toner A from tray 2—discard solution—wash RED print five or six changes of water—cover with Red Toner B.
6. Pour Yellow Toner A Working solution into graduate—add 10 cc. Standard Hypo—mix well—wash YELLOW print once—cover with Yellow Toner A (plus Hypo), continue toning for 3 minutes. Discard Yellow Toner A—wash YELLOW print once —cover with dilute Hypo solution (1 part Standard Hypo, 3 parts water) for one minute—wash YELLOW print through five or six changes of water—cover with Yellow Toner B for 2 minutes—pour Yellow Toner B back into bottle—wash YELLOW print through five or six changes of water—keep in final wash for later assembling.
7. Pour Blue Toner B from tray 3, back into bottle—flush BLUE print with dilute Hydrochloric Acid (one part dilute acid to six parts water) for one minute—wash print through five or six changes of water—add Standard Hypo to cover, for five minutes.
8. Pour Red Toner B from Tray 2 back into bottle—add Standard Hypo to cover—for three minutes—wash RED print through six changes of water—keep in final wash ready for assembling.
9. Drain Standard Hypo from BLUE print in Tray 3, wash print through six changes of water—keep in final wash ready for assembling.
10. Wash YELLOW Print in Tray 1 through six changes of water—ready for assembling.

A very interesting detailed description of the Defender Chromatone Process, its principles and practical application is offered in a booklet that should be secured from the Defender Photo Supply Co. of Rochester, N. Y.

Resident, Shenandoah National Park — Arthur Rothstein
For Resettlement Administration, Washington, D. C.

EDUCATION THROUGH THE EYE

ROY E. STRYKER
EDWIN LOCKE

CHAPTER 17

Learning by Looking

There is no better way to get an appreciation of the camera's possibilities than to pause and take an honest inventory of your knowledge. Ask yourself what you know about geography, politics, economics, or current events. Then ask yourself how much of this knowledge is based on pictures you have looked at. Unless you have been hidden away somewhere, out of reach of newspapers, magazines, books, pamphlets and the cinema, you will find yourself recalling image after image that was originally formed on a sensitized emulsion. You will find that your grasp of things in this modern world would be weak without the camera, which captures events, personalities or landscapes and holds them for you to consider at leisure.

Because of the camera, an ever-increasing amount of our knowledge comes through visual experience. Educators today are aware of this, and it is because of this awareness that a brief survey of the possibilities of visual aids in education is presented here. We wish to emphasize that this is directed not solely at professional educators, but insofar as we all have responsibilities as teachers, to every owner of a camera.

Sources

Visual material has three main sources:

1. Original camera work performed in the field.
2. Clippings from newspapers and magazines, posters, advertisements, books, catalogs, letters, reports (much of this material can best be made available for classroom use by means of photographic copies).
3. Charts and pictographic material.

Original camera work by teacher and student may be general in scope or laid down along the lines of some special interest. The historian may use his camera solely for copying records and documents; the scientist to record experiments and make field notes; the

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Photographs, Courtesy Resettlement Administration.

sociologist to make an objective study of people and their environment. The student, whether he works under close direction or is left free to pursue a general photographic inquiry, not only brings a fresh viewpoint to the subject, but is benefitted directly through his active participation in the learning process.

Importance of a Shooting Script

Whether the work is general or specialized . . . and this concerns every camera user . . . the first step should be the preparation of a "shooting script." Not only will time and materials be saved, but in the very preparation of a script valuable considerations which are likely to be overlooked in the field often arise. Thus a person taking a dozen pictures with a clear idea of what he means to show in them will have material of more interest than the maker of a hundred pictures who, instead of shooting squarely at his subject, shoots around it.

The preparation of a shooting script is a simple job if the following questions are borne in mind:

1. What do I want to show?
2. How can this be done in photographs?
3. Specifically what photographs do I need to make a rounded job?
4. Where am I likely to find my subjects?

Note: (1) In realizing your shooting script with the camera, it pays to be liberal with film. Unless you are unshakeably confident in yourself as a photographer, take your subject from various angles and experiment with different exposures. You will find, on returning from the field, that the extra material thus collected will often spare you annoyance and regret. (2) It is well to realize at the outset that there will be an inevitable divergence between your initial idea as outlined in the shooting script and the final result as expressed in terms of photographs. This is the fate of all outlines, and is more often a good, rather than a bad sign, since it denotes a ferment and development of creative ideas occurring between the plan and the finished product.

Presentation

The effectiveness of visual material depends largely on its presentation. The two most important methods of presentation for classroom use are:

1. **Flat prints** (a term covering photographs, pages from books, magazines, catalogs, copies, clippings, etc.)

a. For individual study or to be passed around class or discussion groups.

b. For wall or bulletin-board display (when placed on convenient and well-lighted bulletin boards, flat prints may be briefly surveyed or studied at leisure).

Note: The importance of good "layout," i. e., the placing of pictures in groups so as to show their relationship to one another, cannot be too greatly stressed. Good layout has a double function: integration and interest. Some suggestions follow:

1. Use prints of varying sizes; the minimum effective size is approximately 8″ x 10″.
2. Select a "theme" picture . . one which is highly significant and dramatic . . . and focus attention on it by enlarging it and placing it in a key position. A few good pictures, well arranged, are better than many which are "just thrown together."
3. Use neat, clear and simple lettering for titles and captions. There are several practical mechanical lettering outfits on the market which make uniform and attractive lettering a simple process.
4. Color can often be used to good advantage in the background on which pictures are mounted.
5. Any device which will create interest without changing or destroying meaning is a legitimate one.

c. Flat prints, especially photographs, when greatly enlarged give a much more vivid experience than they do in small hand sizes. Big enlargements can be mounted on cardboard or composition panels which are hinged, so that they may be folded up when not in use and conveniently stored for future presentation.

d. Flat prints may be used in conjunction with three dimensional objects and arranged to make realistic and interesting exhibits.

e. By means of a reflection projector, which utilizes mirrors and lenses, flat prints of any sort can be projected on a screen. Most reflection projectors accommodate flat material up to 8 x 10 inches in size.

2. **Projection** . . . the most widely used projection methods employ some form of transparency:

a. Glass slides . . . there are two sizes of slides in general use:

1. Standard (3¼ x 4 inches) lantern slides.
2. Leica size (2 x 2 inches) slides. These are becoming increasingly popular because of a process by which individual slides may be made directly from Leica negatives (see chapter 12).

b. Film strips . . . a device whereby pictures may be projected in prearranged sequence. A film strip is similar in appearance to moving picture film, having the same composition, size and sprocket-holes. In a film strip, however, each frame has a different subject from adjoining frames, so that in the projection there is no movement, except the progression from one frame to another. The double-frame film strip, the same sized frame which is used in film for miniature cameras, is becoming more extensively used than the single frame, which is the same size as motion picture frames. All new film strip projectors

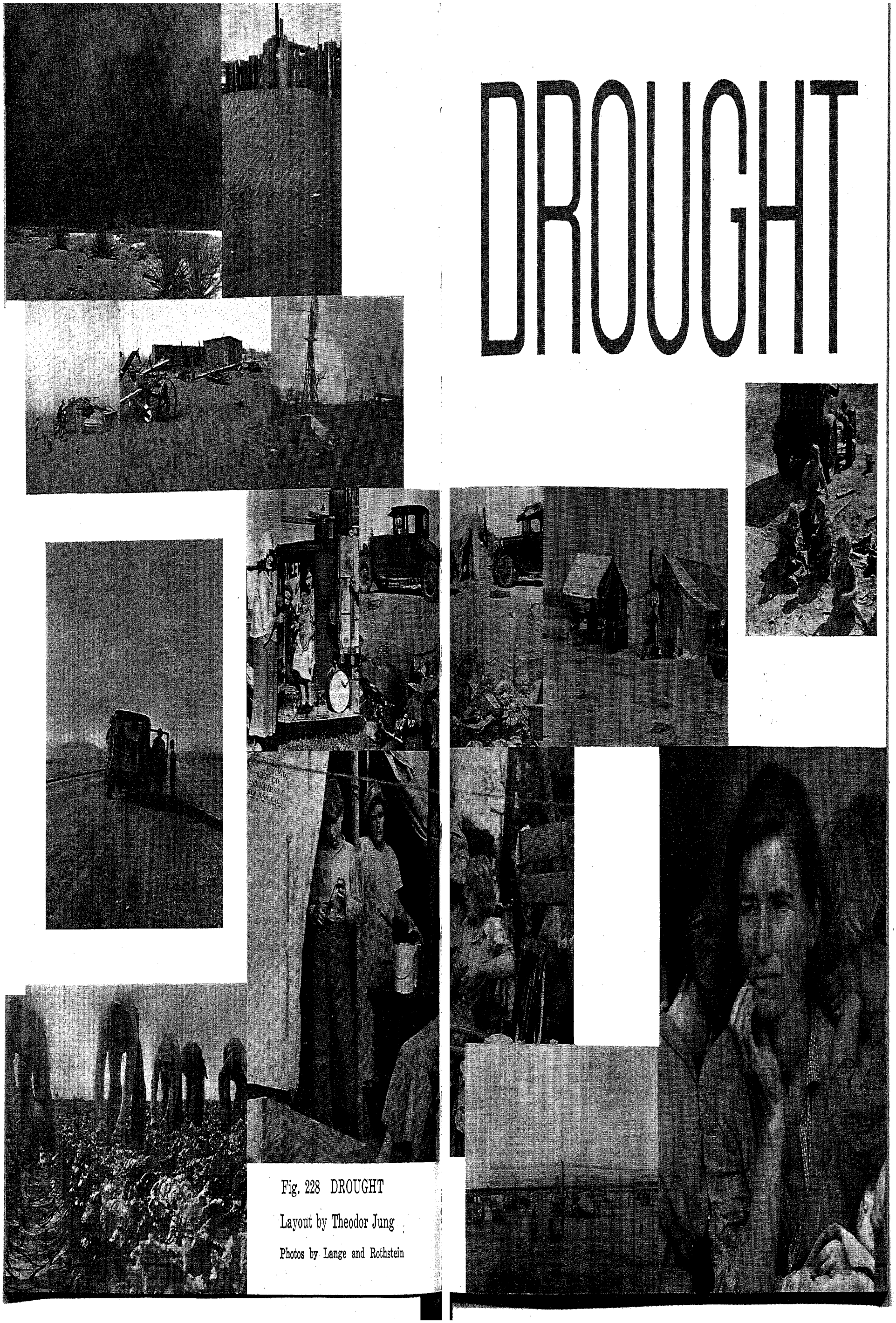

Fig. 228 DROUGHT

Layout by Theodor Jung

Photos by Lange and Rothstein

are being made for double-frame strips. The double-frame strip gives a larger area to project from, and hence gives sharper pictures. Also it is possible to make contact prints directly from miniature negatives.

Note: Glass slides are more generally used than film strips because they are more adaptable in use. A large central file of glass slides can be drawn upon for selections and combinations to illustrate any given subject. Slides last longer than film strips and can be used in any desired sequence.

Film strips, on the other hand, make up for their lack of adaptability by their small bulk and convenience in operation. They should not, however, be considered merely lantern slides in handy form. In conjunction with a narrative given by the instructor from notes or a script, or with a synchronized recorded narration, they can be made as remote in technique from the old magic lantern-lecture combination as the modern "talkie." (Film strip technique is discussed at length farther on in this chapter.)

Notes on the Arrangement of the Drought Layout

The arrangement was made with a definite idea in mind: to show the effect of drought on land and its human consequences. The pictures were selected from about twice the number finally used. Every picture was eliminated that was not essential to the story. Each picture was considered as part of the whole. The choice was finally made on the basis of individual interest in relation to the total effect. The pictures are so placed that the natural movement of the eye follows the sequence of events.

Always use as few pictures as possible. Yet—one drought picture would not have sufficed to give the effect of terrible widespread desolation. Also, the repetition of automobiles emphasizes mass migration. The whole series is finally brought together with the picture of the mother and its challenge to action.

Modern layout, like all modern design, is built on order, simplicity and the subordination of detail to the whole. Use words sparingly. Let the pictures serve as the main vehicle of thought.

Keep lettering simple and legible. Be sure it does not in any way detract interest from the pictures. In the present case, this is avoided because, though large, the letters are thin and light in tone. Avoid any suggestion of the bizarre.

This layout might be used for a wall display several feet in width with running comment by the teacher. It might also be used as a double page spread in a portfolio of similar subjects to be passed around to individual class members. In this case the photographs would be accompanied by brief captions. This arrangement is not a good example of layout for such a small format as the Leica Manual. The pictures are too numerous and some too small.

The pictures used are of different sizes for interest and emphasis. For example: the large picture of the car against the horizon attracts the eye to a new movement in the continuity after the sequence of drought pictures: namely, mass migration.

Note: if you do not feel equipped to organize material into the rather varied pattern shown, use simply rows and blocks of pictures similar to the accompanying line drawing. Again: **avoid complexity of arrangement.**

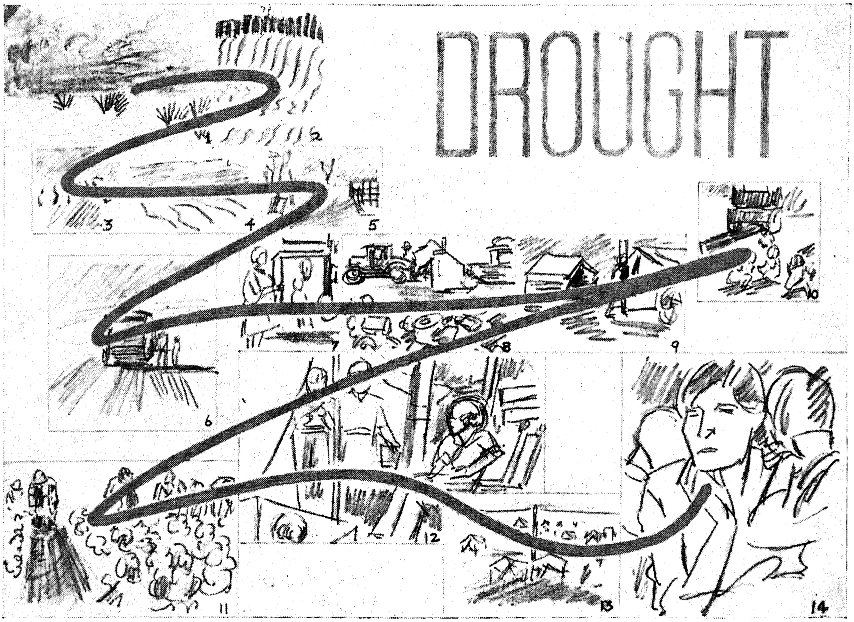

Fig. 229 Diagram Showing Natural Movement of the Eye Across Layout as Shown on Pages 326 and 327

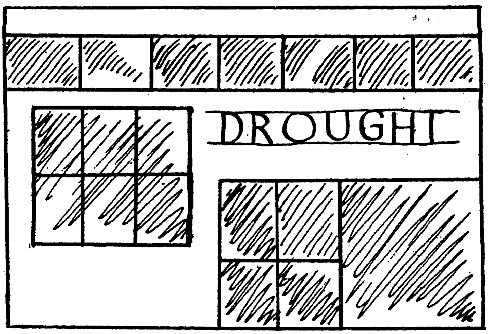

Fig. 230 Diagram of a simplified layout for use when facilities for a more complicated plan are not available

Uses of Visual Material

Visual material, especially the photograph, can be used to good advantage in every branch of knowledge. For an example of its application in pure science, take the study of physics. Photographs taken of each step of an experiment and presented as lantern slides or film strips make it possible to supplant the more laborious and expensive lecture table experiment. A series of laboratory photographs can also serve to illustrate scientific monographs. Or consider another science, such as biology, where the photomicrograph makes possible interesting and highly significant visual material. In those sciences where field work is involved, photographic field notes or records are invaluable for later use in the classroom or for private study.

In the "social sciences," (sociology, economics, government), there is a boundless field for visual material. In these studies the photograph can serve two valuable major functions: dramatization and objectification. In sociology, for example, well-taken photographs supply a human interest that is often neglected in text. A good film strip, by dramatizing a problem, can impress it indelibly in the mind of the student. The study of economics and government can similarly be enlivened by good visual techniques which take advantage of the drama and objectivity inherent in the work of a capable photographer. In addition to the picture, the inclusion of charts and pictographs, cartoons and line drawings, and photographic copies of rare or archival documents, will render any course of study more meaningful and interesting.

A Project in Visual Education

Let us take a sample in visual education. Our subject is, let us say, the Cotton Belt. We will work it out from its beginnings, as a "shooting script," to its completion as a 15 minute film strip.

The first step in the preparation of our script is to ask ourselves what we want to show. Each of us, according to our professional interests, will answer this differently. The teacher of geography, for example, in considering the subject will want to show the extent and nature of the cotton belt, and, if he is an economic geographer, the different methods of cotton cultivation.

Fig. 231 GEOGRAPHY
Alabama Negro Tenant Farmer and Part of His Family Hoeing Cotton

Photo by Lange

The teacher of economics is concerned with the economic structure of the area, its imports and exports, the price fluctuations in cotton; the technologist with the manufacture of cotton and its by-products and the operations of the various industries built around cotton; the sociologist with the influence of cotton culture upon the people, plantation life and its peculiarities; the historian with the plantation sysem, the influence of cotton cultivation on politics and human events; and so on, each considering the subject of the Cotton Belt in a different light, according to his interests.

Once we know what we want to show, we can pass to the second problem: how to show it for visual presentation in a film strip? When we have set down the solution of this problem, our various shooting scripts* may look something like this:

THE GEOGRAPHER:

1. Copy of map showing location of Cotton Belt.
2. Scene in sandy lowlands near the Atlantic coast.
3. " " sand hills of Carolinas or Georgia.
4. " " clay hills of Piedmont area.
5. " " Black Belt of Alabama.
6. " " Black Land Prairie of Texas.
7. " " Mississippi Bottom Lands.
8. Scenes in various seaports of Cotton Belt.
9. Shots of different methods of cotton cultivation.
10. Chart showing date when picking begins.

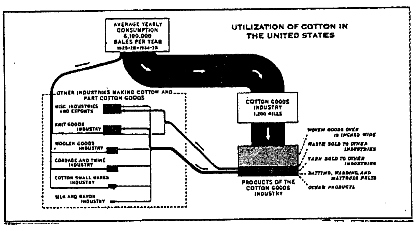

Fig. 232 TECHNOLOGY
Diagram by U. S. D. of Agr.

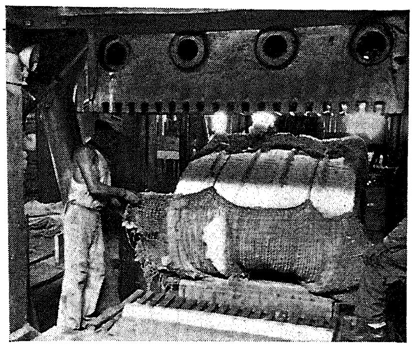

Fig. 233 TECHNOLOGY
Cotton Baling by Eisenstaedt

THE TECHNOLOGIST:

1. Shots of cotton gin showing main and by-products.
2. Shots of cotton oil plant operations.
3. Shots of operations in textile factories.
4. Shots of operations in rayon, cellulose plants.
5. Copies of charts, flow diagrams.
6. Photos of finished products.

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*It is to be understood that these scripts are merely suggestive and very incomplete; any one of these interests might be of such scope as to include material from all scripts.

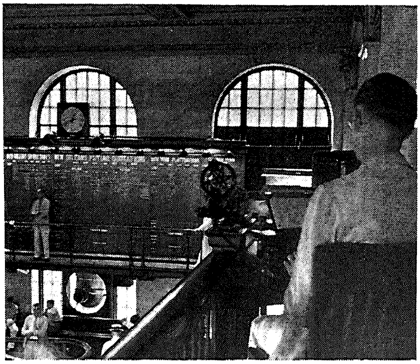


Fig. 234 ECONOMICS
New Orleans Cotton Exchange

Photo by Eisenstaedt
Courtesy Life Magazine

THE ECONOMIST:

1. Photos showing physical nature of Cotton Belt.
2. Copies of charts showing imports, exports, price movements, etc.
3. Shot of cotton exchange . . . candid photos of members.
4. Shot of cotton broker's office.
5. Photos of workers picking cotton by hand.
6. Shots of mechanical cotton picker at work.

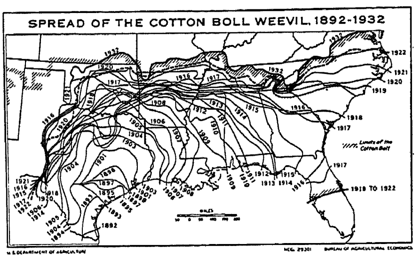


Fig. 235 HISTORY
Diagram U. S. D. of Agr.

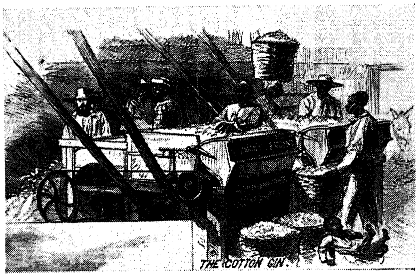


Fig. 236 HISTORY
Early Cotton Gin
Harper's Illustrated Weekly

THE HISTORIAN:

1. Copy of diagram of plantation system.
2. Pictures of slave quarters.
3. Views of plantation house.
4. Photos of sharecroppers' shacks.
5. Copies of line drawings from old bound volumes of Harpers, showing pre-Civil War cotton culture.
6. Map—Spread of the Cotton Boll Weevil.

THE SOCIOLOGIST:

1. Photos of sharecroppers and housing.
2. " of plantation owners and housing.
3. " of different aspects of planation life:
   a. food.
   b. shelter.
   c. occupations,—planting, cultivating, chopping, etc.

d. transportation.
e. recreation.
f. customs.

4. Views of cotton fields.
5. Views of soil erosion.
6. Candid shots taken to show "human erosion."

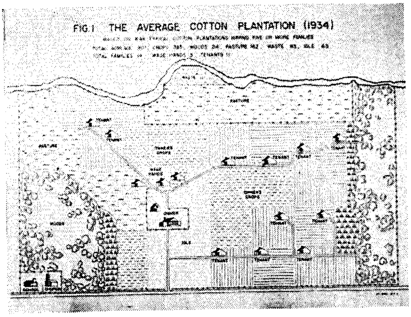
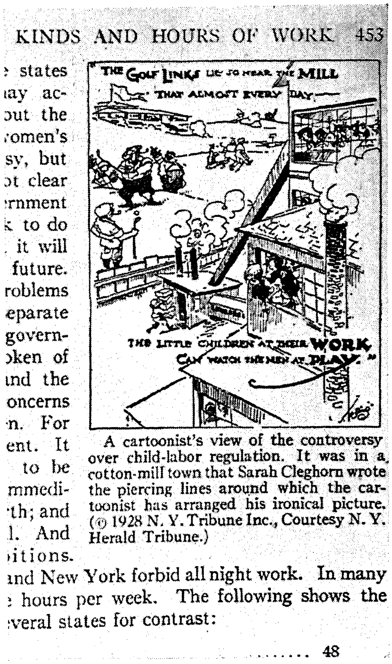


Fig. 237 SOCIOLOGY
Diagram A.F. 1660, WPA


KINDS AND HOURS OF WORK 453

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A cartoonist's view of the controversy over child-labor regulation. It was in a cotton-mill town that Sarah Cleghorn wrote the piercing lines around which the cartoonist has arranged his ironical picture. (© 1928 N. Y. Tribune Inc., Courtesy N. Y. Herald Tribune.)

ınd New York forbid all night work. In many
: hours per week. The following shows the
·veral states for contrast:

.... 48

Fig. 238 Copy of Book Page Example to Show How Special Reference Material Can Be Secured. From American Economic Life, Harcourt Brace & Co.

Fig. 239 SOCIOLOGY
Plantation Owner
Photo by Lange

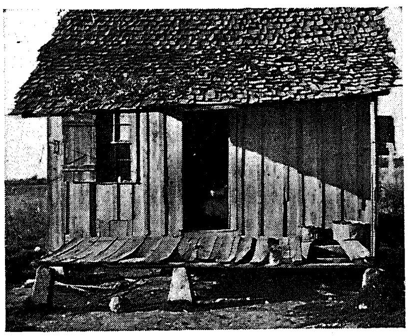


Fig. 240 SOCIOLOGY
Home of Tenant Farmer
Photo by Shahn

Let us say that we have spent our vacations in the Cotton Belt, realizing our shooting scripts as well as we could with the camera. On returning we unmount our f:2 lens and set up our copying attachment (see chapter 11). Now we can reproduce for ourselves and for our classes the necessary charts, maps, line-drawings, engravings, etc., to document our studies. And, if we find that the photographs we have taken in the field are inadequate for one reason or another, remember that except for limitations imposed by copyright laws, we can copy glossy or smooth prints or even half-tones of any photographs which meet our demands.

We have all our material: at least one picture for every important point in our story. We are now ready to make our film strip about the Cotton Belt. Bearing in mind the fact that once the film strip is made it is impossible to change the sequence of frames, we set about arranging our material in the order of its presentation.

A 15-minute film strip should have a minimum of 60 frames. This allows an average of 15 seconds for presentation of each frame. Some may be given less time, some more, according to their intrinsic interest and importance in the continuity. It must be remembered that the film strip can have and should have movement and dramatic structure. Arrange your material so that you have definite climaxes of interest. Give less time to frames which lead up to these climaxes.

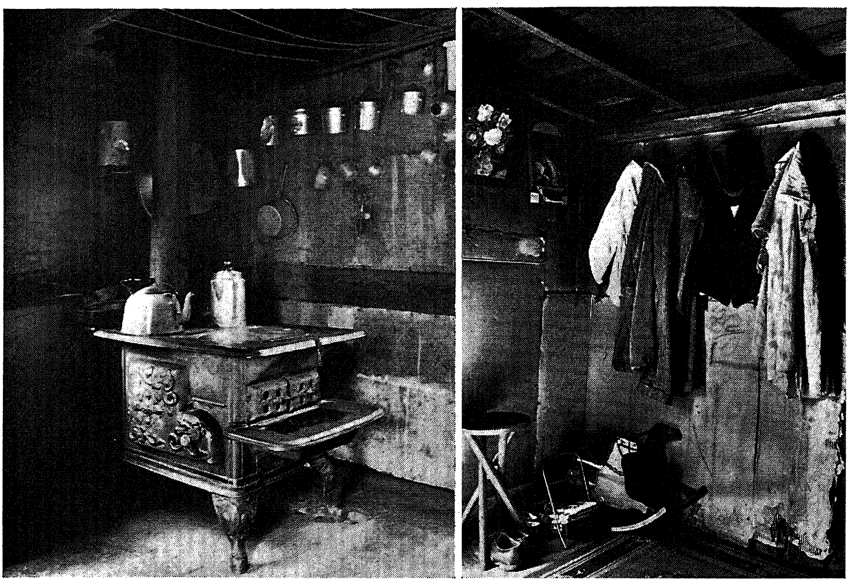


Fig. 241 Cabin Interiors

Theodore Jung
For Resettlement Administration

As an example of climax within the scope of a few frames, a section of a Cotton Belt film strip prepared by a teacher of agricultural economics might look like this:

Examples of Film Strip Pictures with Descriptions and Suggested Narration by Instructor or Synchronized Record

Fig. 243 Start the film strip with photo of large cotton field, boundless sea of white bolls. Then follows picture of negroes — men, women and children—picking cotton. Follow with white workers—woman with sun-bonnet and child —picking cotton.

Narration . . . cotton was cash, cotton was the money-crop, everywhere the land was covered with cotton . . . first the slave, then the sharecropper — men, women and children formed the vast army of labor which planted, cared for, and picked the tremendous crop . . .

Fig. 244 Continue with cotton bales in sunlight, row upon row of them.

Narration . . . cotton was cash—from Texas to the Sea Islands of South Carolina, from Virginia to the Gulf—wherever it would grow it was planted almost to the exclusion of other crops — and compressed into bales which were shipped to markets at home and to many foreign countries . . .

Photographs by Shahn, Rothstein, Eisenstaedt, Evans, U. S. D. of Agr. and Lange

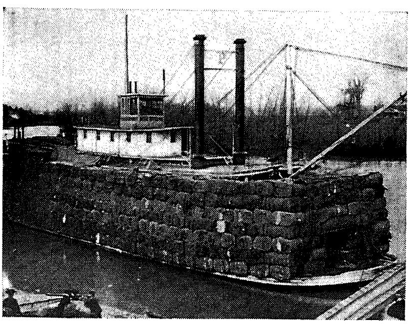


Fig. 245 Mississippi steamboat loaded with cotton bales continues the film along with the suggested narration . . .

Fig. 246 Next we see a scene on wharves of New Orleans: an ocean-going freighter being loaded with bales of cotton . . .

Narration . . . fortunes were built upon it, a way of life was built around it. The planter became a legend for his hospitality, his culture and fine manners. The life of the plantation house was a flower rooted in the land and watered by the sweat of black and white laborers . . .

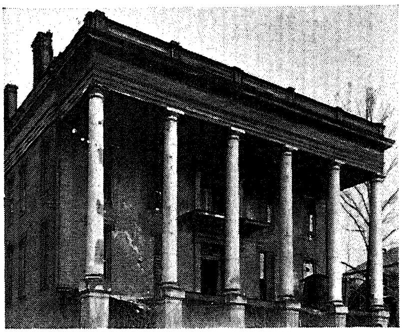


Fig. 248 This picture shows the crumbling remains of an abandoned plantation house, once the show place of Vicksburg, Miss.

Narration . . . proud plantations decayed (the Pickens and Calhoun plantations are now part of a government preserve). Crumbling plantation houses and the wretched shacks of sharecroppers show the failure of the single crop system in Southern agriculture . . . etc.

Include a fine old plantation house gleaming white in the sun, surrounded by spacious lawns and tall trees . . . also add one or two interior shots showing luxury of pre-war South.

Fig. 247 Next picture shows an erosion gully into which adjacent cotton field is crumbling . . .

Narration . . . then, drained of fertility at last by continuous cultivation of the same crop, the money-crop, cotton—the land gave out beneath them . . .

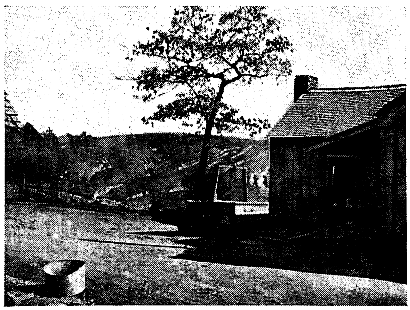


Fig. 249 This shows a crumbling shack of a sharecropper set in the midst of a cotton field that is scored by water erosion . . . Other pictures can be added to clarify and expand the story of cotton. The few pictures already shown will give a basic structure upon which to form the completed film strip.

Synchronized Recording for Film Strips

The film strip in conjunction with a synchronized narrative is an extremely effective method of visual presentation. Double-frame strips are manufactured commercially for approximately 25 cents per frame. If the instructor wishes to deliver the narrative from a script at each showing of the film, a small projector costing about $15 may be used. Captions or title frames may be devised simply by lettering the desired text on a white background and then using the copying camera to make a negative. If the strip is to be shown often, and especially if it is to be routed among schools or discussion groups, it is advisable to have a synchronized recording made of the narrative. The narrative for a 15 minute strip film is recorded on a single disk in which the narrator's remarks are punctuated by a signal which notifies the operator of the projector when to change the frame on the screen. The price for a master recording, exclusive of the service of a professional narrator, is $50. Duplicate recordings can be bought for $1.50 each.

A machine, which in addition to the projector has a turntable, loudspeaker and amplifying apparatus for recorded narration, costs about $100. If film strip work is to be done effectively and to any extent, a machine of this type is indispensable. In addition to film strip presentation it has other uses. With the turntable revolving at the speed used for synchronized narration (33 revolutions per minute) the sound apparatus can be employed for the playing of electrical transcriptions; at a faster speed (78 revolutions per minute) ordinary phonograph recordings can be played.

A policy recently adopted by at least two large industrial concerns may make it unnecessary for occasional users of the film strip to purchase the machine. These companies have placed film strip projectors in each of their branch offices throughout the country as sales promotion devices, but it is understood that they will make these available to nearby schools.

In concluding this discussion two important points should be made regarding the preparation of the film strip:

1. DO NOT MAKE ANY POINT IN THE NARRATIVE THAT IS NOT MADE ON THE SCREEN.
2. SINCE THE FILM STRIP IS A FORM OF VISUAL PRESENTATION, SUBORDINATE THE STORY TO THE VISUAL MATERIAL.

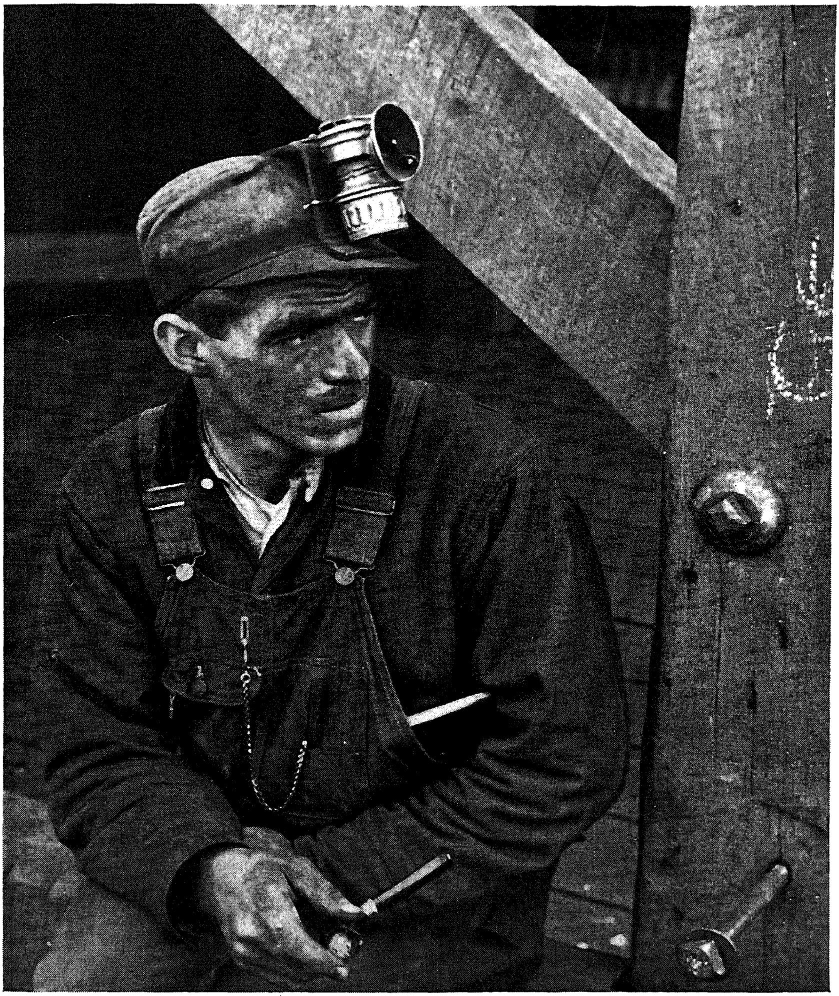
Summary

Since an adequate treatment of the uses of visual aids in education would require hundreds of pages for its development, it has been attempted to confine this article to a brief and suggestive survey. Many of the possible uses of visual material have been left to the imagination of the reader. The use of photographs to "warm up" a class at the opening of a period is worth considering. Good photographs are stimulating, they make one eager to learn more about the subject upon which they bear.

How to obtain these photographs and other visual material? In schools which employ the project method of teaching the building up of a good visual file is not difficult. The collection of visual material can be made a project in itself. The camera can be of great help in building such a project if students are encouraged in the use of it and instructed in the elements of photography. When a child is old enough to understand the rudimentary principles of operating a camera, he is old enough to take pictures, and it must be remembered that children, with their freshness of viewpoint, often bring in surprisingly worthwhile results. In addition to camera work, students should be encouraged to clip pictures, sketches and line drawings from newspapers, magazines, books and catalogs. They can also be taught to draw diagrams and charts, and otherwise to aid in contributing to the school's file of visual material. Any school interested in having such a file, upon which all courses of study might draw, would do well to get in contact with local camera clubs which are in a position to contribute a good deal of interesting photographic material.

A Practical File System

A good deal of care should be exercised in setting up a file, especially insofar as it consists of photographs. A school which has built up its file by original camera work by students or teachers will have a great number of negatives. Negatives must be sedulously protected from damage, yet must be filed so that they may be easily found and identified when it is necessary to make additional prints. The safest way to accomplish this is to number them, place them in cellophane jackets which in turn are put into numbered manila envelopes and filed in fireproof cabinets. Numbering can be done with a fine pen and India ink in the border of the film **on the emulsion side.** Miniature negatives are handled more easily both in filing and in projecting when cut into strips of five frames. Cellophane jackets are made to fit strips of this size. In this way, when numbering, it is only necessary to give a number to the strip, since the frame wanted can be identified by its position on the strip. A cardinal principle in the care of negatives: apart from going to the laboratory for printing, **they should never leave the file.** This should be a fixed rule, not only because a nega-



Kentucky Coal Miner
For Resettlement Administration

Ben Shahn

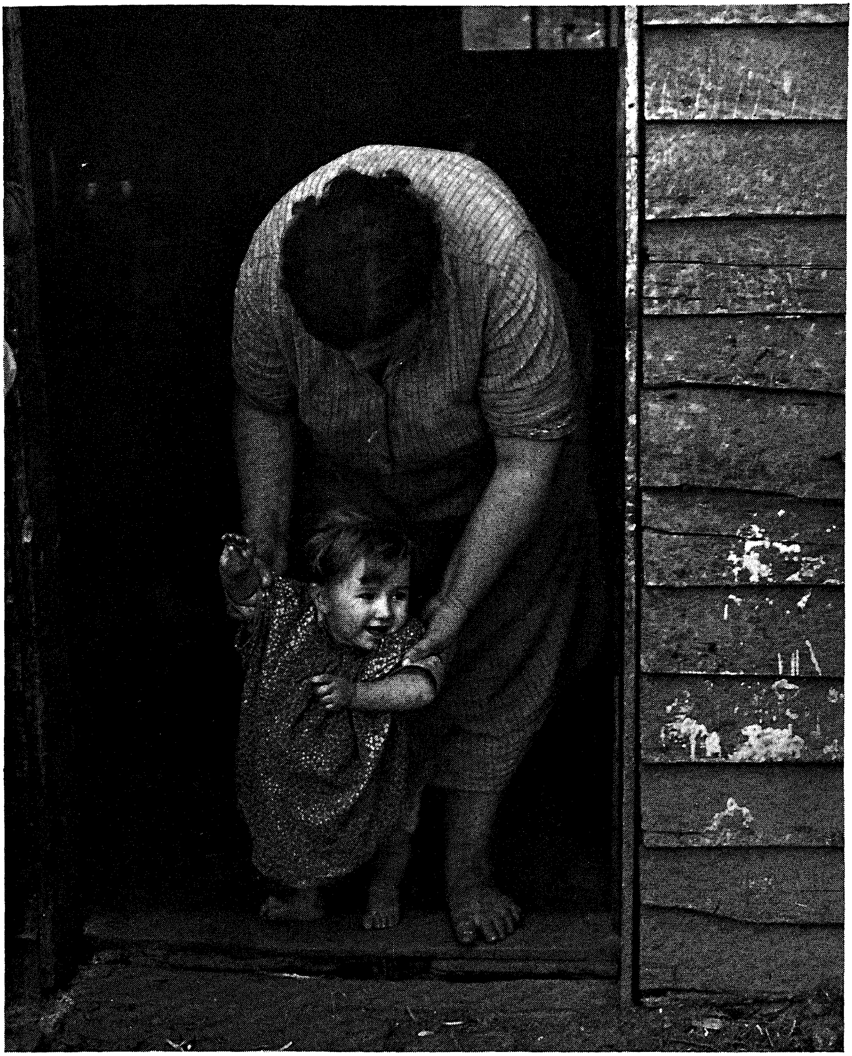
tive is irreplaceable when lost, but because even in careful handling fingerprints and scratches on the delicate emulsion surface are likely to result.

It has been said above that negatives should be numbered, but nothing has been said about how to find them in the file. Location of negatives is provided for, however, in setting up the print, or positive, file. Before any negative is filed at least one print should be made from it and mounted on a durable card. This card should bear the title and other data relevant to the picture, as well as the number of the negative from which the print was made. If these cards are kept in a separate file and classified according to subject, they will not only serve as an index to the negatives, but also as a reference collection. Because they are an index to the negative file, they should be referred to in place only, and never carried off.

A file of duplicate prints must exist to take care of all requests for pictures. These prints, kept in whatever quantity seems necessary, should be kept in manila envelopes which are given the same number as the negative from which they are made. If this system is adhered to, there will be no difficulty in finding the desired pictures, nor will there be any danger of lost negatives.

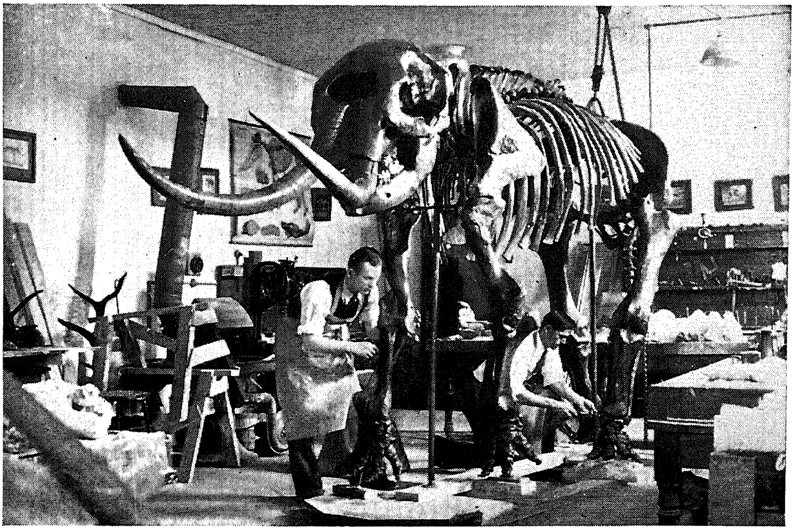
Although in this survey the use of visual material in schools has been stressed, it should be pointed out that it has its value wherever knowledge is to be imparted. In discussion groups, in public forums, in the pre-school education which the progressive parent gives his children . . . everywhere that people gather together to learn, a visual presentation of knowledge can be effective in creating interest. The rapid growth in number and circulation of magazines devoted almost entirely to pictures and the renewed interest in rotogravure pages testify that there is a need, and consequently a demand, for the visual presentation of events and ideas. Learning by looking is a modern symptom, and is, if guarded against lapsing into mere superficiality, a healthy and fruitful one.

Cotton Blossom and Plant



First Steps
Summar 50mm, 1/100, f:6.3, Du Pont Superior

Arthur Rothstein



SCIENCE . . . How Are the Bones and Fragments of a Prehistoric Animal Assembled and Mounted? Photo by Dr. A. L. Lugn

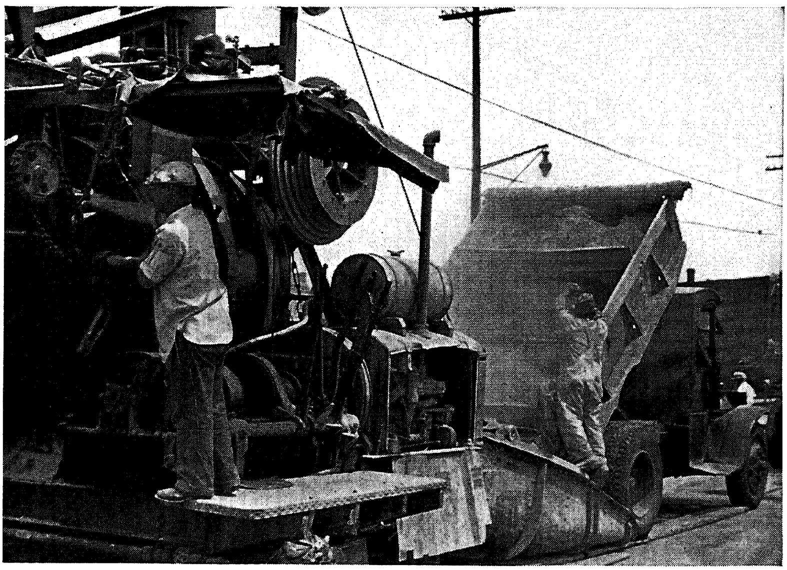


Fig. 252 ECONOMICS . . . The Concrete Mixer W. H. Friedrich
An excellent action picture which shows the mixer in actual operation with humans to give the scale and a more personal quality

THE LEICA IN HISTORICAL RESEARCH

JAMES A. BARNES, Ph. D.

CHAPTER 18

Modern scholarship demands of the research worker of today impeccable evidence to substantiate his assertions. Such evidence can very rarely be presented in the form of originals of historical material. True copies are therefore required. These not only must be good and accurate reproductions; they must be obtained speedily and effectively. The Leica camera conveniently fulfills these requirements.

At one time the student spent the greater part of his day in laboriously copying his finds or discoveries. Materials of the most varied character—illegible letters, worn diaries, old faded newspapers, statistical tables, and intricate election returns—may be copied. These records can be secured photographically far more efficiently and in incomparably shorter time. Subsequent ability to enlarge to almost any size is an added advantage as it greatly contributes to the legibility of such records.

There can never be a question concerning the accuracy of reproduction; not only the form of the original is retained in such a copy but frequently even its spirit and intent.

The research worker, when he comes to writing, need not, as he must when working from typed copies, wonder if the typist or the original writer made the strike-over, the omission, the abbreviation, the cancellation, the interpolation, or any of the peculiarities which mark all human documents. The genuineness of signatures and handwriting and even the character of the paper used may be easily authenticated. There can be no doubt as to whether a letter was handwritten, typed, or printed; that a letter was dictated and *signed in his absence* is easily discovered. Such apparently trivial but sometimes important points as whether the address given on a letter was merely a printed name or a part of the written manuscript itself are readily established. Quotations in the final copy for a book may be checked against the original document.

A very important asset in copying by camera is inclusiveness. An entire manuscript or document can usually be recorded as cheaply and as quickly as it can be extracted. Seemingly insignificant sentences in a manuscript may take on, at a later date, a meaning not discerned at the time of copying. The mere fact that a letter contains no mention of a current event or existing condition may later prove of great value if one can be certain that the omission was committed by the writer and not the extractor. Adjacent paragraphs may give to a statement meanings or modifications not perceived at the time the research worker copied the document. By recording the entire original, the camera retains the proper setting of desired extracts.

The camera not only provides accuracy, speed, and inclusiveness in copy work; it enlarges the field of research. No longer must the scholar limit his labors to what seems at the moment important; as already mentioned, he may copy somewhat lavishly without adding perceptibly to the bulkiness of his material. Maps, charts, and graphs may be readily copied in whole or in part. By use of the extension tube the smallest section of a chart or graph may be lifted out of its original setting and enlarged for particular study. The cartoon, most pungent expression of contemporary opinion, may now make up an important and significant part of the files of the research worker who uses the camera. The writer's collection of several hundred cartoons, gathered from every section of the country at small reproduction expense, interpret the local attitude on economic and financial questions in the period of the eighties and nineties more poignantly, perhaps, than any other one possible type of source material.

Obtaining Complete Historical Record Pictures

But maps, charts, graphs, and cartoons do not complete the list of new sources made readily accessible. Highway signs, terrains, badges, handbills, broadsides, uniforms, machinery and implements, deserted villages, abandoned mining camps, relics, ancient, medieval, and modern inscriptions, and even flora and fauna, are readily and accurately recorded by Leica miniature photography. Whatever the eye can perceive as source material, the camera can record and preserve. My own files on *the great depression of 1929* may in future years prove richer because of their inclusion of photographs of silent factories, of bread lines, of the unfortunates seeking warmth and a place to rest in the St. Louis Public Library, of the bonus marchers, of men and boys tramping the highways and riding the transcontinental freights looking for work, and of many other evidences of economic turmoil. The *New Deal* may prove more interesting because of a photographic record of the inauguration, of closed banks, of farmers plowing under cotton, and of emergency workers on government payrolls.

There are other advantages. The research worker often finds the amount of time that he can spend at a given place limited. The camera prolongs his stay in effect by enabling him to accomplish more than he can by any other method of copying; it also permits him to bring exact reproductions of the original documents to the quiet of his own study for careful analysis and interpretation. This is particularly important where translation is necessary. The scholar who works in European archives on a summer's journey has not the time (and often not the money) to spend hours puzzling over a manuscript the chief difficulty of which is translation, when he may project the writing in an enlarged form on a wall or screen in his own home.

A university friend whose time for traveling was extremely limited recently photographed enough of the literature of the Pennsylvania Dutch in a few weeks to employ all his study hours for a year. Transcription too sometimes presents problems. The writer discovered a particularly valuable diary in Kansas; unfortunately,

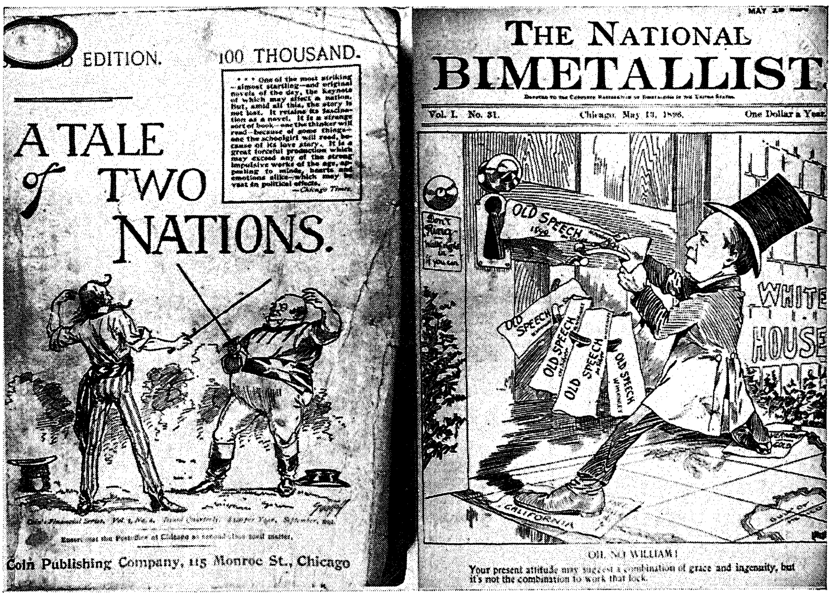


Fig. 253 Books, Manuscripts, Cartoons, and Similar Subjects can be Copied for Historical Research. Photos by James A. Barnes

it was written in a system of shorthand with which he was not familiar. Its value was attested by the convenient fact that many pages had been partially transcribed. The diary was photographed quickly and cheaply and later consultations with expert stenographers resulted in its complete transcription.

The Research Equipment

The entire camera outfit for traveling research is little bulkier than a typewriter. I recently completed a twelve-months research trip through the West and the South in which I collected more than twenty thousand copies of manuscripts. My equipment consisted of a Leica camera, Fuldy Copy Attachment, baseboard, upright and sliding arms, two extension tubes, and two ordinary goose-neck lamps fitted with one-hundred watt bulbs. It is well to carry also a developing tank and some standard prepared developer. Films may easily be developed each night and carefully checked for omissions. This checking is made reasonably simple in my own case by the fact that I keep a careful index of every photograph, recording the date, place, person, subject, and collection or library from which the material is obtained. The collection and library as well as an identifying number are easily photographed with each manuscript. Identification and number may be on a simple typed slip or a regular holder with movable letters and figures. The size of the original may be shown by established measuring marks on the baseboard. Each roll of film also is identified by a number, photographed at the beginning and the end.

A scientific knowledge of photography is not necessary in order to use the camera as a research instrument. Careful observation of results and some idea of the fundamentals of lights and shadows are helpful. The research worker is primarily interested in obtaining the best possible photographs in the least possible time. He may be compelled to compromise between quality and quantity. He cannot spend too much time on artistry. The perfect negative, however, is worthy of attempt because of the possibility of enlarging it for future use as illustrative book material. **For the beginning photographer of ordinary manuscripts the two fundamental things to remember are: first, keep lights as uniform as possible over the field to be photographed; and second, be sure that the camera is in focus.** The goose-neck desk lamps are conveniently carried, but care must be exercised in placing them. Turn the shades so that the rays cross over the manuscript. A magnifying glass is helpful in focusing, particularly on newspapers.

The length of exposure in copying varies with the intensity of the light used, the size of the diaphragm opening, the color of the paper which is being photographed, and the nature of the film employed. Practice alone can establish the best exposure for any particular equipment. The use of a dependable exposure meter is highly recommended. The f:9 diaphragm opening has proved the best in my own work. It is small enough to give clear-cut lines in the photograph, and yet it permits enough light to ascertain whether the manuscript is in proper condition, when using the Fuldy attachment, without opening the diaphragm with each exposure. **Where single sheets of paper of somewhat uniform size are being photographed, there is no need for repeated focusing.**

The cheapest and perhaps best general film for ordinary reproduction seems to be the regular positive stock. This film with the f:9 opening and two one-hundred-watt bulbs photographs black and white papers at an exposure of about one second; yellow newspapers may run to three seconds. Allowances must be made for the difference in intensity between direct and alternating current lights, and also for extremely bright days. Filters are valuable, but longer exposures must be made when they are employed. Panchromatic film such as Du Pont Micropan should be used and especial care taken in copying graphs, charts, and cartoons which are intended for illustrations in books.

The most economical method of buying film is in bulk; the two hundred-foot lengths have many advantages. The traveling research worker, however, must learn to load both his cartridges and his developing tank in darkness. Bathrooms and closets are most frequently pressed into service as darkrooms, and one often finds that there is no place for attaching the safety lamp. A little practice makes it possible to load in complete darkness almost as quickly as with a lamp. An infallible test for determining the emulsion side of the film is to touch it to the tongue because the tongue sticks to the emulsion. Practice and observation, while they may not make of the researcher an expert photographer, will soon lead to qualifications sufficient for his work.

The student may use his material in two ways: either make enlargements on regular photographic paper, or else use a projector. For concentrated study enlargements on paper are preferred. Projection of the negative film itself of that material which is to be used only a few times is thoroughly satisfactory. The total cost per page when used in this manner is only a fraction of a cent. If repeated projections are to be made, it is safest to make them from positive prints. By carefully reading the special chapters on developing, copying, making positives, and projecting, a thorough understanding of this subject may be acquired.

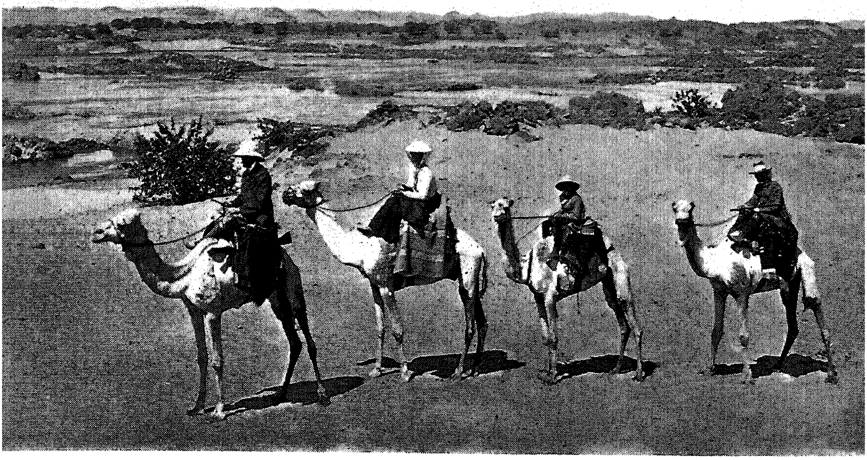
Fig. 254 Abu Simbel, Nubia — Oriental Institute

A carved wall relief in the great temple of Abu Simbel (see fig. 256), showing Ramses II slaying his enemies. Photographed by slow exposure, lighted by magnesium-tape flare, on an 8 x 10 inch glass plate—one of several thousand taken between 1905 and 1907 by the University of Chicago's Egyptian Expedition

Fig. 255 Northern Sudan in 1907 *(page 349)* Oriental Institute

Left to right: Dr. James H. Breasted, leader of the University of Chicago's Egyptian Expeditions; Mrs. Breasted; the author, aged ten; and Mr. N. de Garis Davies, staff member. The black granite rocks in the background form the treacherous rapids of the Second Cataract of the Nile, which forced the Expedition to abandon boats in favor of a camel caravan

ARCHEOLOGY AND EXPLORATION



CHARLES BREASTED **CHAPTER 19**

From 1905 to 1907, a photographic enterprise called the Egyptian Expedition of the University of Chicago, led by the late Dr. James Henry Breasted, made a photographic record of every known ancient Egyptian inscription along the 1200 miles of Nile Valley from Assuan in Nubia to Khartoum in the Sudan. Due simply to the accident of birth, the writer was lucky enough, as a youngster of eight, to be taken along on this unorthodox photographic adventure.

Sound reasons prompted such an ambitious undertaking, the first comprehensive attempt to copy in photographs the tremendous mass of widely scattered inscriptions cut in the walls of ancient temples and tombs, or in the rocks and cliffs along a major section of the most historically important river in the world. First, the inscriptions were known to comprise invaluable original historical source material, eagerly sought by archeologists and historians; and second, in many instances the originals were disappearing due to vandalism or natural weathering and decay.

During most of its campaign the Expedition operated from boats—in Nubia it travelled in a *dahabiyeh* or native Egyptian house-boat; in the Sudan it used *giyassas* or native cargo boats. The latter had to be especially covered with a deck, and equipped with living accomodations built of wooden framework covered with palm-leaf matting and tarpaulins, excepting for the dark-room which enjoyed the luxury of sealed boards (all lumber used in Egypt and the Sudan is imported from as far north as Scandinavia). Nile water is full of silt, hence had to be filtered for dark-room use.

Roll films for smaller cameras were already being widely used by 1905, but the principle of cut films had not yet been successfully applied to the larger cameras which at that time were the only instruments capable of the photographic standard required for such expeditionary work. Hence the Egyptian Expedition had to take with it thousands of 8 x 10 inch glass plates, packed in hermetically sealed cartons, each enclosed in a soldered tin case. The latter was opened at one end with a wire key, like the proverbial sardine tin, or the tennis-ball tins of today. The soldering, done by hand, was sometimes too heavy for the overlaid strip of tin which, in being twisted off, would snap along with the photographer's patience while he tried to complete the job without cracking the glass contents. But this was only a minor annoyance—there were many worse.

For instance, there were the sand storms which would blow incessantly for a fortnight at a time. There were what the natives called *nimitti*, clouds of gnats as thick as tar smoke and so tiny that no screens could exclude them. There were ferocious rats, which defied capture or poisoning, and villainously attacked everything including the members of the party. There were scorpions and tarantulas. At times the heat was so intense that the air bubble of the camera spirit level would actually disappear.

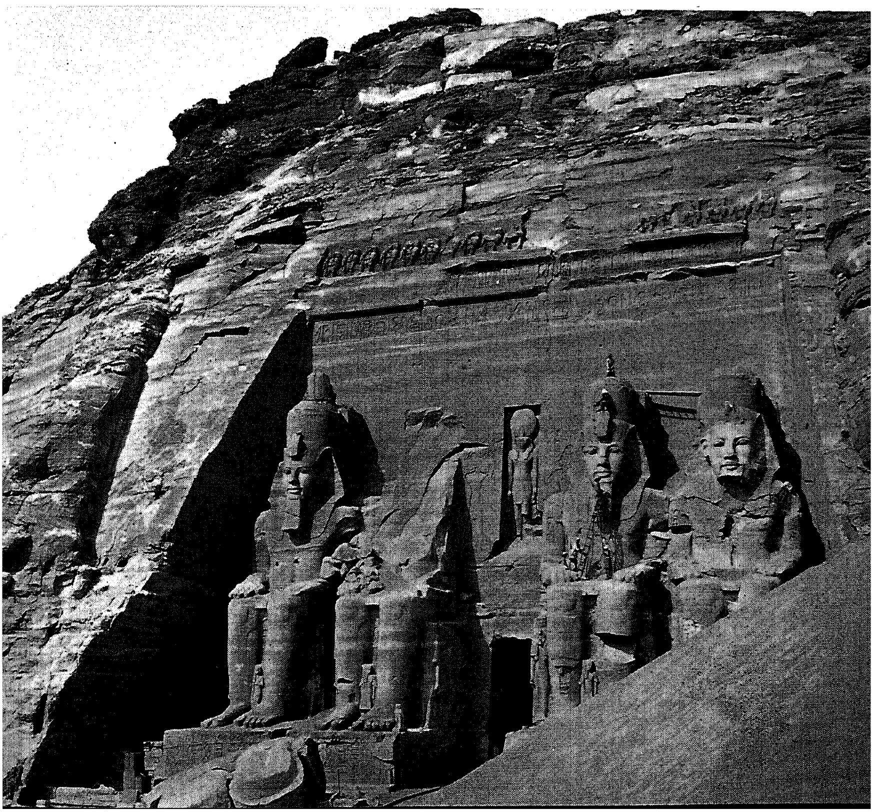
At the Third Cataract, the main *giyassa*, aboard which were the dark-room and most of the Expedition's equipment including the exposed and unexposed glass plates, food supplies, and instruments of all sorts, was driven onto a rock in a swirling current, and the hold filled in a few minutes. The native crew dove for its personal rags, was held to its duty at the point of Dr. Breasted's revolver. A line was run ashore from the main mast-head just in time to save the boat from turning on her side and being swept to destruction in a deep, rock-filled current. The thousands of glass plates were salvaged, the packing cases ranged on shore to dry. So was the whole soaking supply of Triscuit, our only bread. Whatever had been bought in Europe was usually properly packed for the tropics, but everything of American manufacture was well permeated with Nile water. Suffice it that when the boat was refloated, the rats which had mysteriously disappeared were with us again.

The cameras were of the latest design of the day . . . imposing, clumsy contraptions, with great leather bellows. Lenses were excellent but slow. With plate-holders and incidental equipment, the outfit required an unwieldy set of containers more like small trunks than "carrying cases." The photographer always had to have a crew of two or three Nubians.

The location of scenes or inscriptions to be photographed varied greatly. Sometimes they would be high up on some rocky

Fig. 256 Abu Simbel, Nubia — Oriental Institute

In 1906 the University of Chicago's first Egyptian Expedition took this picture of the renowned temple which Ramses II carved out of a sandstone cliff, modestly adorned with four gigantic statues of himself enthroned. The helmeted figure kneeling on the forehead decoration of the right-central statue is Dr. James H. Breasted, taking measurements (overall height of statues is 71½ feet). The author is seated on the statue's right hand!



promontory overlooking a great stretch of the Nile, where some official of an ancient Pharaoh may have sat for many days, counting his sovereign's cargo ships as they brought tribute or imports from inner Africa such as ebony, ostrich feathers, ivory, captive animals, etc. In his *ennui,* often mixed with vanity, he would carve an inscription in the neat hieroglyphs of a practised scribe, giving his rank and station, his honors, the year of his Pharaoh's reign and the date when he sat thus counting the royal ships, and frequently a few casual comments or items of the greatest historical significance. Though several thousand years had elapsed since he went his way into oblivion, the inscription in such cases would sometimes be as bright and clean as if cut the day before. To photograph them, the photographer would frequently have to use his portable scaffolding, his heavy camera mounted precariously on flimsy "stilts".

Or he might have to spend long days in the suffocating blackness of the inner chambers of rock-hewn tombs, or the windowless storage rooms of temples. He would have to make all his adjustments by candle light (the convenient electric torch with its dry battery was still unperfected). In such places the air was not only insufferably hot, unchanged since antiquity, but stank unspeakably from untold generations of bats hanging in regiments from sooted ceilings. The bats would beat out the candle's flame, or fly into the burning magnesium tape during an exposure.

The camera crew of Nubians, an exceptionally intelligent race, in this instance became so adept as to be able to focus the camera, change plates, and perform skilfully many important functions both on location and in the darkroom. They never ceased to derive childish enjoyment from watching the brilliant glare and thick white smoke of the burning magnesium tape, even though it entailed laboriously fanning out the smoke so that picture taking could be resumed. They seemed to comprehend the practical problem of properly placed lighting to bring out carved reliefs, and would handle with remarkable judgment the shiny tin-covered reflectors built by the Expedition to throw light on shadowed or hidden walls.

At the head of the long and treacherous rapids of the Second Cataract, the Expedition had to abandon boats in favor of camels, some forty of them, mostly laden with packing cases full of glass plates. For this stage of the campaign a special dark-room tent had been devised, consisting of two black lined tents, a smaller one within a larger, with the entrance to the inner tent on the side opposite that of the outer. The passage between the tent walls served as a "baffle". All water had to be brought in goatskins from the often distant Nile and had to filtered.

By this time the *hamseen,* or 50-day wind, was blowing a 24-hour-a-day sand blast. One awoke in the mornings literally buried in sand. It was constantly in one's eyes, mouth, nose, ears—in the food, in one's watertight watch. In the sweltering dark-room tent, the photographer winced

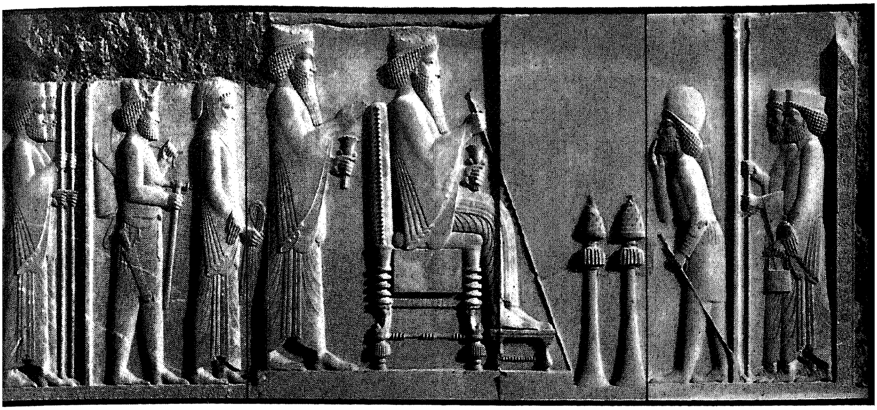


Fig. 257 Persepolis, Iran Oriental Institute

A Monumental Wall Relief of about 489 B. C. from the Courtyard of a building of Darius the Great, portraying Darius the Great (seated), his son Xerxes (standing behind throne), receiving foreign emissaries

as he felt it crunching among his trays of glass plates. Camels would go berserk, dash away into the desert with their loads of glass plates. Pegs would give way, and tents would be blown away like balloons. Under the howling, hissing, lashing of the witheringly dry wind, lips and corners of the mouth would acquire permanent cracks, as would finger ends at the nails, and wrists. Normally even temperaments became jumpy, prone to carping resentments, and nerve ends became unendurably raw.

But the photographic project continued until as much of the Nile Valley had been covered as funds permitted. The glass plates, of which very few were broken, today constitute a unique photographic record, not to say a monument to scientific courage and devotion. And, incidentally, with one exception the writer is the only surviving member of the Expedition's party.

It is almost saddening to realize how much time and travail could have been saved had the Leica then existed. For with a fraction of the weight and cubage, it could without question have accomplished as much as, if not more than, the Egyptian Expedition's ponderous cameras and enormously heavy glass plates. We should take stock of our blessings.

The Leica in Archeology

The field of modern scientific archeology is one of the very best examples of the miniature camera's value as a scientific recording medium. It differs from most fields of scientific investigation in that the "scenario" (of which more later) was written long ago by humankind of past ages. In the Near East, where civilization first arose, the story lies buried in the stratified wreckage of ancient city mounds.

These mounds are like "layer cakes", each layer representing a period of habitation, city after city having been built each upon its predecessor after its destruction through war or natural decay.

The oldest layer, often containing the remnants of a Stone Age settlement, is naturally at the bottom, and the latest is at the top, exactly like sedimentary rock. Just as such rock enables the geologist to reconstruct whole eons of the earth's development, so an ancient city mound presents to the archeologist the raw material of history. Where index fossils enable the geologist to estimate the approximate date when different rock strata were laid down, the archeologist can determine historical periods from the broken pottery found in a given stratum. For strangely enough, in every part of the world, each stage of early human development has produced pottery utensils of similar design and finish.

Modern archeology began in 1868 with the excavation of Troy by Dr. Heinrich Schliemann. Unfortunately no one at the time understood how to excavate an ancient city mound. Under his necessarily inexperienced direction, Schliemann's workmen burrowed like dogs after a rabbit into the site which all his life he had contended was Troy. As their helter-skelter diggings proceeded, they unwittingly destroyed the very evidence which would have proved to him, had he known how to interpret it, that this *was* the Troy he sought. Photography was still a clumsy process, unavailable for this sort of work, hence no adequate record was kept of this superlatively important campaign. The excavation of Troy is at once one of the major discoveries and one of the irreparable losses of modern science.

Today such a site is carefully surveyed, and the entire area, ranging anywhere from a few acres to twenty-five or more, is subdivided by an invisible "grid" of 20-meter squares. Tall metal or wooden pegs are driven in at every intersection point. This "grid" remains unchanged throughout the excavation of the mound. It simply travels downward with the descent of the clearance. A record is kept of the provenance of everything which is uncovered, always in terms of the square meter within the 20-meter square in which it was found, and in terms of the level, i.e., period of occupation.

Besides pottery sherds, the archeologist finds quantities of other evidence which lack of space precludes our discussing here. Suffice it that his fascinating quest demands a combination of executive ability and scholarly training with the ability to interpret circumstantial evidence with a proficiency worthy of Scotland Yard. We are concerned primarily with the part played by the camera in his work of excavation.

His complete dependence on an infallible photographic record of every step in his progressive clearance of ancient houses, palaces, streets, stables, market places, wells, temples, storehouses, garrisons, libraries, worshops, etc., becomes evident when it is pointed out that unavoidably he must *destroy* all this circumstantial evidence as he proceeds. For after the level of a city as it existed in a given age has been meticulously recorded in photographs and architectural ground plans, it is "peeled off", and the level immediately below it gradually exposed. The camera is *sine qua non* in this process. The moment a skilled native digger's pick signals the presence of some object close to the surface of the hard-packed earth and debris, digging at this spot is intermittently suspended, while the camera records the appearance of everything before and during clearance and removal.

Every object discovered, be it a tiny bead, is also recorded in a field register kept at the expedition headquarters. Each piece or group of pieces receives a number; a brief description, the date of discovery, exact provenance, and any other pertinent data, complete the entry. Here again the Leica is invaluable: for whether large or small, all finds can be photographed, and contract prints from each negative can be pasted in the field register opposite the entry of the object. Scale is always indicated by including a metric rule when taking the photograph.

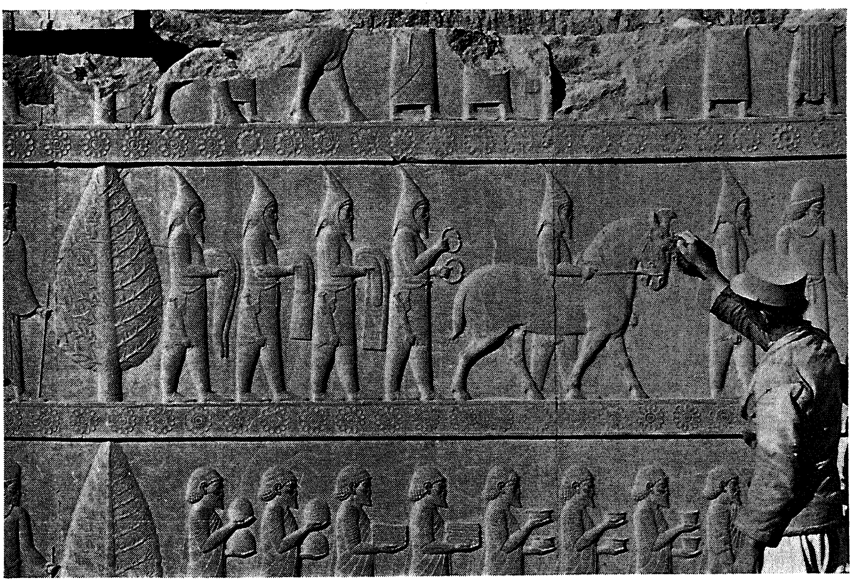


Fig. 258 Persepolis, Iran — James H. Breasted, Jr. *Courtesy of Oriental Institute*

Scythian tribute bearers—a small segment of the Oriental Institute's tremendous find of magnificent carved stone reliefs adorning the royal buildings of the Persian emperors

Fig. 259 Persepolis, Iran James H. Breasted, Jr.
Courtesy of Oriental Institute

From this stone carving of a lion attacking a bull, grew the legend of the lion and the unicorn; the sculptor thought of the bull's farther horn as being hidden by the nearer horn, made them look like a single horn

During the dozen years following the photographic campaign of the Egyptian Expedition, Dr. Breasted gradually evolved a plan for a great research laboratory devoted to the study of how civilization arose and developed. His contemplated organization, to be called the Oriental Institute of the University of Chicago, provided for a headquarters at Chicago and a whole series of field expeditions in the Near East, strategically distributed through Anatolia (Turkey), Syria, Palestine, Egypt, northern and southern Iraq, and Iran (Persia).

By 1919, with Rockefeller funds, Dr. Breasted was able to found the Oriental Institute, of which he was appointed director. In due course the present writer was made responsible for the organization and practical administration of what became one of the major scientific archeological enterprises of the present day. It sent out some fourteen expeditions, of which twelve were at times working simultaneously. Annual visits to these units enabled the writer to follow closely the development of their work, and on occasion to assist in solving new field problems as they arose.

Each expedition headquarters building has its complete dark-room equipment, usually including enlarging apparatus capable of large sizes. The major bases have electrical generating plants of standard make (32 or 110-volt), which greatly facilitate the photographic work. At the Luxor Expedition, the electrical plant includes electric refrigeration.

The methods of excavation and of applying photography described earlier, are those generally employed by the Oriental Institute's expeditions, and with some variations, by most such enterprises in the Near East. The Leica has been used at various times by all the Institute units, usually in conjunction with the work of larger cameras. At present writing, its Megiddo Expedition, excavating ancient Armageddon in Palestine, is relying altogether on the Leica for its entire photographic work.

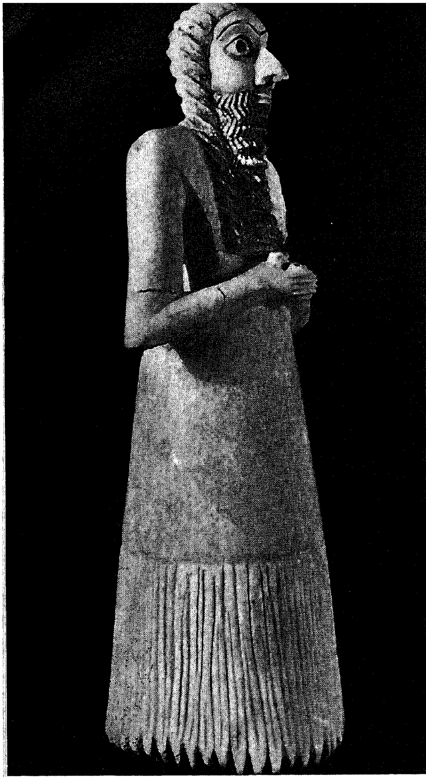
At its Chicago headquarters, the Institute is gathering a huge compendium of archeological data and information about the entire ancient world, called the Archives Project. This is built chiefly on photographs, for which the Leica is used exclusively.

Aerial Photographs

Air photography is of tremendous value to the archeologist. With the sun at the proper angle, such pictures time and again will reveal evidences of ancient cities and structures which can not be discerned at all from the ground. For this purpose the Elmar 90mm is admirable, yielding results which for practical needs, vie with those of the larger cameras made expressly for air photography. Only perplexing obstacle sometimes encountered by the writer was the atmospheric distortion caused by the exhaust gases from motors in planes with exhaust pipes cut exceptionally short.

Fig. 260 Persepolis, Iran (Persia) — James H. Breasted, Jr. *Courtesy of Oriental Institute*

This "Versailles" of ancient Persia was destroyed by Alexander the Great in 331 B. C., is today being excavated and restored by the Oriental Institute. The great terrace is 50 feet high, built of blocks sometimes weighing 40 tons



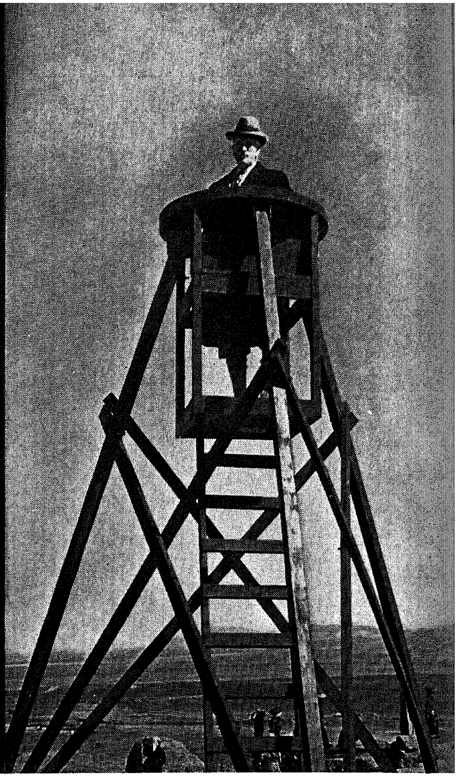


Fig. 261 Sumerian Statuette (left) Oriental Institute
Many of these figures depicting religious worshippers were found by the Iraq Expedition. The eyes were inlaid

Fig. 262 Archeological Crow's Nest (right) James H. Breasted, Jr.
Courtesy of Oriental Institute
The late Dr. James H. Breasted, founder and first director of the Oriental Institute, watching its Syrian Expedition excavating a city mound on the Plain of Antioch

Despite the proverbial prevalence of brilliant sunlight in the Near East, the consistent absence of greenery necessitates longer exposures—much longer than the newcomer at first realizes. Shadows are exceptionally black and, wherever reflectors are available, should be softened. Otherwise, exposure should be made **for the shadows,** just as in Mexico and other countries of extreme *chiaroscuro.* Green and yellow filters must be used judiciously, for they seem to affect definition somewhat more than in our own country. The Hither Orient, as the Near East is often called, is a constant challenge to the camera, but even the work of consummate artists can not escape the subtle monotony inherent in its vast barren reaches, its dusty tan deserts, its inhabitants clad to ward off the pitiless sun and dessicating winds. These brooding lands are moribund . . . all past, with no

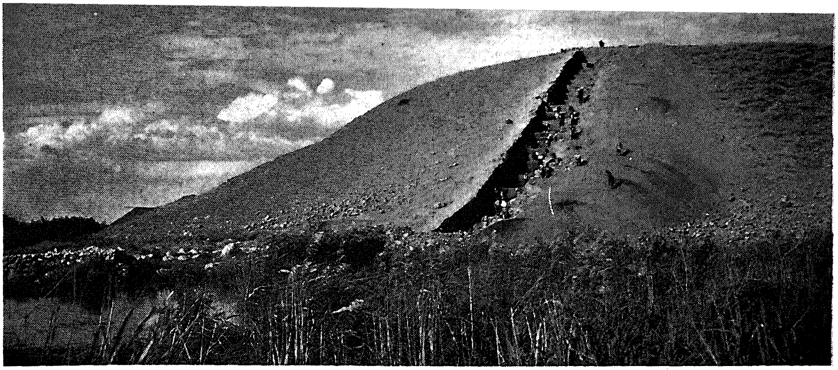


Fig. 263 Tell Judaidah, north Syria Oriental Institute
The Oriental Institute's Syrian Expedition has cut a test trench into the side of a city mound or "layer cake" of ancient cities to determine the age and civilization of each level. The lowest level (oldest) may contain Stone Age relics

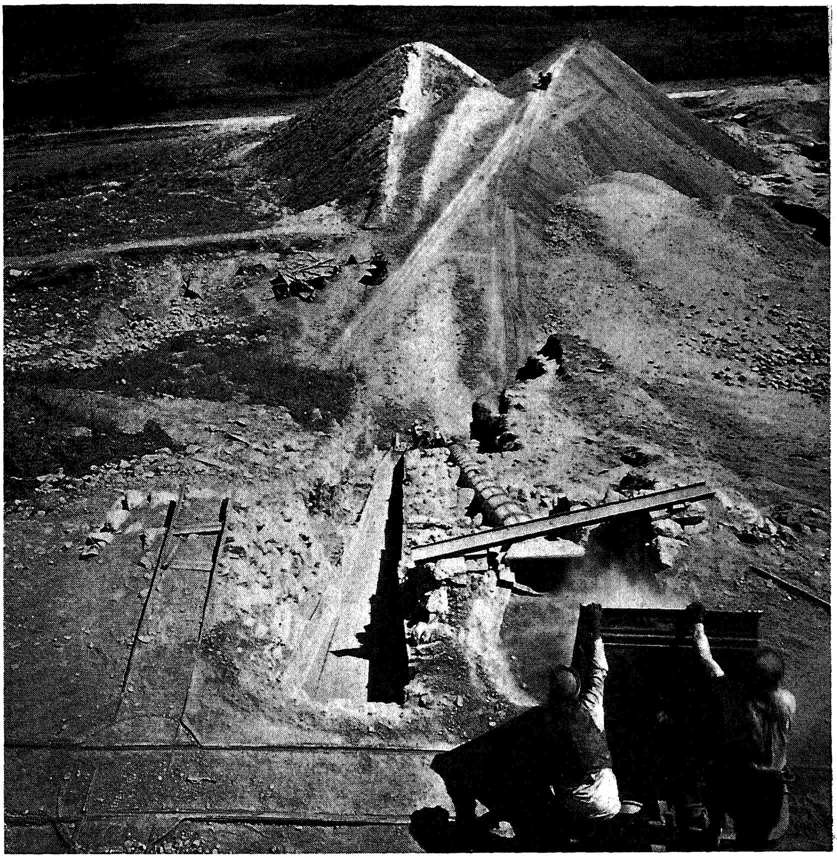


Fig. 264 Megiddo Expedition (ancient Armageddon), Palestine Oriental Institute
Layer after layer of ancient cities is shot down this steel chute onto a vast "dump." Every cubic inch of debris has been sifted. The load just going down is from a city of King Solomon's time (Tenth Century, B. C.)

future . . . but in their very monotony resides a beauty which is haunting and gets into the blood of archeologist and cameraman alike.

Technical Applications: Slides and Copying

A member of the Oriental Institute's scientific staff at Chicago, Dr. Neilson C. Debevoise, who has for a number of years served on the Near Eastern field staffs both of the former organization and of the University of Michigan's expedition at Seleucia, on the Tigris River in Iraq, describes his specialized uses of the Leica as follows:

"At the Institute I utilize the Leica chiefly for two purposes: first, in the preparation of slides; and second, in copying such materials as inscriptions, title pages of books, and other work where absolute accuracy is essential.

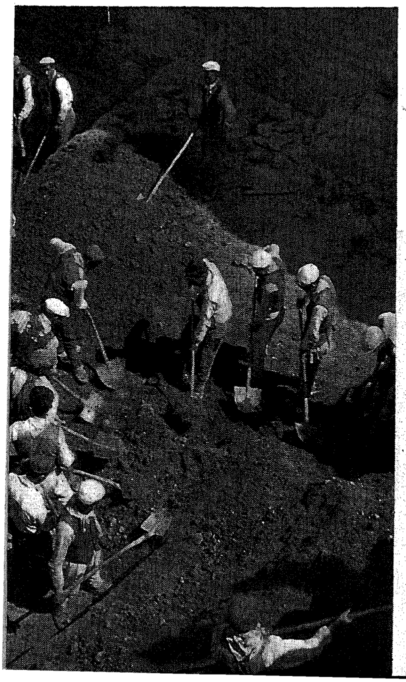
"The negatives for the slides are made on DuPont Micropan, developed in a soft-working glycin developer. The set-up for making the negatives consists of a photostat book-bed for holding large volumes open and flat, and the regular ground glass Leica copying

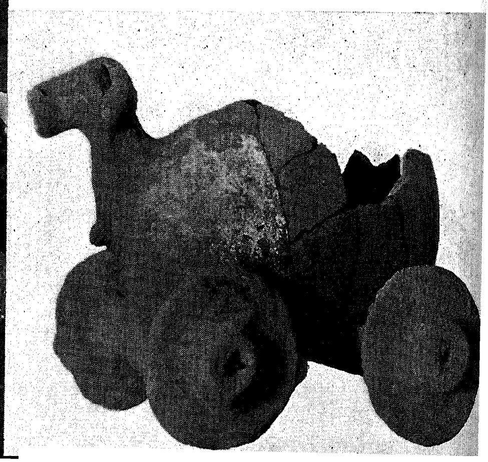
Fig. 265 *(left)* Alishar, central Anatolia (Turkey) James H. Breasted, Jr.
Courtesy of Oriental Institute

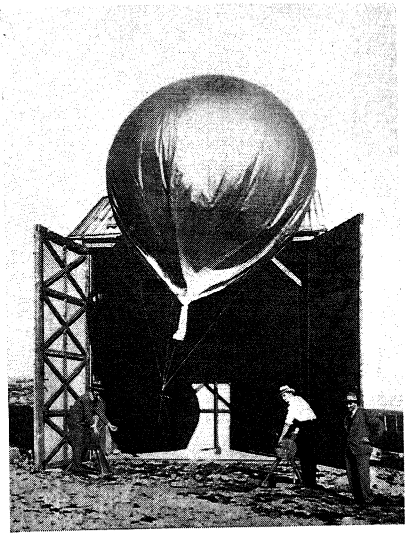
Native workmen of the Oriental Institute's Anatolian Expedition are sinking a 20 metre-square test shaft to the bottom of an ancient Hittite city mound. The Stone Age inhabitants of the bottom level may have lived ten thousand years ago.

Fig. 266 Ancient Sumerian Toy, 26th Cent. B. C. Oriental Institute

More than 4,500 years ago, a child in ancient Babylonia pulled this pottery toy wagon by a string tied to the eyelet in front. It was found by the Oriental Institute's Iraq Expedition at Tell Asmar. 50 miles from modern Baghdad







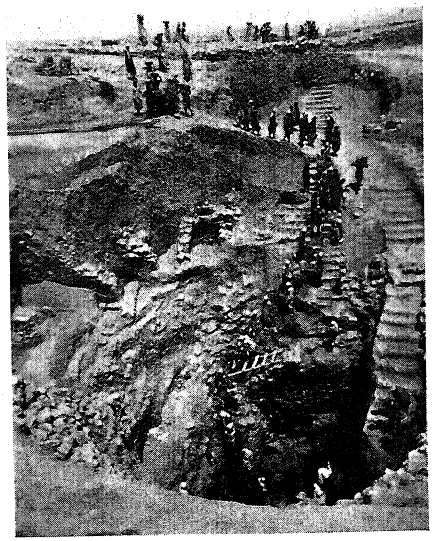
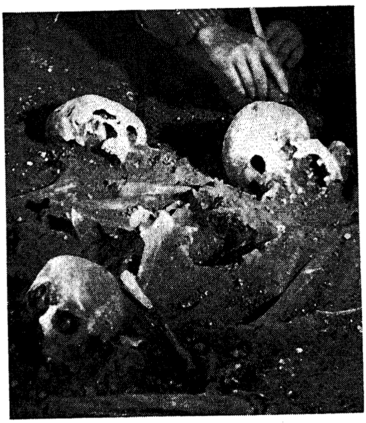


Fig. 267 Archeological Air Photography (*left*) Oriental Institute
With a home-made box camera suspended from a large captive meteorological balloon, the Oriental Institute's Megiddo Expedition makes an air mosaic of each level laid bare by excavation. Shutter is electrically operated.

Fig. 268 Megiddo, Palestine (*right*) Oriental Institute
The largest pre-Semitic engineering project yet discovered—a great shaft with a stairway descending 120 ft. to a 165 ft. tunnel leading to a cave containing a spring which furnished Megiddo's emergency water supply during siege



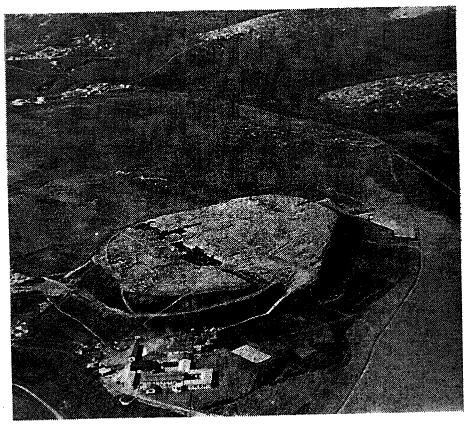


Fig. 269 Megiddo, Palestine (*left*) Oriental Institute
Skulls of men who once walked the streets of Megiddo were found by the Expedition in a cave burial at the base of the mound

Fig. 270 Air View of Megiddo (*right*) Charles Breasted
Courtesy of Oriental Institute
The city of King Solomon's time, here visible, has been "peeled off" since this airplane picture was taken. The Expedition headquarters are in the foreground, its photographic balloon is seen riding above it

attachment. Illumination is provided by two 250-watt lights set in large desk lamps with reflectors. The slides themselves are made by projecting from a regular Leica projector directly on the glass positive. Standard size slides are used instead of the small ones, as a matter of economy. The resulting slides thus made with the Leica are in every way equal to those made from larger negatives, and there is a great saving both in material and labor.

''In the course of my work I have occasion to borrow many rare books. From these I make extensive notes, and I must have a correct bibliographical reference if I ever desire to cite these in print. I therefore photograph the title pages of these works, using the same set-up as above described for lantern slides. Bibliographical data thus secured are unquestionably correct. Similarly, in working on inscriptional material, it is possible to photograph the inscription as it appears in its published form and then to paste a print in one's notes. This permits constant reference to the material without return to the original volume which may be difficult to secure, and does away with the errors attending hand copying.''

Archeological Corpus

"The Leica was selected for work on the Archeological Corpus first because of the rapidity with which negative and prints could be prepared, and second because of the lower cost of preparing such negatives. Illustrations from printed works, as well as actual antiquities, are photographed with the same set-up used for making lantern slides, and the same developer is used. It was felt undesirable to employ the Leica of extra large film capacity (see Page 29) because frequent development affords closer control over exposures and other variable factors. The strips are printed in a regular Leica projector, and are then cut into 6-picture lengths which are filed in glassine envelopes.

"To save labor, expense, and filing space, the pictures are printed in approximately 2″ x 3″ size on 5″ x 8″ cards the whole surface of which is sensitized. Data as to age, provenance, etc. of an antiquity are recorded on the white portion of the card, which is then filed in a standard steel cabinet file. Identification of negatives with prints is effected by the use of small reference numbers which are photographed with the object, so that cards may be filed in the same order as the negative strips."

The Seleucian Expedition of the University of Michigan

Through the courtesy of Professor Clark Hopkins, General Director of the University of Michigan's Expedition at Seleucia, on the Tigris River in Iraq, Dr. Debevoise has been permitted to describe an electric generating plant evolved by the Expedition to facilitate processing of its Leica films, as follows:

"The larger part of the photographic work of the University of Michigan's Expedition at Seleucia for the season of 1936-37 was done with a

Leica which proved both speedy and efficient. To facilitate the development of negatives and the making of prints, electricity was deemed advisable. This was secured from a wind charger of the type used to charge radio batteries in this country.

"The electricity generated by it was stored in three of the largest automobile batteries available in Bagdad, and was run into the darkroom by means of a No. 4 wire. Dark-room equipment was standard in every way, except that 6-volt bulbs were screwed into the sockets. These can be obtained in 10, 15, 25, and 50 watts, identical in appearance with the standard bulb and giving exactly the same candle power.

"Our chief problem in dealing with this arrangement proved to be the large sized wire necessary to carry the low voltage. In a number of cases we had to rewire apparatus, and auxiliary switches occasionally had to be installed since the ordinary ones would not carry the high amperage. There was never any difficulty in securing sufficient electricity to operate printer, enlarger, and safe lights during the season, or even toward its close when work sometimes went on from 8:00 A.M. until midnight, with both printer and enlarger simultaneously in operation."

Archeology, Natural History, and Exploration for the Amateur

Amateur or veteran explorer, archeologist, anthropologist, ethnologist, botanist, geologist, naturalist, every student in fields where constant note taking and accurate observation are indispensable, needs the small film camera in his kit. It is one of the best note books ever invented. Though you may have eagle eyes, excellent memory, wide vocabulary, a genius for freehand drawing, this little servant will always surpass you. None of these attributes can compete with the versatility of Leica lenses.

The principles underlying the technical uses of photography in certain branches of science as discussed in this chapter, apply to the

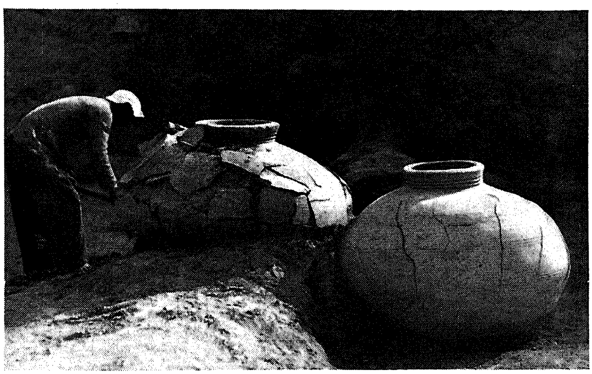


Fig. 271 Istakhr, Iran (Persia) Oriental Institute
Storage jars as uncovered by the Institute's Persepolis Expedition, excavating the capitol of ancient Persia

amateur just as much as to the professional. The cardinal point to remember is so obvious that you are apt to regard its re-statement here as an affront to your intelligence: USE your Leica, have it always 'round your neck, ready to "shoot"!

Whether you are a member of a small camping party, or on the staff of an ambitious, long-distance exploratory expedition, be THE one to capture pictorially every phase of an incident or continuing process, when all your colleagues are preoccupied with the experience itself. Photograph the packing of equipment before the party leaves civilization, and later, its base. Take pictures of every stage of its journey from start to finish. When climbing a mountain, remember to photograph **the peak!** What may seem to you obvious or prosaic at the time, will constitute the "connective tissue" for your complete picture story of the expedition.

Constant alertness should enable you to secure the foregoing *general* record. But remember that this is subordinate to whatever may be the main purpose of the expedition. To insure getting maximum coverage of everything it is setting out to accomplish, you should beforehand write a scenario fully covering the objectives and everything related to them of which you can think in advance. Amplify this scenario as you go along. Have a copy always in your pocket, study it each evening before turning in. Never leave a location or region without checking over your list of subjects to make certain your sequences are complete. Remember that you may not re-traverse this particular terrain, and that retakes will be impossible. Keep a "log" of everything you photograph, roll by roll, and check this against your scenario and list of subjects. Guard these records carefully: you'll find them invaluable on your return.

Suppose you live in the country and are interested, for example, in making a picture story portraying the gamut of living organisms inhabiting a nearby swamp. Here again a scenario is invaluable, to help you in a logical presentation of the story and to guard against omissions. From general views "establishing" your swamp, you will begin to move up on the infinite life within it. The story will be incomplete unless, like the archeologist, the amateur naturalist first photographs his subjects exactly as he finds them, in relation to their natural context. The importance of this can not be over-emphasized. Then, after this has been carefully done, he can capture his various subjects in containers, take them to his laboratory at home, and record their life cycles and habits in microphotography as described in Chapter 21.

Fig. 272 Mosul, Iraq (*left*) James H. Breasted, Jr.
Old Iraqi type in a bazaar Persepolis, Iraq (*right*) Young Iranian girl

Whether you are a student on an anthropology, geology or botany field trip, the same photographic principles still obtain. Consistently good photography in any field is not a matter of luck, but of infinite care and intelligent attention to details, combined with pictorial imagination. As applied to science, pictorial imagination doesn't mean the production of "pretty pictures", but the comprehensible, logical, thorough presentation of the subject. If possible, the pictures should in themselves be interesting, but frequently science pictures must lean on their captions for their significance. At all times, the subjects you are photographing should be a challenge to your ingenuity, and the resulting pictures should reflect the spontaneity and freshness of approach which can only spring from your own genuine interest and enjoyment in taking them.

Indirection Photography

Often a story can be more successfully told by "shooting" around the subject, that is to say, by indirection, than by ordinary logical progression. For instance, that gifted camera artist, Alfred Eisenstaedt, told me that once toward the beginning of his camera career, he was sent by an editor to cover an important wedding. He

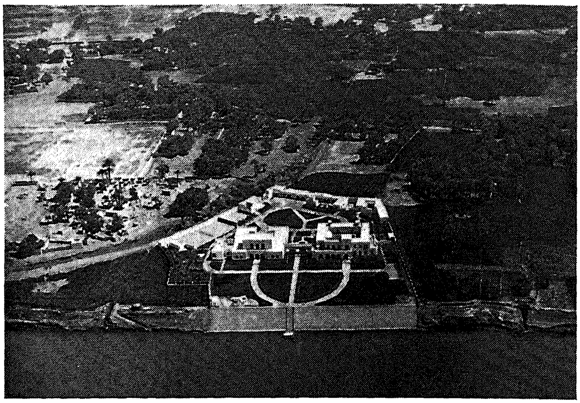


Fig. 273 Egyptian Headquarters of the Oriental Institute

Air view of the Institute's largest plant. Combining photography with artists' draughtsmanship, its work is to make facsimile copies of the historical wall reliefs and inscriptions in the great temples of ancient Thebes (modern Luxor)

became so engrossed in photographing the preparations for the event —the cake, the guests, the little human incidents—that he returned from the assignment without taking pictures of the bride and groom! The omission was easily filled because all the other photographers had taken nothing else. His own coverage was unique. But it taught him a lesson. Today he has become one of the ablest exponents of indirection through the photographic "essay", but as a precaution, he always takes the obvious pictures first!

Sometimes, however, the omissions can not be remedied. A well known world traveler, hunter and explorer returned recently from a unique journey to the Kingdom of Nepal as the guest of its King on the occasion of the latter's twenty-fifth anniversary (Silver Jubilee) of his accession to the throne. Impregnably aloof in the Himalayan fastnesses of northern India, Nepal is forbidden to white men except at the King's personal invitation. The few fortunate ones thus honored must follow a prescribed travel route, are constantly watched, may not venture outside Khatmandu, the capital city. Automobiles are carried over the high mountain passes on the heads of native bearers, the trails are steep and tortuous, the elevations are incredible. Our friend carried a good camera with him, took many pictures. But on his return to New York, when he submitted them to the editors of a large weekly picture magazine, he was chagrined to find that most of his pictures were long shots; he had neglected to secure photographs of his caravan while on the move, or of heavy equipment being carried over the mountain passes on the heads of bearers. And the pictures of ceremonial processions, and of the King riding in state on a bejewelled elephant, were not snapped as they were approaching the camera but after they had passed!

Also lacking were pictures of the striking geological formations along the route, of the flora and wild life; unposed pictures of the Nepalese natives engaged in their ordinary activities, or of interesting human types, local customs, styles of dress, unusual signs, bridges, wells, or of the countless manifestations significant of the life of another people. Had he been *thinking pictorially,* his camera might have captured not only the coherent story of a unique experience, but also a record of great value to students in several fields of science. He had prepared no scenario, taken no notes.

This discussion has tried constructively to clarify the man-sized job of first class scientific and explorational photography. Whatever has been said is not simply theoretical but has been drawn from actual experience and observation. The writer is frank to confess that had he himself thoroughly understood years ago the principles herein set forth either by direct statement, implication or example, he would today possess a photographic library of exceptional quality and contents.

Perhaps no one has better summarized the new significance of pictures, or the task of the photographer today, than my friend Willard D. Morgan: "For centuries human beings have been taught to read the printed page. Now they must learn to read pictures with equal facility." The mushroom growth of recently established picture magazines' circulation is symptomatic of the public's apparently insatiable interest in photography, however uneven in quality. In this situation, the responsibility for setting the pace rests upon the photographer, for it is axiomatic that the instructor must always be many jumps ahead of his pupils.

Ideally, the Leica is an extension of your own imagination. An audience of millions craves good pictures. What are you going to do about it?

Courtesy of Oriental Institute

Fig. 274 Air View of Pyramid Excavations, Lower Egypt

James H. Breasted, Jr.

This pyramid and its temples, between Dashur and Sakkara, about 25 miles from Cairo, is being excavated by the Egyptian Government. The long "fingers" are debris dumps

Choice of Equipment and Its Care

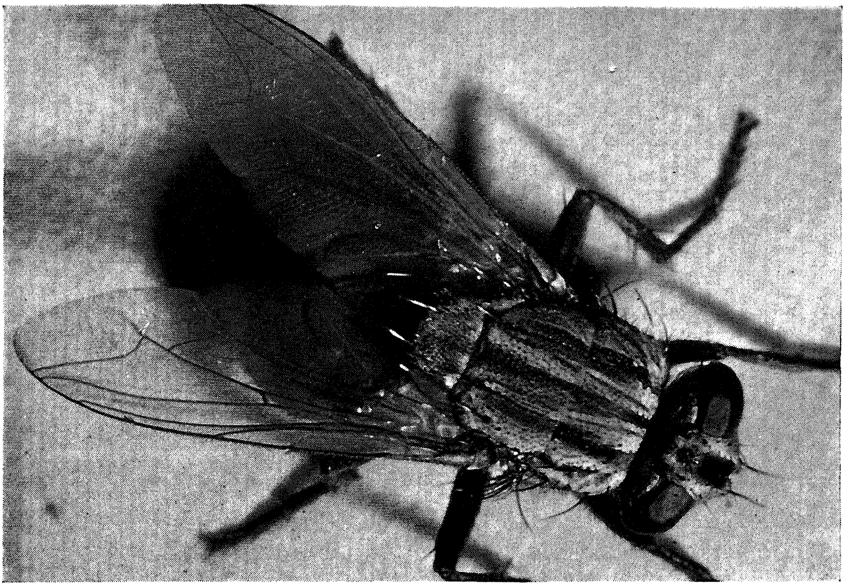
Every one has his favorite Leica outfit to meet his special needs. After about six years of personal experience, supplemented with chronic questioning of other users, the writer has assembled an equipment which seems to him ideally balanced for expeditionary, exploratory or general use. It consists of the following: A Model G Leica; a Summar 50mm f:2 lens; a Hektor 28mm f:6.3 extremely wide angle lens, with Special View Finder and Special Sunshade; an Elmar 90mm f:4 lens; a Vidom Universal View Finder; Panchromatic Green, Yellow II, and Infra Red I filters; an Optical Short Distance Focusing Device; an Adjustable Lens Sunshade; a Wintu Angle View Finder; a Weston Leicameter; a collapsible tubular tripod with universal para & tilt head; and an Everready Carrying Case.

Excepting for tripod and Carrying Case, the entire outfit (including 6 or 8 rolls of film, plus extra space for small gadgets) is stowed in a custom built case 13⅞ x 7⅜ x 3¾ inches. Selection of portable developing, printing and enlarging equipment will naturally be determined by the prevailing field conditions under which it will be used. Usually all of it can be carried in a good sized suitcase. Especially recommended are stout cases of fibroid composition of proven immunity to extremes of tropical moisture and heat, and to mildew and termites. To guard against sand or dust storms, all lenses or other delicate, vulnerable pieces should be kept in double-seamed chamois bags with draw strings rather than zipper openings. Extreme moisture in the tropics is a difficulty which no one has yet fully solved. But it can be minimized by *wrapping* equipment in sheets of new, good grade rubberized silk. The packing or films for the tropics is now standardized by the leading manufacturers, who are always glad to offer the benefit of their experience.

With the outfit listed above, the range of your photographic activity is limited partly by the extent of your technical experience, but mainly by your ability to **think in pictures.**

The author gratefully acknowledges the permission of the Oriental Institute and of his brother, James H. Breasted, Jr., to reproduce in this chapter a number of the latter's Leica photographs.

THE MINIATURE CAMERA FOR MINIATURE MONSTERS



J. M. LEONARD

CHAPTER 20

Photographs by the Author

The photographer who is weary of portraits and pictorials or who is bored by the discussions of purist versus creative may take new hope. If he wishes to combine amusement and education with a host of interesting photographic problems, he should explore the world of miniature monsters which awaits him in his own backyard. He will find a life as fascinating and as bizarre as any that ever roamed the hot sands and the reeking swamps of prehistoric times.

Such an exploration, through the eye of the camera, will reveal creatures clothed in bone, in feathers, and in hair; creatures with from two to eight eyes, and from one to nearly thirty thousand lenses or facets to each eye; creatures so weird in appearance that they seem to belong to another age. These are the insects and the spiders. Their variety of form is boundless; and in brilliancy of color they equal if not surpass the most gorgeous flowers. Their habits and their social conduct are of such absorbing interest that the insect

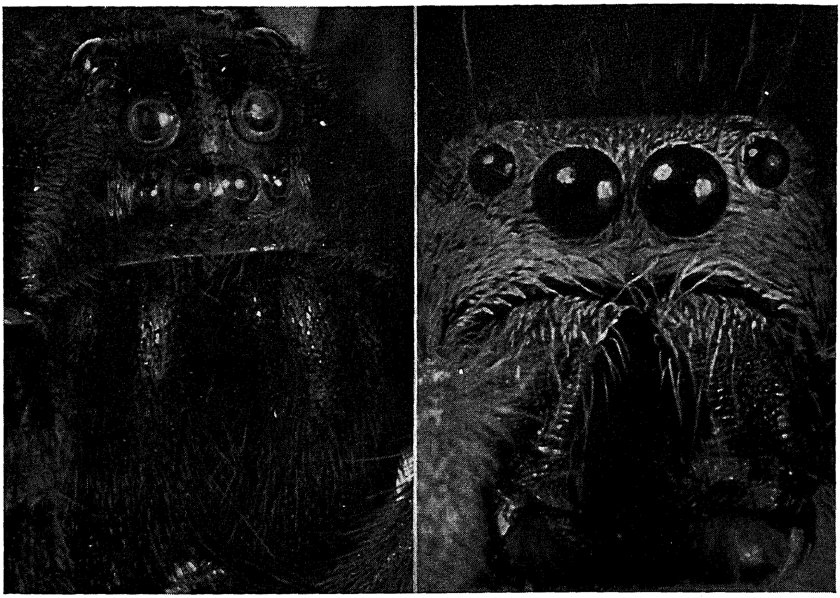


Fig. 276 Head of Wolf Spider Fig. 277 Head of Jumping Spider
Note How Eye Arrangement Differs.

photographer need not feel surprised should he suddenly find himself more interested in studying the actions of the insects than in photographing them.

Entomologists estimate that there are a half million or more known species of insects. They constitute by far the largest group of living creatures and greatly exceed the combined total of all others on the earth, in the air, and under the water. Doctor Frank E. Lutz of the American Museum of Natural History states that there are approximately fifteen thousand species of insects to be found within fifty miles of New York City, and nearly eleven thousand species within the state of New Jersey and these, bear in mind, are species and not individuals. The photographer who takes up this branch of work will never lack subjects. Also he will have a year around hobby, for the insects may be photographed alive in the field or may be mounted and saved for the long winter evenings.

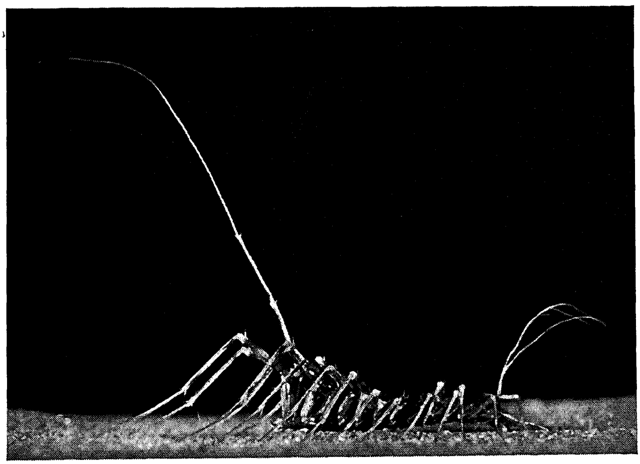
Catching the Insects

Although insects are so numerous and so widely distributed, a few hints as to where to look and what to look for might be helpful. The collector doubtless needs no suggestions as to where to find such household insects as the roach, silver fish, clothes moth, house fly and mosquito. These, however, constitute a very small percentage of the thousands of varieties which lie beyond the screens and the front door.

While many insects are much in evidence some of the most interesting ones prefer seclusion and their society must be sought. Turning over an old board or a rock in a field may admit one to the private lives of a few crickets, a family of sow bugs, or a miscellaneous collection of beetles. Other insects will be found under bark, in rotten wood, in flowers, among the roots of plants, and in fact, practically everywhere that the careful collector cares to look. The chief requisites of a collector are active curiosity, quick fingers, and nimble legs. For the capture of moths, butterflies, dragon flies, or other flying insects a net is essential. This may be purchased for a reasonable price from any dealer in entomological equipment.

While all insects are interesting photographically, there are a few of the common ones which, because of certain outstanding points of interest, should appeal to the beginner in insect photography. The spiders—which by the way are not insects but are of the class *Arachnida,* order *Araneida*—are interesting because of their ferocious appearance and the number and arrangement of their eyes (figs. 276 and 277). The normal number of eyes is eight and all of the eyes are simple: in none of them is the outer layer divided into facets as in the compound eyes of insects. The normal arrangement is regarded as two rows, each containing four eyes, but they may be found in three

Fig. 278 The Northern Centipede which Lives in Houses



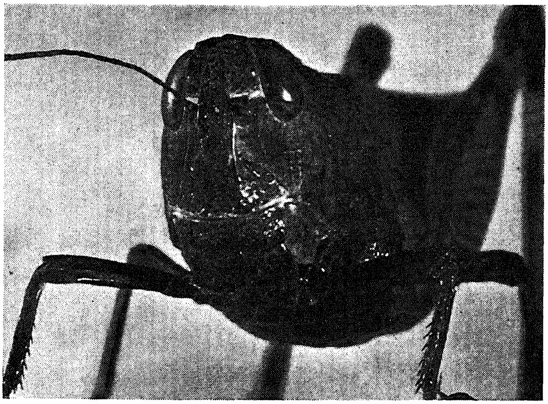


Fig. 279 Grasshopper
Elmar 135mm lens, S. F. Attachment, 60mm ext. tube, 16 seconds at f:18, DuPont Superior Film

and even four rows. Grasshoppers are interesting because of their smug expressions (fig. 279). *Scutigera Forceps,* the northern centipede which lives in houses, appears like a bleached carcass on the desert when photographed on sand against a black background (fig. 278). The larvae of many of the large moths such as *Cecropia, Promethia,* and *Cynthia* look like prehistoric dragons in the photographic enlargements. The points of interest are endless but the experimenter will soon find his own favorites.

The Camera Equipment

The camera used in photographing insects must fulfill several important requirements if the best results are to be secured. Ground glass focusing is essential because of the very small depth of focus which is available when the object to be photographed is only an inch or two from the lens. The equipment selected should be such that the distance between the lens and the film may be varied sufficiently to produce either photographic reduction or enlargment of several diameters. The range in the size of insects is such that a fixed amount of bellows extension will not serve for both the large and the small ones. The image of a praying mantid would have to be considerably reduced before it could be recorded on a 35mm film, whereas a mosquito or a fly would need a corresponding amount of enlargement to bring out any detail.

The Leica camera, which is used by the writer, fulfills all of the essential requirements. The sliding focusing copy attachment provides ground glass focusing, and the lens extension tubes which are used with it, permit a wide range of photographic reduction and enlargement, particularly when used with lenses of different focal lengths. As an added advantage the copying attachment and camera may be mounted on a tripod and used in the field for photographing live insects. The question of which model of the Leica to use is significant only in one respect. Any model is satisfactory but the Model F has the outstanding advantage of including speeds between 1 and 1/20 second, and it is in this range that many of the insect exposures will be made.

The accessory equipment for this branch of work will vary with the ideas of the individual and with the state of his pocket-book. A fairly comprehensive list is as follows:

Sliding Focusing Copy Attachment and Magnifier
30mm, 60mm and 90mm Extension Tubes
Elmar 35mm lens..........Elmar or Summar 50mm lens
Lens Shade.........................Wire Cable Release
Ball Jointed Tripod Head................"Triax" Tripod

For field work the 50mm lens and the 30mm tube generally will be sufficient. This combination in connection with the Copy Attachment will produce a .82x magnification of the image which is about all that can be tolerated when working with a live insect of average size. If greater magnification is used it will be difficult to obtain critical focusing because of the reduced depth of focus combined with the need for fast work when photographing a live insect. The additional tubes and the 35mm lens will be found useful for higher magnifications when the work is done indoors under controlled conditions.

Photographing in the Field

Photographing the insects in their natural haunts will provide the occasion for many a long and interesting walk. The woods, the fields, and the shores of ponds and streams are teeming with life. The close observer will find ceaseless activity and industry to an extent unrivalled among living things. He will find every trait and characteristic that can be found in human beings and many others besides.

For field work, the equipment should include the sliding focusing copy attachment and magnifier, a 30mm tube, lens shade, tripod with ball jointed head, and wire cable release. In addition, a can of ether or carbon tetrachloride, a small glass jar and a medicine dropper will be found useful.

A little experience in trying to photograph a live active insect will soon show the difficulty of doing so. Some insects are easily frightened and others appear to have a constant urge to go somewhere. Usually by the time the camera is set in place and the somewhat critical focusing has been done, the insect has succumbed to this urge and is nowhere to be seen. The job will be made much easier and the chances of a successful picture increased if the insect is placed under better control.

The following method has been used with good results:

1. Select a twig, shrub, rock or any other place where you would like to have the insect resting when it is photographed.
2. Focus the camera on the particular spot selected.
3. Next catch the insect and place it in the jar with a few drops of ether or carbon tetrachloride. It should be carefully watched and should be removed from the jar as soon as it appears stupefied.

4. Place it in the spot previously focused on, arrange its legs in a natural position, quickly check the focus and take the picture.
   If it has been etherized just the right amount it will be able to cling to the twig or leaf but will not be able to crawl or fly away for a minute or so.
   Too much ether will kill it, and too little may enable it to leave before the picture is taken.

The insect may be mounted in the field if desired and thus kept under more complete control. About twenty years ago Dr. David Fairchild of Washington, D. C., made a number of very interesting insect photographs which were published in the National Geographic Magazine and later in book form as ''The Book of Monsters''. Dr. Fairchild describes his method of mounting as follows:

"Cover the top of a small block of wood with a thin, even coating of paraffin or ordinary candle wax by letting the drippings of the candle fall upon it. Pick a large leaf and turn its upper surface down upon the wax, before it cools, and let it stick there; this will give a natural looking ground for the insect to stand upon. Hold the insect over the block of wood and arrange the legs in as natural a position as you can with a long needle or fine dental tool. Then fasten each foot in place by heating the needle in the candle flame and pricking a hole in the leaf just under each foot so that the wax will come up through the leaf and hold it fast." The insect is anesthetized just before the mounting operation is undertaken, and is photographed immediately after it is mounted.

There are times when it pays to proceed with caution and to observe closely what the insect is doing instead of immediately capturing and etherizing it. An interesting series of pictures may be the reward of restraint and patience. The insect may be engaged in an operation which is seldom noticed and less frequently photographed. Careful scrutiny may show a cricket laying its egg through a long tube which has been thrust into the earth, a jumping spider dancing before its mate or a praying mantid depositing its egg mass.

An example of a seldom noticed phase of insect life is illustrated in Fig. 281 which shows the courtship and mating of two mantids and the thorough manner in which the female disposed of her mate after she tired of him.

In observing this series the following action will be seen—the male (the slender insect) pursuing the female; the mating; the female pursuing and catching the male, and finally, the female devouring all of the male except his head and neck, which in one picture is seen on the ground with eyes directed upward toward the gruesome spectacle of the remainder of his body being devoured. The head, by the way, remained alive for twenty-four hours, exhibiting during this time normal characteristics and reactions.

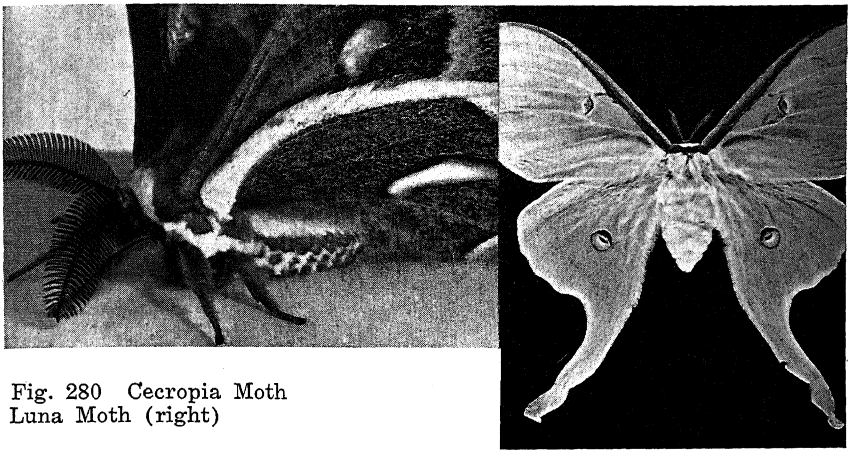


Fig. 280 Cecropia Moth
Luna Moth (right)

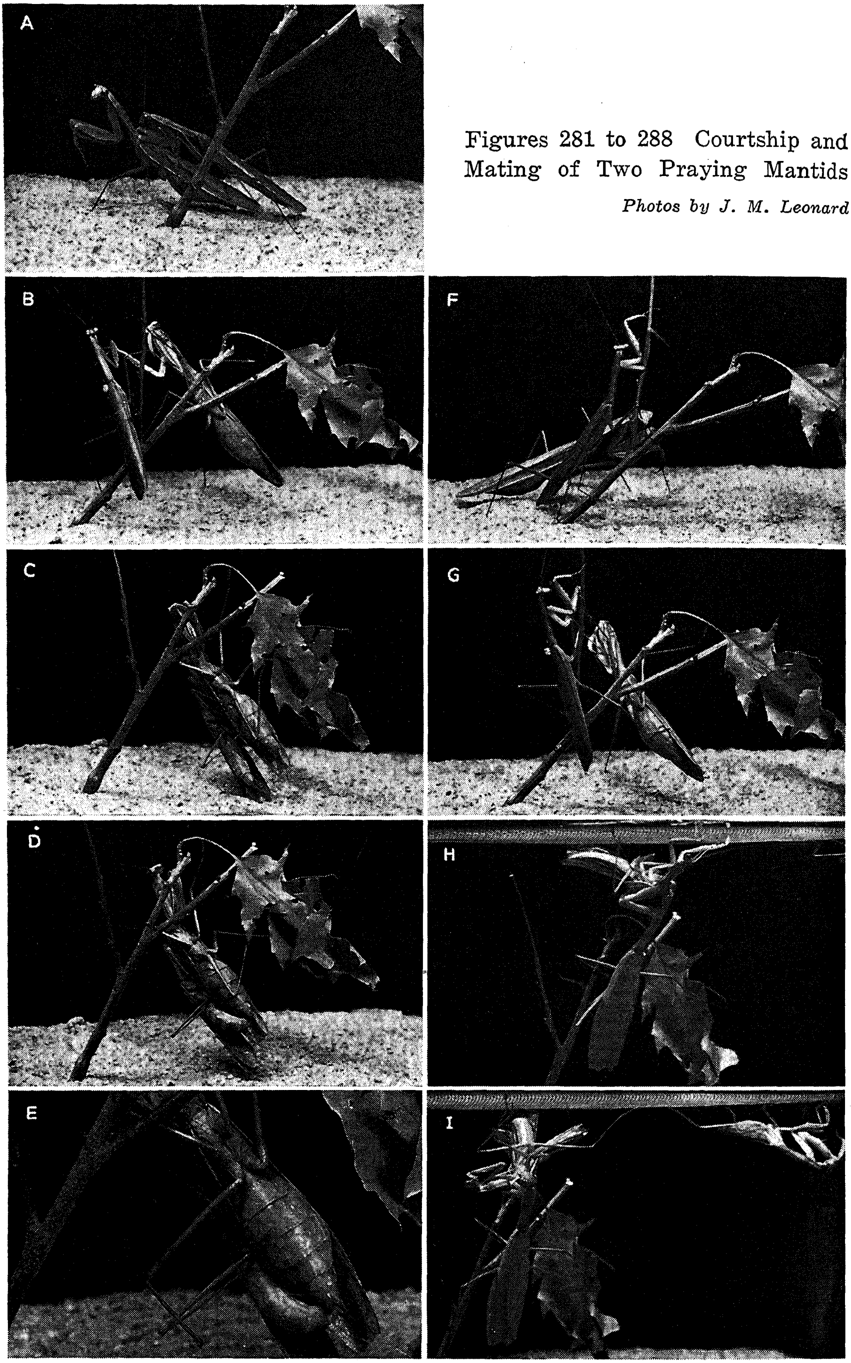
While it may be possible to photograph such a series in the field the chance of being in the right place at the right time is so remote that success is very unlikely. It is better to bring the live insects home where they may be under constant observation as was done in this case.

Selecting the Correct Photographing Angle

In insect photography, as in any other kind, the position of the camera in relation to the object being photographed is an important factor in determining whether or not the picture will be interesting. A photograph of a man or a horse taken from an elevation with the camera pointing directly downward would not be particularly pleasing and would give little idea of what the subject really looked like. Following this line of reasoning best results will be obtained if the camera is in the same plane as the insect, or in other words, at insect level, although this rule may be varied by angle shots from slightly above or below the subject. This point is illustrated in figure 280 which shows two moths, one photographed from above and the other from the side.

It is for the reasons given that the "Triax" tripod is suggested for field work. It is one of the few that is so constructed that the legs when spread out so that they are in one plane, cannot be raised above that plane. When the tripod is placed on the ground with the legs spread in this manner the camera will be only a few inches above the ground and will be rigidly supported.

The proper exposure time can best be determined by means of an exposure meter, bearing in mind that a correction factor must be applied if the extension tube is used. Using the 30mm tube and the 50mm lens set at infinity with the diaphragm at f:6.3 the exposure as determined by the meter should be multiplied by 2.2. It should be remembered that when

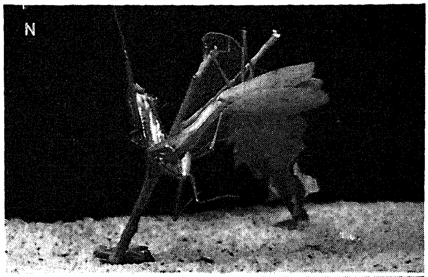


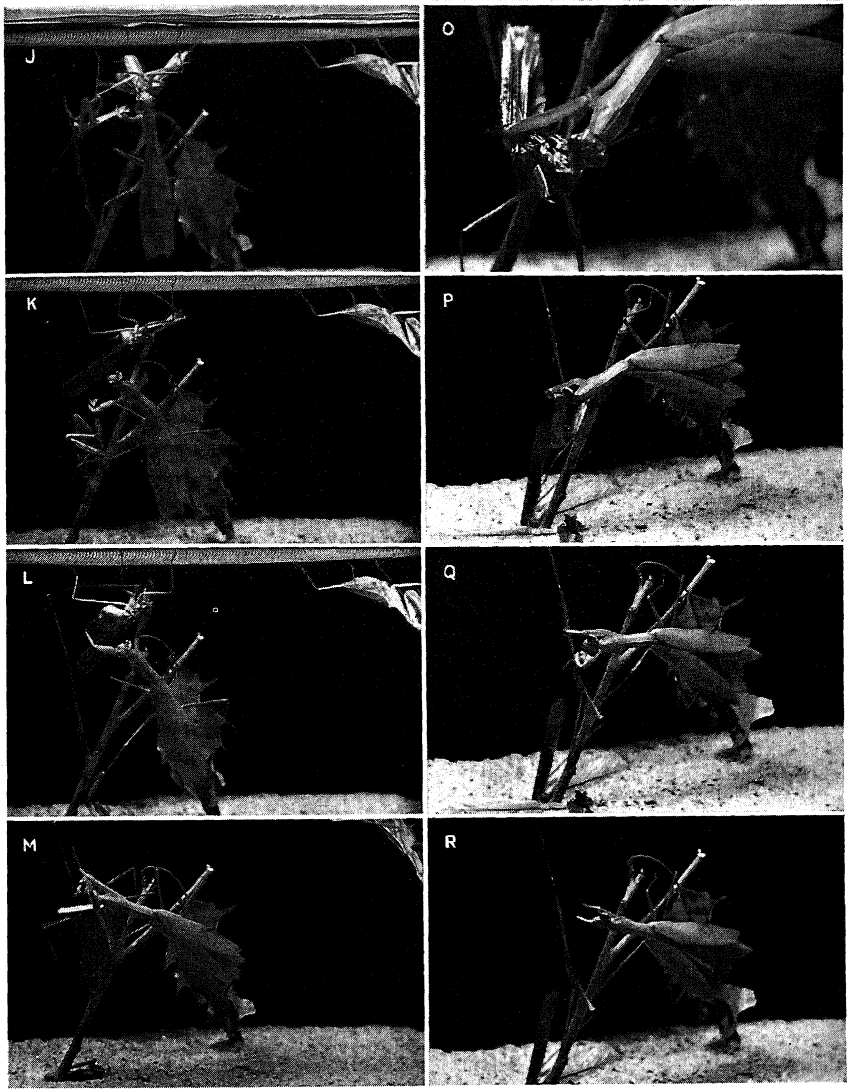
Figures 281 to 288 Courtship and Mating of Two Praying Mantids

Photos by J. M. Leonard

Figures 289 to 297 Mantids Showing Final Disposal of the Male by the Cannibalistic Female

Courtesy Life Magazine





an extension tube is used between the lens and the camera the f values of the diaphragm do not mean the same as when the lens is used without the tube. Moving the lens away from the film increases the size of the image at the plane of the film and therefore a given amount of light coming through the diaphragm aperture will be spread more thinly over the image than would be the case with the lens in its normal position in the camera. This is equivalent to reducing the f value and proportionately longer exposures will be required.

Field trips in search of insects will disclose other interesting subjects for the camera. The hog-nosed snake, the neighbor's cat and the praying mantid (fig. 281) are among the many trophies of such rambles.

Bringing Home the Catch

If the insects are to be brought home to be mounted and photographed at leisure, instead of being photographed in the field, small straight sided bottles having large mouths and screw caps will be found convenient for transporting them. A word of caution, however, about properly segregating the occupants of the bottle: the writer, on one of his collecting trips, found some magnificent specimens of huge black and red ants. He captured a half dozen of the finest looking ones and placed them in a small cardboard box. He carefully brought the box home and opened it to find a grand collection of spare parts—legs, heads and bodies scattered about. In the midst of the destruction was the victor—minus all six legs—still waving avid mandibles, in search of more victims. A safe rule is to have a separate container for each insect.

Moths and butterflies should be killed as soon as they are captured. This may be done by carefully but firmly pinching the thorax between the thumb and finger. If they are alive when placed in the container they will thrash about and injure their delicate wings.

Mounting the Insects

Insects which are to be photographed at leisure must be permanently mounted. This is a difficult job and, if naturalness is to be achieved, calls for steady hands and endless patience. There probably are many ways of mounting and the experimenter may wish to develop his own.

A method which was adopted by the writer after many experiments is as follows:

Take a piece of cardboard measuring about 2 x 3 inches for the smaller insects and proportionately larger for those of greater size. Cement to this a piece of Dennison's gummed cloth mending tape with the gummed side up. Place the etherized insect on this and putting each leg in turn in the proper position, moisten the gum around the foot with a small pointed stick which has been dipped in water. The events leading up to and following this operation are as important as the mounting operation itself. The live insect is carefully studied until all of the details of one pose are firmly pictured in the mind. This includes the position of the antennae and of each of the six legs, the angle of the head and of the body, and the distance between the under side of the body and the mounting surface. The insect is then etherized. This may be done by inverting a water glass over it and placing a few drops of ether under the edge of the glass with a medicine dropper. Experience will show the proper amount, which varies greatly according to the kind of insect. A few drops suffice for a fly while some beetles and spiders literally must be bathed in it. Care must be taken to remove the insect after it is properly anesthetized. Too much ether will kill it, and the way the contracting muscles of a dying beetle will pull its six legs into a tangle would discourage the most patient experimenter. Place the insect quickly on the gummed tape and fasten each foot in the position it assumed when alive. After this job is about half done the chances are that it will suddenly come to life and pull its feet free so that the whole operation will have to be repeated.

When all legs are in place the insect is blocked up to the proper height by inserting under it small rolls of tinfoil or bits of cardboard. The head is held at a natural angle in a similar way or by letting it drop into the crotch formed by two pins which are stuck into the cardboard in such a way that they cross just under the head. The antenna may be held sloping upward to the front by a piece of cardboard so folded that one part of it rests flat on the mount forming a base for the other part which extends upward at the desired antenna angle. The antennae are carefully laid on

Fig. 298 A Mantid's Close-up Portrait . . .

Taken with Sliding Copy Attachment and Extension Tubes

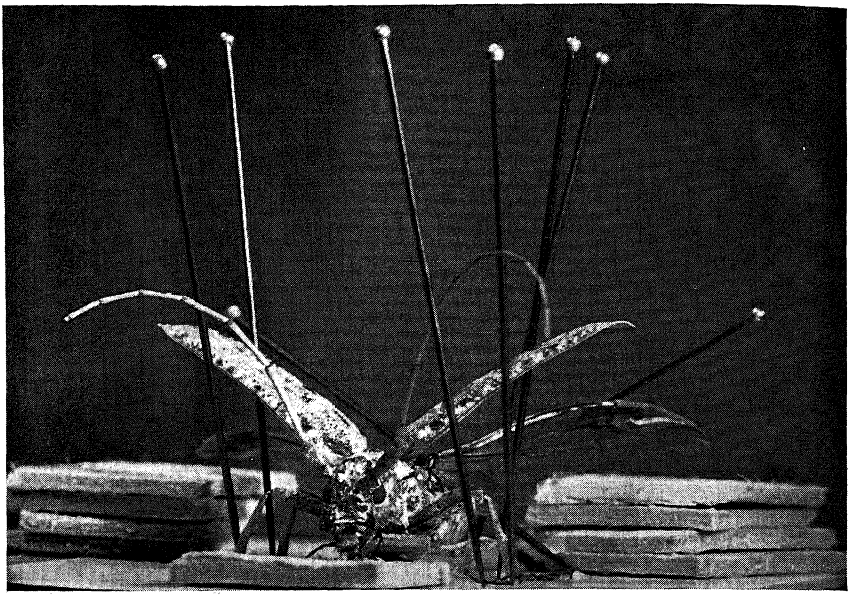


Fig. 299 The Insect Is Carefully Mounted as Shown and Left to Dry in a Fixed Position

the sloping piece. Antennae which are carried in a horizontal position may be held in place by a small block of tinfoil placed under them. Legs which tend to buckle in the wrong direction are braced by pins stuck into the cardboard mount. Ordinary pins may be used but those are not as satisfactory as the pins used by entomologists for mounting insects. This pin is about 1½ inches long and has a very small head and a sharp point. After the insect is finally mounted and is blocked in a lifelike position it should be killed. One of the most satisfactory ways of doing this is by inverting a large mouthed cyanide bottle over the insect. The cyanide fumes do their work in a very few minutes. The insect is carefully put aside to dry and in four or five days the pins and blocking may be removed. The insect will remain permanent in the position in which it was mounted. Figure 299 shows a beetle which was mounted by the method just described. Figure 300 shows the same insect as finally photographed.

The supplies and implements for mounting are few and simple. They are: a can of ether, a medicine dropper, some pieces of cardboard, a small sheet of tin or lead foil, a roll of gummed cloth mending tape, a tube of cement, one or two long flexible tweezers, some pins, and a few slender pieces of wood with needles stuck in their ends. The needles are used for arranging the insect's legs and antennae. One of them may be made more useful by heating the needle point and bending it into a very short hook. One more accessory which is almost a necessity is a binocular loupe magnifier such as is used by oculists. Lacking this a reading glass may be used but it should be mounted on a support so that both hands are left free to work on the insect.

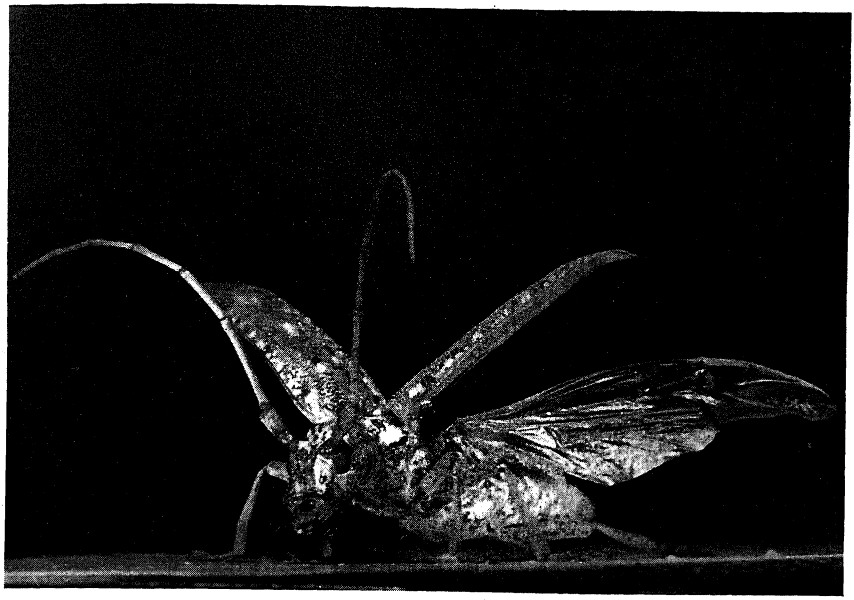


Fig. 300 After the Mounting Pins Have Been Removed the Insect Takes on a Very Life Like Position

The question has been asked many times as to how insects should be preserved to prevent decomposition. The answer is that preserving is not necessary for the reason that the insect wears its skeleton on the outside. The outer part of the insect's body is composed of a substance known as chitin. This is an organic chemical compound and the parts of an insect's skin which contain it are hard, tough and lasting. Spiders, however, require special treatment as otherwise the body will gradually shrink and collapse until it is flat and unnatural in appearance. Before mounting a spider the under side of its abdomen should be slit open and it should be thoroughly cleaned out. It should then be stuffed with cotton until it is filled out to natural size and appearance.

To prepare the mounted insect for photographing, a thin layer of fine sand may be sprinkled on the cardboard mount to produce a natural looking foreground. A piece of cloth or cardboard may be placed a few inches behind the insect for a background. This may be white, black, or some shade of gray, depending upon the color of the insect and the photographic effect desired. For a dead black background a piece of black velvet is excellent.

Lighting

Lighting a subject as small as an ant or a fly in such a way as to bring out the desired contrasts is difficult and requires much experimenting. Almost any source of illumination can be used, but the results obtained will be somewhat dependent upon the amount of control that can be exercised in the application of the light. The lighting originally used by the writer consisted of three 100-watt Mazdas in goose neck desk lamps. While fairly satisfactory results were obtained with this lighting arrangement it was not all that could be desired. The size of the light source was so large compared to the subject being photographed that it was difficult to produce the desired effects. Photoflood lamps may be used if it is desired to materially shorten the exposure time, but these too, have the disadvantage of being much larger than the subject.

The most satisfactory lamps so far used were improvised from old style De Vry still projectors. This so-called projector really consists of only a lamp housing with its support and a very good condenser system. Projection originally was accomplished by clipping a De Vry camera in front of the condenser and using the camera lens as the projection lens. The camera however is not necessary in constructing the insect spot lights. The first steps in adapting the projector are to remove the lamp housing from its support, discard the support and the transformer which it contains, and substitute a double contact bayonet socket for the single contact socket. The double contact socket is standard and may be obtained in any automobile supply store. A 50 or 100-watt 115-volt projection bulb will fit this socket and is the right size for the lamp housing. The housing should then be mounted so that it may be moved up and down or may be tilted. This requires only a little ingenuity and in figure 301 it is shown in use. It consists of a lead-filled lamp base, a rod with sliding clamp which ordinarily is used to adjust casement windows, and a brass coat hanger for adjusting the position of the lamp when the housing becomes too hot to touch.

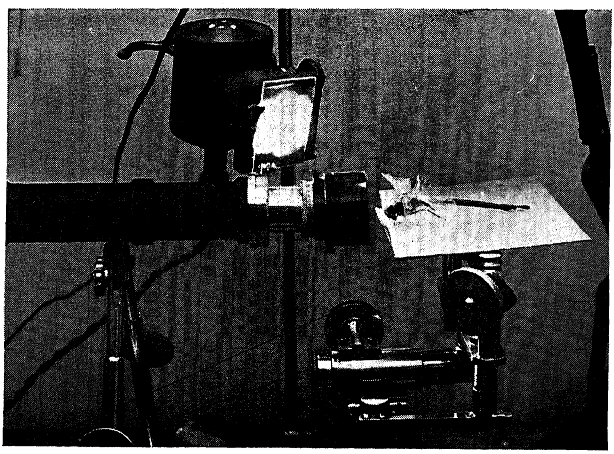
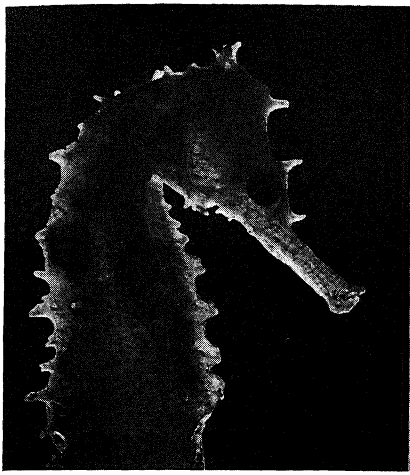


Fig. 301 Close-up View of Photographic Equipment Showing Position and Construction of Spot Light and Arrangement of Insect and Lens



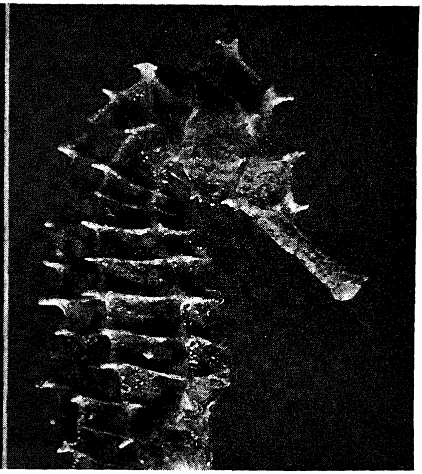


Fig. 302 Sea Horse with Back Lighting Effect

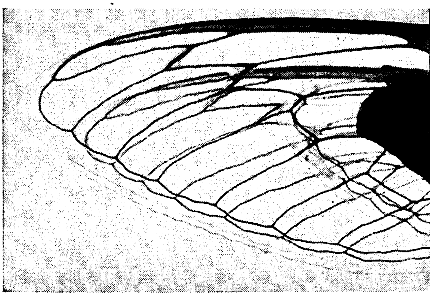
Fig. 303 Sea Horse with Front Lighting Effect

A piece of ground glass clamped in front of the condenser lens to diffuse the light, completes the outfit. This lamp produces a brilliant concentrated spot of light ¾ inches in diameter at about 2½ inches in front of the condenser lens, and a well di/used light at a distance of eight or more inches. The light has a value of 1500 to 1800 candles per square foot in the ¾ inch spot and about 600 candles at the 8 inch distance.

In arranging the lighting in preparation for the exposure a good general rule is to place lights on both sides of the subject with a third light above and to the front of the insect. In order to avoid flat lighting the lamps should not be equidistant from the subject, but should be so placed that proper shadows are cast. Care should be taken, however, to avoid multiple shadows. By changing the position of one or more lamps, any desired parts of the insect can be

Fig. 304 Transparent Wing of Small Insect: Front Illumination; White Back-ground

Fig. 305 Transparent Insect Wing, Cross-Illuminated Against Dark Back-ground



thrown into relief. A useful combination of lights consists of two photoflood lamps with tracing cloth diffusing screens and a single spot light. The photofloods are placed on either side of the subject to give full and uniform illumination and the spot is used to bring out the desired contrasts.

Back lighting produces interesting results and seems particularly effective in the case of insects having semi-transparent wings. Entirely different effects in wing photographs may be produced by back, front or cross lighting. A beam from a single spot light directed across the surface of the wing makes the wing veins stand out in relief. In contrast to this, front lighting against a white background silhouettes the veins. Interesting effects with other subjects will result from varying the position of the lights as shown by the sea horse in figures 302 and 303. In figure 303 lighting was entirely from the front, while in figure 302 the lights were placed back of the sea horse and below the level of its head with the beams directed slightly upward.

Many pitfalls will be encountered. The smooth shiny body of a beetle will reflect brilliant patches of light. Undesirable reflections will be produced by the eyes. The under side of the insect will appear on the print as a black area with no detail unless care is taken to place one or more lights at the level of the insect's body or slightly lower. Many other difficulties will be encountered which can be solved only by experiment. In general, most of the lighting principles which are used in portrait work apply equally well to the photography of insects. The difficulty lies in the practical application of these principles. The subject is so small and the effects of the lighting are, in consequence, so difficult to judge, that many times it is only when the final enlargement is made that the correctness of the lighting arrangement is known.

Ultraviolet Light

If extreme resolution of detail is required, it will be necessary to depart from the usual sources of artificial light and take advantage of the short wave lengths of the ultraviolet region. An inspection of the equation for resolving power of a lens will show that decreasing the wave length of the light used increases the resolving power.

The use of ultraviolet light for photography immediately suggests quartz lenses and quartz lamps, but these are very expensive and are not necessary for ordinary work. The usual types of camera

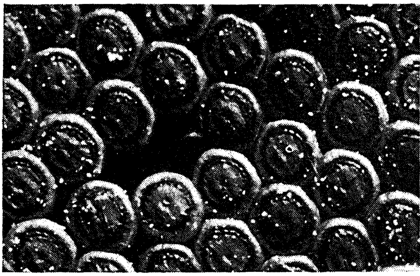


Fig. 306 Eggs of Canker Worm Photographed by Ultra-Violet Light

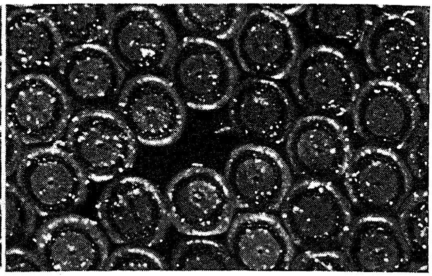


Fig. 307 Same Section of Egg Mass Photographed by Mazda Light

The improvement in definition resulting from the use of ultraviolet light is shown in figures 306 and 307. These are photographs of the eggs which produce the inch or canker worm so destructive to foliage. The pictures were taken on the same roll of film with the same lens so that all conditions except the light source were identical.

Increased definition is only one of the results of the use of ultraviolet. Experiments conducted by Dr. Frank E. Lutz and others indicate that insects see by ultraviolet rather than by the light to which our eyes respond. By using the short invisible waves to photograph the insects we are able to picture them as they possibly look to each other. Comparison photographs of the same insect taken by white and by ultraviolet light will in some cases reveal interesting differences in the marking. Figures 308 and 309 show two photographs of a butterfly taken in one case by white light, and in the other by ultraviolet.

The determination of the best film to use in ultraviolet photography must be left to the reader to determine, as the writer has not yet had time to make complete comparative experiments. DuPont Superior Panchromatic with which the accompanying illustrations were made has given excellent results, although possibly other films may be found which are better suited to this light.

Equipment for Indoor Work

In preparing the photographic apparatus for indoor use, the camera should be so mounted that the axis of the lens is horizontal, and both the camera and the platform upon which the insect is placed for photographing must be mounted very rigidly in order to eliminate vibration and consequent loss of definition. As the amount of photographic magnification is increased this becomes a serious problem and unless the whole structure is very rigid every nearby truck, train or street car will cause noticeable vibration. Another matter of importance is to support the extension tube at a point near the lens. If this is not done the vibration will be excessive no matter how firm the remainder of the structure may be.

One of the arrangements used by the writer is shown in figure 310. The bed on which the equipment is mounted consists of two 5-ply hard wood panels bolted together and weighing about 40 pounds. Sponge rubber blocks are placed between the panel and the table top to absorb vibration.

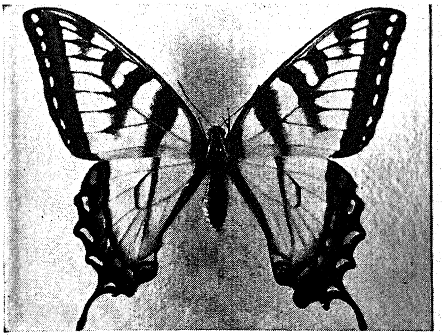


Fig. 308 Yellow Tiger Swallow-Tail Butterfly. Photographed by Mazda Light.

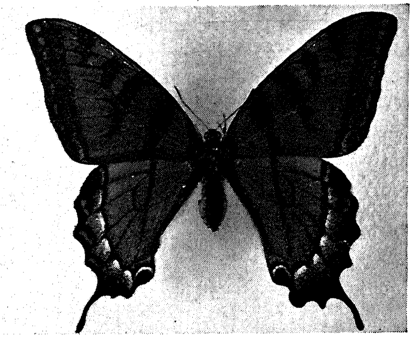
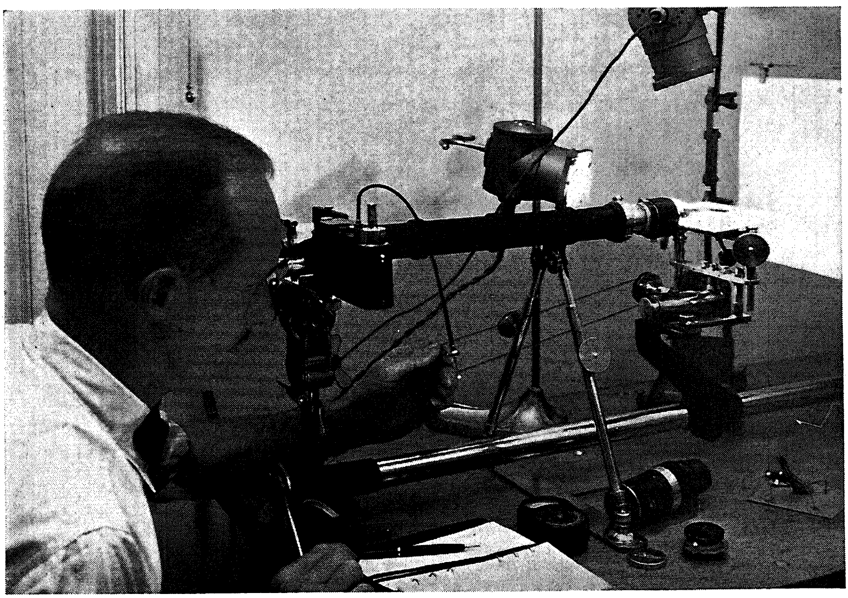


Fig. 309 Same Butterfly. Photographed by Ultra-Violet Light

The table itself rests on cork. The camera is attached to a tripod head from an old German machine gun mount. These can be picked up in some of the stores dealing in second hand war material. The various adjusting screws on the tripod head make it possible to raise or lower the camera, to rotate it from side to side, and to tilt it in any direction.

The mounting bed carries a heavy walled brass tube which is strongly braced and on which are two Leica sliding arms. The outside diameter of the tube is 1¼ inches which is the correct size to fit the sliding arms. A small platform on which the insect is placed for photographing is mounted

Fig. 310 James M. Leonard and his Camera Equipment for the Photography of Insects



on one arm and the other is used to support the backgrounds. The platform can be moved forward or back by means of a rack and pinion. A movable support for the end of the extension tube rests on the mounting bed.

Photographing at Home

The insect to be photographed is placed on the platform and the sliding arm is moved to get about the proper working distance between the lens and the insect. The fine focusing adjustment is made by means of the rack and pinion.

Having put the insect in place and arranged the lights all that remains to be done is to focus, expose, develop and print. These few operations, however, bring up some very interesting problems. For example, the question of the proper diaphragm opening is a vexing one and usually resolves itself into a compromise between depth of focus and definition. Stopping down the diaphragm increases depth of focus but in the case of some lenses it results in a loss of definition. Opening it may increase the resolving power but gives almost no depth of focus. A fairly wide open diaphragm may be permissible when photographing an insect's head or other part which will not include the foreground or the mount on which the insect is placed. If, however, these are included in the picture the result will be far from pleasing. The foreground will show a clean cut section which is in sharp focus while everything in front of and beyond this section will be completely out of focus. As the diaphragm is closed the section in focus will widen and the line of demarcation between it and the out-of-focus area will grow less distinct. The optimum opening is reached when the areas which are in focus and those which are not blend into each other, the important parts of the insect being, of course, in focus.

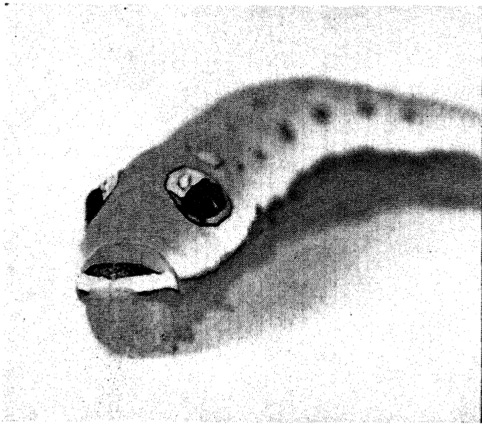
Some difficulty may be encountered in determining whether or not the insect is sharply focused because of the small amount of light reaching the ground glass when the diaphragm is partially closed or when several sections of extension tube are used. Focusing will be made much easier if the ground glass is given a light coating of oil. Cocoanut oil is very satisfactory for this purpose. Place a drop on the ground side of the glass and spread it with the finger, rubbing lightly in one direction and then at right angles to that direction to insure even distribution of the oil. Do not use cloth to spread the oil because pieces of lint are likely to adhere to the gloss. Wipe the surplus oil from the finger after each rubbing in order to reduce the film to the right thickness. The proper amount remains when objects several feet distant appear indistinct when viewed through the glass.

Fig. 311 *Amblicorypha Oblongifolia*—A Relative of the Katydid

Exposure

The proper length of exposure can best be determined by the trial and error method. An exposure meter will help, but the subject being photographed is so small that the amount of light which it reflects toward the lens is insignificant compared with the light reflected by the mount or the background. About the only way to be sure of getting a usable negative is to make four or five exposures of each subject. The first exposure should be somewhat shorter than the estimated correct time and each succeeding exposure should be 1½ or 2 times the preceding one. A record should be kept of the subject, the lighting used, the length of the extension tube, the diaphragm opening, and the time of each exposure. A study of such a record will soon enable the experimenter to make a sufficiently good guess at the exposure time so that if not more than three exposures are made as just described one of them will produce a negative of the correct density.

The table on page 232 will be very helpful in determining the relative exposure for any length of extension tube and includes other valuable information as well. Also consult the chapter on Copying and Reproduction,



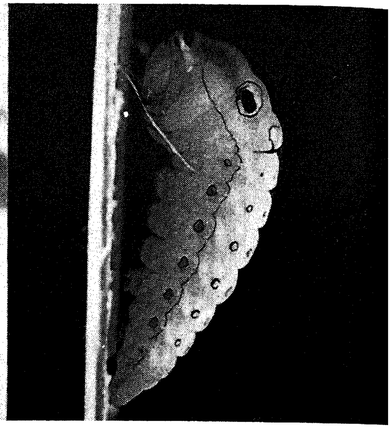


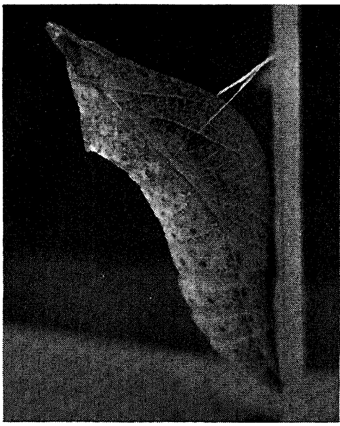
Fig. 312

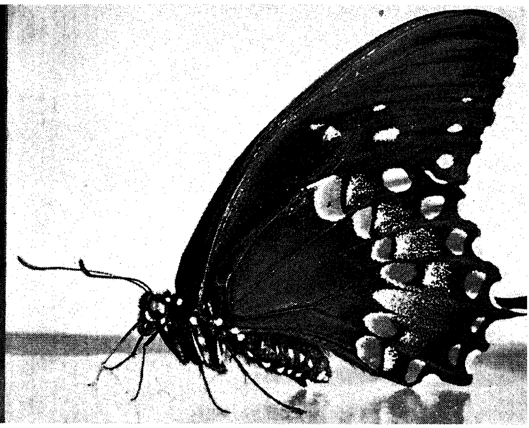
Fig. 313

The Life Cycle of the Spice-bush Swallow-tail Butterfly

Fig. 314

Fig. 315





by Willard D. Morgan, for information on other lenses and on depths of focus.

Any reference to films and developers may seem unnecessary. These subjects have been fully covered in many publications. A few personal opinions will be ventured, however, in the hope that they may help the beginner in insect photography. If extreme definition is desired the order of preference probably should be (1) positive film, (2) orthochromatic and (3) panchromatic. If proper rendition of the colors is the first consideration the order should be reversed. Many insects, particularly the moths and butterflies are marked with red or orange and if the various gradations and shades of these colors are to appear in the finished print the use of panchromatic film is essential.

The writer has adopted DuPont Superior panchromatic film and the so-called Sease No. 3 developer for his own use. The formula for this developer has been published many times but will be repeated here for the sake of completeness.

Sodium Sulfite	3 oz. 76 grains	90 grams
Paraphenylene Diamine ..	154 grains	10 grams
Glycin	93 grains	6 grams
Water	33 oz.	1 liter

Developer at 68° F.	
Gamma in fourteen minutes..........................	0.54
Gamma in twenty-eight minutes....................	0.76
Gamma in forty-two minutes........................	0.86
Time to reach 0.7 gamma..........................	24 minutes

While this developer has the disadvantage of requiring approximately double exposure it has the advantage of excellent keeping qualities and of producing fine grain. The writer has developed twelve rolls of film in a liter over a period of months and the developer still appeared to be in good condition.

It is hoped and believed that those who take up insect photography will find it a fruitful source of enjoyment and relaxation. The use of a little imagination in departing from the usual procedure of photographing the entire insect will produce interesting, and sometimes amusing results. A collection of insect portraits may be made, or individual parts of the insect, rarely seen in detail by the unaided eye, may be photographically enlarged. Figure 311 is a typical insect portrait, the subject, in this case, bearing a surprising resemblance to the head of a horse. Figures 319 and 318, the egg case of a cockroach with its zipper top, and the poison-sting which is the scorpion's weapon of attack, are examples of parts of insects so enlarged that their details may be seen. Caterpillars found in the garden or the field may be brought home to develop their fascinating and mysterious life

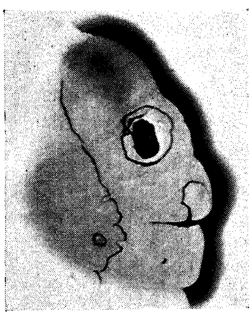
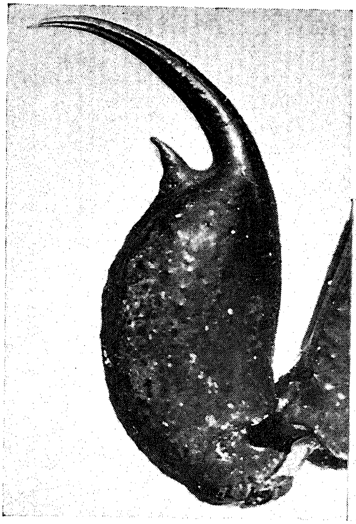


Fig. 316 Portrait . . . Portion of Fig. 313. Who is the Father of our Country? . . .



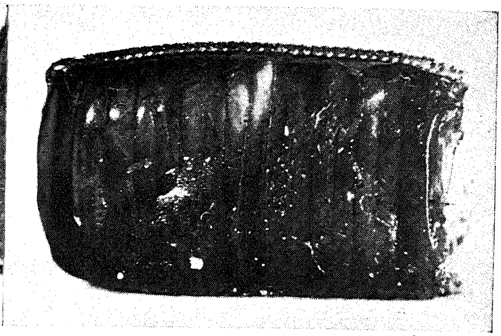


Fig. 318 (left) The Poison Sting at the End of a Scorpion's Tail

Fig. 319 The original Zipper Purse—The Egg Case of a Cockroach

cycle within reach of the camera. Figures 312 to 315 show four stages in the life cycle of *Papilio-troilus,* the Spice-bush Swallow-tail butterfly. These few suggestions by no means exhaust the possibilities of this interesting branch of photography. The field is limited only by the bounds of imagination.

PHOTOMICROGRAPHY WITH THE LEICA CAMERA

H. W. ZIELER

CHAPTER 21

The Leica camera, the pioneer of miniature cameras, has opened so many new fields to photography and has been used successfully for so many different tasks where it replaced larger cameras, that it is not surprising when it enters the field of photomicrography.

It has become well known that for certain types of photography the miniature camera is directly essential, due to special optical conditions which are verified in this kind of camera. The combination of high speed of the objective and depth of focus in the picture which has been thoroughly discussed in the chapter on lenses, establishes the necessity of miniature cameras for many special tasks such as candid photography, photography of small objects, stage photography and others. For these purposes the miniature camera is essential because it does what no larger cameras can do. When trying to use the Leica camera for photomicrography it may appear upon superficial consideration that something paradoxical is being attempted. If small objects are to be photographically reproduced at a high ratio of magnification, it seems necessary to have a large negative, rather than crowding the enlarged detail again into a small negative. The sceptic may readily admit that photomicrography with a miniature camera is not altogether impossible but he may consider it more or less useless or unsatisfactory and, at any rate, not specifically advantageous. It is interesting that a closer investigation of the optical principles proves beyond doubt that for certain types of photomicrography the miniature camera is essential and it is only with its help that some apparently unsurmountable difficulties can be solved.

When to Use the Leica for Photomicrography

In order to fully appreciate why the Leica camera can be used for photomicrography and why it may be the only means towards achieving success, we must again dive into several intricate optical problems. Some of them have been thoroughly explained in the chapter on Leica lenses and need only short recalling.

To begin with, we must realize that **the very purpose of photomicrography is to record minute detail** which is so small that it must be magnified in order to become visible. In the microscope there are two lens components which participate in the process of magnifying, and in taking the photomicrograph a third factor enters to make the process complete:

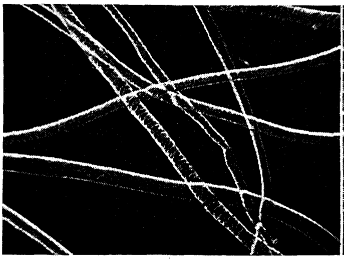
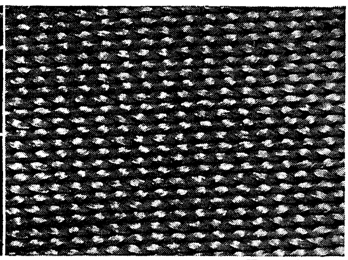
1. the microscope objective forms a magnified image of the object under investigation
2. the eyepiece of the microscope remagnifies this image
3. the distance between the eyepiece and the negative on which the picture is recorded determines the area which the magnified image finally occupies in the photograph.

It is interesting and important to know, that **only the first** of these three stages of magnifying is capable of revealing finer detail. The function of the eyepiece and the *projection distance* in recording the image on the negative is comparable to an enlarging process. In the enlargement we find the same detail which was in the negative but stretched over a larger area to bring it within the limit of visibility of the eye. Every single detail which we find in the enlargement was also in the negative, only it may have been so close together that the eye could not see it.

In photomicrography we find all revealable detail in the first magnified image which the objective produces. In this image, however, the detail is crowded into such small space, that considerable enlargement is possible before it is fully detectable by the human eye. We could place the negative in the plane where the objective has formed the first magnified image and simply enlarge this negative with a regular enlarging apparatus. In doing this we would meet with some technical difficulties. In the first place the grain size of the silver deposit in the finished negative would limit us in producing greatly magnified enlargements. And then, as was mentioned in the chapter on lenses, there is always a certain loss of detail in recording the image on the turbid emulsion of the film. The light, in penetrating through this layer, is scattered and thus the rendition of detail is slightly decreased.

Therefore it is advisable to call for the assistance of another optical unit to participate in the process of enlarging the image which the objective has formed. But although we can let the eyepiece carry the entire burden of the enlarging process so that in the original negative we find the detail separated far enough to make it visible for the eye (in which case a contact print could be made from the negative) we may, with equal justification, divide the task so that for instance in the negative the detail is still four times more crowded than is permissible for the eye to see it. In this case we simply enlarge the negative again four times in our regular enlarger.

The realization is of utmost importance. We must not forget that any process of magnifying is naturally connected with a reduction of the light intensity in a given area. In fact, the light intensity decreases with the square of the size of the negative so that for instance in taking a photomicrograph on a plate of 5 x 7 inches we require an exposure which will be 25 times as long as that which a Leica negative (1 x 1½ in.) requires if it is placed so much closer to the eyepiece, that

Emil Keller

Fig. 321 Wool 110x

Fig. 322 Silk 10x

the same area of the object is reproduced on it. There are many occasions where a short time of exposure in a photomicrograph is essential because the specimen under the microscope may be living and moving around so that it can only be photographed by instantaneous exposure. Often it is not possible to increase the intensity of the light by selection of a stronger light source because the enormous concentration of light in the plane of the object may quickly destroy the delicate structure of the specimen. In these cases there is just one solution: the miniature camera. It is not surprising that it was the important field of **photomicrography of living objects** which came to its full practical significance only through the miniature camera.

But, whereas the miniature camera is indispensable for this type of photomicrography, it can also be used with great convenience for many tasks of **general photomicrography** without serious disadvantage. Whenever a great many photomicrographs have to be taken under identical light conditions and magnification, it is, of course, a great convenience to have the Leica with its great film carrying capacity, its inexpensive negative material and the great variety of film emulsions. General Photomicrography with the Leica is economical and convenient. Only in rare cases will it happen that the requirements for recording even the very minutest detail, are such that the method with the small negative may show slightly inferior results when compared to photomicrographs on larger negatives.

Photomicrography of living objects and general photomicrography are of great importance for the scientist. But also the amateur can become interested in it and he can derive an infinite amount of pleasure from it. So we have a rather popular field of application for the Leica camera in **photomicrography as a hobby.**

To summarize, we can form three groups and this classification is not arbitrary but has quite an important influence upon the selection of the best equipment:

1. Photomicrography of moving objects: the Leica is a necessity,
2. General photomicrography: the Leica is an economical convenience,
3. Photomicrography as a hobby: the Leica is a source of pleasure.

How to Adapt the Leica Camera to the Microscope

In describing the technique of photomicrography with the Leica camera we must, of necessity, give preference to those details which relate specifically to the camera. The problems pertaining primarily to microscopy must be treated more briefly, because we wish to condense the information into a chapter rather than into a library. Therefore we shall, for the present, consider the microscope as one unit, and the Leica camera as another one and then describe the best method of combining these two units for the various purposes of photomicrography.

Among the accessories offered for the Leica camera, there are devices which permit three different ways of adaptation of the camera to the mircroscope. Which of these three devices should be used, depends again upon the type of work which we want to do.

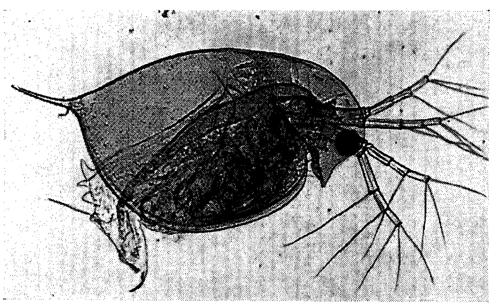


Fig. 323 Daphnia Pulex
C. G. Grand
2x Objective, 8x Eyepiece

Photomicrography of Living Matter with the Micro Ibso Attachment

When using the Micro Ibso attachment, the regular Leica lens must be removed from the camera. That means that this attachment cannot be used with Leica Model A. The attachment, shown in figure 324, is to be adapted to the camera body like a regular Leica lens. At its lower end it is equipped with a microscope eyepiece. This eyepiece has a magnifying power of 10x when used for visual observation. Used in connection with this device, however, this power is not fully developed because the small negative of the Leica camera is placed so close to the eyepiece. The microscopist knows that only if the negative is placed 10 inches from the eyepiece, the magnification of the latter in photomicrography will be equal to that which prevails in visual observation. With the Ibso attachment the eyepiece does only one-third of its performance for visual observation. But this is just enough to spread the detail conveniently over the area of the Leica negative. That means that a Leica negative, enlarged to the size of 3 x 4½ inches, will represent a photomicrograph with the same magnification as that which prevailed if the same objective and eyepiece would have been used for visual observation.

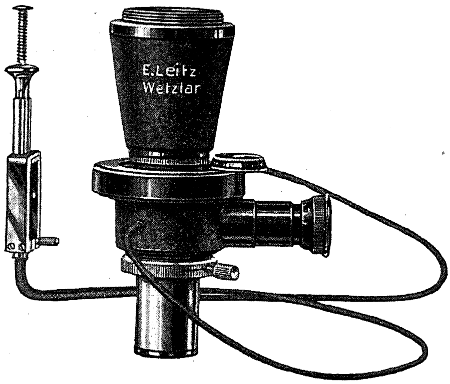


Fig. 324 Micro-Ibso Attachment with synchronized cable releases: one activating the Compur Shutter, the other throwing the prism out of the path of light rays

The eyepiece can be removed from the Ibso attachmnt by unscrewing the knurled adapter ring with which the entire device is clamped to the microscope tube. It is not abvisable to use eyepieces of different magnifying power. It must be realized that the field seen through the microscope is circular whereas the shape of the negative is rectangular. On the other hand we find in photomicrography that it is

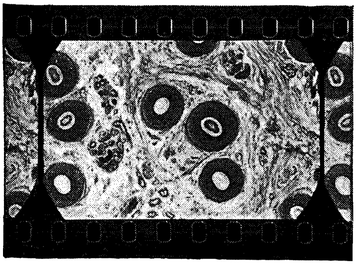


Fig. 325 Leica Photomicrograph made with the Micro-Ibso Attachment

often next to impossible to have the entire field appear uniformly sharp in focus. Especially at higher magnification the outer portion of the field is more or less out of focus. The eyepiece with which the Ibso attachment is equipped has such magnifying power that the most valuable portion of the field is utilized. How the image of the specimen fills the frame of the Leica negative is shown in figure 325.

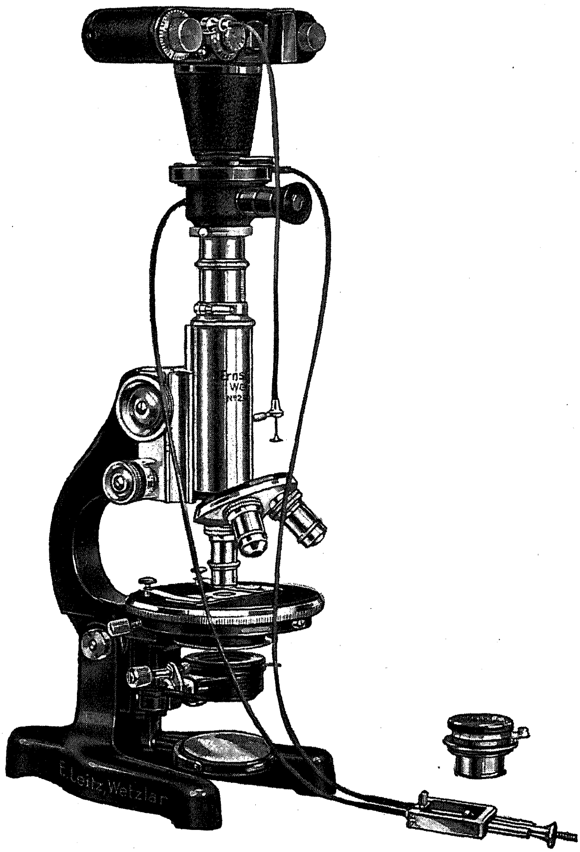


Fig. 326 Micro-Ibso Attachment with Leica camera placed upon Microscope—ready to use

The middle section of the Ibso attachment contains a beam-splitting prism which can be removed from the course of rays by operation of a wire release. So that this prism may also be **held** outside of the course of rays, the wire release is equipped with a clamping screw. A certain portion of the light which has passed through the microscope is reflected by the prism into a side telescope where the micro image can be visually observed and focused. The balance of the light passes onto the film. Above the telescope there is a Compur shutter with which the actual exposure is made. A conical housing is attached to the middle section and this is of such length that the image will fill the negative as shown before. This housing also contains a lens system for the purpose of correcting the passage of the rays so that at this short distance a sharp image can be produced.

It is the beam-splitting prism and the side telescope which make the Ibso attachment so valuable for photomicrography of living objects. When the specimen is in motion it is essential that we have a method of observing and focusing continuously until the very instant before the exposure is taken and these two features enable us to do so.

And in order to shorten the time of exposure as much as possible we do not only benefit from the small negative size of the Leica but also from the fact that during the (general instantaneous) exposure the beam-splitting prism is removed from the course of rays, thus conveying the entire available amount of light onto the film.

The side telescope is equipped with an adjustable eyelens. This is an important device which is often overlooked. When focusing visually we must realize that there are differences in the eyesight of different observers. When the image appears in focus for one observer, it may not be sharp for another; yet the image must **always** be sharp **in the plane of the film.** These differences are compensated by the adjustable eyelens. In looking through the side telescope a cross hair ruling is visible. Before focusing the microscope the observer must turn the mount of the adjustable eyelens until the cross hairs appear in perfect focus. Only when this is done should the microscope be focused with the coarse and fine ajustment. In this case there will always be coincidence of focus in the side telescope and in the plane of the film. If a different observer looks through the side telescope and finds the micro image out of focus, the cross hairs will likewise lack in sharpness. But simply by turning the mount of the adjustable eyelens crisp focus can be established for both, the image and the cross hairs.

It may appear strange that a Compur shutter is required to take the photo inasmuch as the Leica camera has a focal plane shutter. This shutter, however, when released, moves in a direction which would create a lateral momentum and cause vibrations which would affect the sharpness of the picture. The Compur shutter avoids this danger. But since the transporting of the film is coupled with the winding of the Leica shutter, the procedure of taking successive photomicrographs is somewhat complicated and the photomicrographer will have to accustom himself to the following sequence of manipulations.

1. Remove the lens from your Leica camera and adapt in its place the Micro Ibso attachment to the camera body of Leica models C, D, E, F, FF, or G.
2. Remove the regular eyepiece from the microscope tube, set the tube to the correct mechanical tubelength prescribed by the manufacturer (some microscopes are equipped with draw-tubes, others have stationary tubes; the manufacturers have different standards as to the length of the tube and when the microscope is equipped with a draw-tube, this must be correctly set) and place a rubber ring or metal clamp around the draw-tube so that the weight of the camera with Ibso attachment will not change the tubelength. A rubber ring is supplied with the Ibso attachment.
3. Adapt the Ibso attachment with Leica camera to the microscope by inserting the eyepiece of this attachment into the microscope tube. Then tighten the clamping screw on the knurled ring at the lower end of the Ibso attachment.
4. Fasten the two wire releases to the Ibso attachment. The one with clamping screw is for the beam-splitting prism, the other one is for the Compur shutter.
5. Attach the regular wire release to the Leica camera. Wind the focal plane shutter of the Leica camera and set it for time exposure.
6. Adjust the eyelens of the side telescope so that the cross hairs appear in sharp focus.
7. Focus the image of the microscope with coarse and fine adjustment while looking through the side telescope.
8. Set the Compur shutter for the correct time of exposure.
9. Press the wire release of the Leica camera and clamp the wire release in this position so that the focal plane shutter will remain open. You are now ready to take the exposure by pressing the wire release of the Compur shutter. If you wish to have as much light as possible for the exposure, you can also swing the beam-splitting prism out of the course of rays. Thus you will have to operate two wire releases simultaneously. But you must also operate the fine adjustment of the microscope continuously and since we have only two hands, you may wish to make use of an automatic release attachment which permits with one motion to swing out the prism and immediately afterwards to take the exposure. This attachment is likewise shown in fig. 326.
10. After the exposure has been taken, loosen the clamping screw of the Leica wire release, thus closing the focal plane shutter. Wind to the next frame, press the Leica release again, clamp it in this position and you are ready for the next picture.

Whereas the Ibso attachment can, of course, be used for every task in photomicrography with the Leica camera, regardless of whether the object is moving or stationery, other devices may be preferred in the latter case. The Ibso attachment, after all, is not inexpensive and other Leica accessories may be used equally well, having the added advantage of the possibility of other applications.

General Photomicrography with the Sliding Focusing Attachment

Excellent photomicrographs can be taken with the Leica camera adapted to the sliding focusing copy attachment when the latter is attached to the extension arm on the upright of the Valoy enlarger (or other models) and is provided with an extension tube of a certain minimum length. Also in this case, Leica Model A cannot be used because the camera body alone must be attached to the focusing attachment. The general set-up is shown in figure 327. After having removed the lamp housing from the upright of the enlarger, the special arm which holds the focusing attachment with the Leica camera is fastened to the upright. An extension-tube of 6cm should be used attached to the sliding focusing attachment. The arm carrying the entire Leica equipment is lowered until microscope tube and extension tube just overlap. A light-proof connection can easily be established by wrapping a piece of black paper or cloth around the lower end of the extension tube.

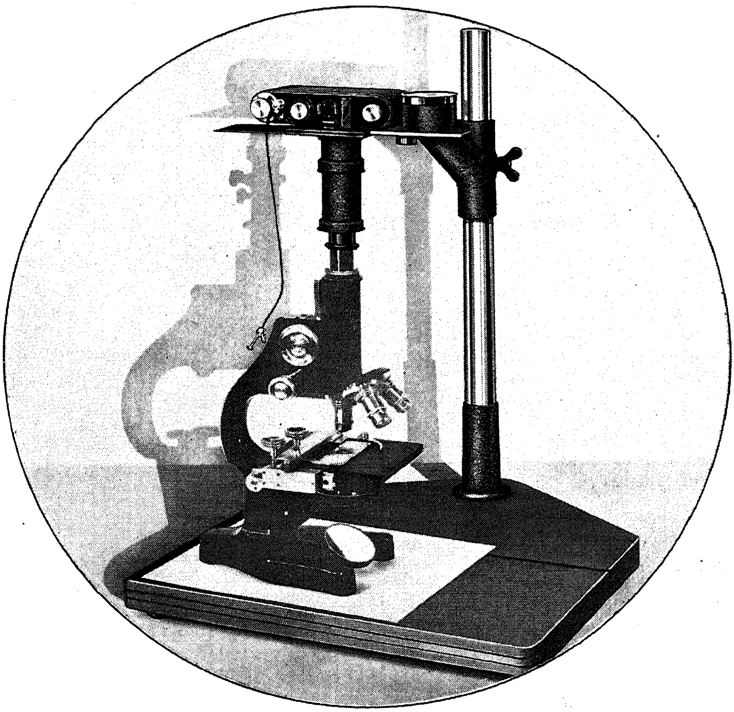


Fig. 327 General set-up showing how a Sliding Focusing Attachment is used with the Leica for Photomicrographic work

It is, of course, possible to use extension tubes of any length. The total length of the tubes used will determine the magnification of the image in the plane of the film and therefore also the area which the image occupies. A tube of 6cm has been suggested for definite reasons. When this tube is used, the image will occupy about the same area as that shown in fig. 325, when an eyepiece of 10x magnification is used, as in the case of the Ibso attachment. It is also possible to use eyepieces of different magnifying power. When these eyepieces are used for such short projection distances they do not yield their total magnifying power which would prevail in visual observation. Only if the total distance from the rim of the eyepiece to the plane of the film is 10 inches will the eyepiece yield the same magnifying power as in visual observation. For shorter distances this power decreases correspondingly. When the total distance is only about 3 1/3 inches (as it will be be when the 6cm tube is used) the eyepiece magnification is also reduced to 1/3 of its full value, which corresponds to that which we use when taking photomicrographs with the Ibso attachment.

For those who want to proceed in strictest accordance with correct optical principles it may be mentioned that when taking photomicrographs with the focusing attachment, they may use eyepieces with adjustable eyelenses to compensate for the short projection distance. The principle involved is too complicated and the benefit derived too minute to require special explanation. The reader who is interested is referred to literature about microscopy.

The procedure in taking photomicrographs with this equipment is as follows:

1. Before placing the focusing attachment with Leica camera and extension tube in position, focus the microscope roughly for visual observation so that the microscope tube will not have to be displaced too much in vertical direction after the light-proof connection has been established.
2. When the microscope has been focused visually, lower the arm on the upright until the extension tube overlaps the microscope tube and make the light-proof connection. Tighten the clamping screw on the extension arm when the image on the ground glass appears as shown in figure 327 (provided a 10x eyepiece and 6cm tube were used).
3. Attach the wire release to the Leica camera.
4. Focus the image sharply on the ground glass by means of the fine adjustment of the microscope and slide the Leica camera into position. You are now ready to take the photomicrograph.

When the focal plane shutter is released there is no danger of vibrations affecting the sharpness because the Leica camera is held rigidly in the focusing attachment.

Obtaining Critical Focus

Critical microscopists may resort to a simple trick in order to avoid any error in focusing on the ground glass. A small piece of thin clear glass, such as a cover glass, used for protection of micro slides, may be pasted to the ground glass with a small droplet of cedar wood oil. The covered area will become transparent and the aerial image may be focused with a special 30x magnifier (a special ground glass with a clear strip and calibrated scale is also available). This magnifier, however, must also be focused to the plane of the cover-glass. Therefore, before attaching the coverslip, a small pencil mark should be made on the ground glass. The magnifier may be raised or lowered in its mount until this pencil mark appears in sharp focus. Then the fine adjustment of the microscope must be operated until the micro image also appears in sharp focus.

The results which can be obtained with this equipment are so satisfactory that for many purposes of general photomicrography it finds more and more extensive use. As long as stationary objects are to be photographed it is often preferred to the Ibso attachment because it seems easier to obtain a critical focus although with some training the other method yields equivalent results.

There is another method of photomicrography with the Leica camera which requires less equipment. This method may be suggested to the amateur who may not wish to go too deeply into this type of work.

Amateur Photomicrography with the Micro Adapter Ring

When using the Leica camera with the micro adapter ring the lens must be left in the camera. Therefore it is also possible to use Leica Model A for this type of photomicrography. The micro adapter ring is slipped over the tube of the microscope and its upper part is so shaped that it can be adapted to the rim of the Leica lenses of 50mm focal length like a light filter.

The method of focusing is as simple as it is interesting. Focus the microscope for visual observation, focus the Leica camera independently for infinity and then place it over the microscope into the micro adapter ring where it is held in place by tightening the clamping screw in the upper part of the adapter.

This method of focusing is so interesting because it reminds us of the fact that the human eye is really a very small miniature camera, perhaps the most remarkable miniature camera in existence. The human eye is equipped with a lens which forms images on the retina. But this lens has no focusing mount and yet it can be focused. It is certainly a wonderful creation. Since nature preferred not to provide our eyes with bellows or focusing mounts which would permit changing the distance between the lens and the retina, **the lens in the human eye focuses itself automatically by changing its focal length according to the distance from which we look at the object.** When this distance is small, the lens increases its curvature (controlled by a most ingenious mechanism of muscles) to shorten its focal length until the image is sharp on the retina. If the object is farther away the muscles relax and decrease the curvature to increase the focal length just enough to have again a sharp image on the retina. And this complicated mechanism works so perfectly that we operate it unconsciously and instantaneously as soon as we open our eyes.

Nevertheless it is a strain for the eye when it looks at an object at close distance whereas it relaxes as much as possible when it looks at an object which is infinitely far away. And since the microscopist must often look through the instrument for long periods at a time the scientists designed the optical equipment of microscopes so that the **eye can be as much at ease as possible.** In other words **the lens in the eye focuses itself as if it would have to look at an object at infinity.** And if we replace the human eye by another miniature camera (or, for that matter, by any photographic camera, regardless of size) the lens of this camera must likewise be focused to infinity.

Not every observer has perfect eyesight. Some are near sighted others are far sighted. That means that their focusing mechanism is out of order. Such defects may happen to the focusing mechanism of other miniature cameras. But as long as we deal with manufactured cameras we can send them to the manufacturer for readjustment. He can determine the amount of the error and can either place an intermediate ring under the objective mount or he can shorten this mount until the images are always in focus if we operate the focusing mechanism with the rangefinder. Unfortunately there are no similar repair shops for our eyes so that we must content ourselves with a correction of the discrepancy by adding front lenses which we call *spectacles,* to the lens of the eye. **And everybody who must wear eyeglasses for correction of defects of his eyelenses, should always leave them on when focusing the microscope visually before taking pictures with the Leica and Micro Adapter Ring.**

Before adding the weight of the Leica camera with adapter ring to the microscope it is also advisable to attach a rubber ring or a metal clamp to the draw tube of the microscope at the correct length.

The distance between the Leica camera and the microscope is now so small that the magnifying power of the eypiece is still further reduced to only one-fifth of its power for visual observation. In other words, if the Leica negative is enlarged five diameters the final print will represent a photomicrograph which has the same magnification which would have prevailed in visual observation with the same objective and eyepiece. Figure 329 shows the relation between the Leica negative and the area covered when taking a photomicrograph with the micro adapter ring, using an eyepiece of 12x magnification. Eyepieces of different magnifying power can also be used, but sometimes it will be difficult to avoid internal reflections within the optical system.

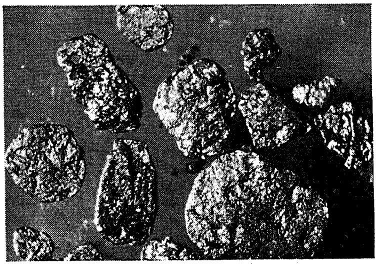


Fig. 328 Placer Gold. Photomicrograph by R. E. Head, made with Ultropak and Leica

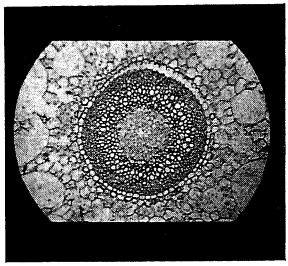


Fig. 329 Leica used with Micro Adapter Ring and 12x Eyepiece covers area shown

The procedure of taking photomicrographs with the Micro Adapter Ring can be summarized as follows:

1. Set the draw tube of the microscope to the correct length and fasten a rubber ring or metal clamp so that this tube length will be maintained when the Leica camera is placed into the Micro Adapter Ring.
2. Detach the black lacquered upper part of the Micro Adapter Ring from the lower metal part, withdraw the eyepiece from the microscope tube, fasten the lower part of the ring to the tube and tighten the clamping screw.
3. Insert the eyepiece into the microscope tube and attach the upper part of the Micro Adapter Ring.
4. Focus the microscope for visual observation.
5. Focus the Leica camera independently for infinity. Attach the wire release and wind the shutter which must subsequently be set for the correct time of exposure.
6. Attach the Leica camera carefully to the upper part of the Micro Adapter Ring and tighten the upper clamping screw. You are now ready to take the photomicrograph.

Those who possess an enlarger and an extension arm may prefer to attach the Leica camera to this arm, place the microscope with the adapter ring on the baseplate of the enlarger and lower the arm until the Leica lens mount connects with the upper part of the Micro Adapter Ring. Thus the weight of the Leica camera does not rest on the microscope. This has not only the advantage of avoiding the danger of vibrations when releasing the shutter but also that of affecting the accurate focus, especially at high magnifications.

This method of photomicrography with the Leica camera, incidentally is optically the most correct one because the microscope retains the same focus as for visual observation and the correction of the entire optical system of the microscope is at its best under these conditions.

How to Select the Microscope For Photomicrography of Living Matter

Whereas prepared microscopic specimens are generally mounted on glass slides as thin sections and can be observed by sending light **through** them, living organisms or unprepared objects are mostly more or less opaque and of irregular shape. They not only require a microscope stand of special design but also special illumination arrangements. These illumination devices also influence the design of the microscope.

As long as these opaque objects are to be photographed at low magnification the illumination offers no difficulties. Under these conditions the distance between the front lens of the microscope objective and the object is comparatively long. (This distance is generally called *working distance,* a term which should not be confused with the focal length of the objective). The light emitted by a suitable microscope lamp may be concentrated by a so-called *bull's eye condenser* and may be so guided that it falls obliquely upon the surface of the specimen. But as the magnification increases the working distance decreases so rapidly that even at moderately high magnification there is not enough clearance between objective and specimen to *squeeze* the light between the two.

Microscopists who examine the surface structures of metals use a device known as *vertical illuminator.* It is attached to the lower end of the tube. The light, entering laterally, is reflected into the direction of the *optical axis* of the microscope and passes through the objective which simultaneously acts as a condenser, to concentrate the light in the plane of the object. From the surface of the object the light is reflected and passes again through the objective which now acts as an image forming unit.

This method of illumination, which yields satisfactory images of the highly reflecting polished and plane surfaces of metals, fails if applied to the illumination of rough low reflecting and uneven surfaces of organisms or other materials. As the light passes through the objective on its way to the specimen, partial reflections occur at the surfaces of the different lenses which produce a haze thus greatly reducing the contrast in the image. This haze may even obliterate the detail completely.

The situation can be compared with one which you undoubtedly have often observed: a picture hanging on the wall may be covered with a glass plate. Under certain light conditions the glare produced through reflections of light by the glass plate may be so strong that you cannot see the picture at all.

Another illumination method was developed for observation of objects of low reflecting power which avoids the double passage of light through the objective and can be used even at the highest magnifications. The device used for this purpose, the Leitz *Ultropak,* was introduced only a few years ago and it has pioneered this important and utterly fascinating field of microscopic observation and photomicrography of opaque objects with surfaces of low reflecting power at high magnification. The illuminator is shown in figure 330. The light, entering horizontally, is reflected by a ring-shaped mirror and passes through a condenser system which surrounds the objective. This condenser collects the light so that it illuminates the object with highly oblique rays. From the rough surfaces of the object the light is diffusely reflected, passes through the objective, a central hole in the ring-shaped mirror and forms the image.

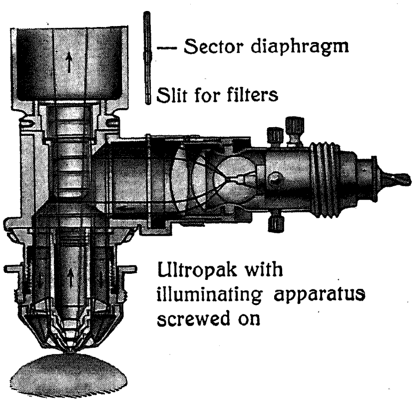


Fig. 330 Diagram showing path of rays of Ultropak

The Ultropak is attachable to every standard miscroscope tube. It is equipped with a small incandescent lamp which is satisfactory for visual observation but not strong enough for instantaneous photomicrography. In such cases a more powerful light source such as an arc lamp must be used. A special lens system can be attached to the light entrance tube of the Ultropak to concentrate this light. The complete equipment assembled for photomicrography with the Ibso attachment is shown in figure 331.

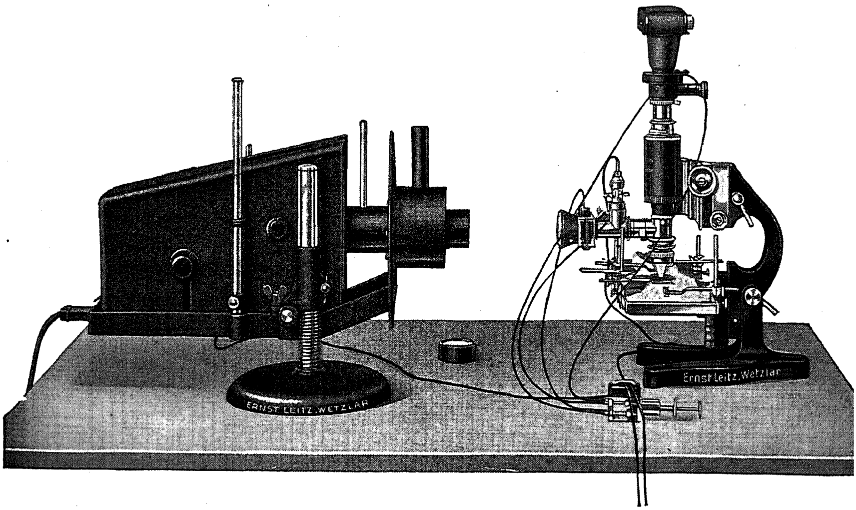


Fig. 331 Micro-Ibso Attachment with Microscope and Arc Lamp for Photomicrography of living matter

This arrangement makes a special type of microscope almost imperative. Generally a microscope is focused by raising or lowering the tube which, for this purpose, is equipped with a coarse adjustment by rack and pinion and a fine adjustment by micrometer screw. The arc lamp, however, not being attached to the tube, would not follow these focusing motions and the horizontal beam would not always pass through the condenser lens which is attached to the Ultropak. In other words, the operation of focusing the microscope would throw the illumination system out of alignment. This difficulty can be overcome by using a type of microscope where **the coarse focusing is done by raising or lowering the object stage.**

Microscopes of this type provide for much space between the tube and the stage so that even comparatively large objects may be placed on the stage in their entirety. These models are recommended for photomicrography of objects which make the method of illumination by Ultropak or vertical illuminator necessary. They are of such design that substage illuminators for photomicrography by transmitted light can be attached to them.

For General Photomicrography

As mentioned before, specimens which have been specially prepared for microscopic observation are generally mounted as thin sections on glass slides and they are illuminated by sending the light through the thin layer of the object. The structures may allow only certain colors of the light to pass through, whereas others are absorbed. These structures will become visible in those colors which could pass through them. It may be that other structures absorb all colors equally, either completely or partly, and those structures will appear black or any shade of gray against the lighter background. In other words, the structures become visible because of partial transmission of light and the illumination method for these objects is generally called *by transmitted light.* The variety of microscopes available for this type of work is considerable. Essentially all models are built on the same principle although the various features may differ in regard to completeness or design. They consist of an illumination apparatus which guides the light through the object, a stage plate to support the object and an observation system with focusing facilities.

For the selection of a microscope which is to be used for photomicrography a few hints may be of value:

The Illumination Apparatus

The mirror which guides the light from its source through the condenser should have one plane and one concave surface. The condenser should be of the divisible type so that the front lens can be removed when taking photos at low magnification. The illumination apparatus should be equipped with an iris diaphragm to regulate the intensity of the light. There should be a rack and pinion movement to raise or lower the condenser. It is also advisable to have the condenser mounted in a centering adapter. When the photomicrographs are taken at high magnification and microscope lamps with concentrated filaments are used for this purpose, a centering adapter is of essential importance.

Object Stage

It is convenient, though not essential to have a device for the mechanical displacement of the specimen. Such devices are known as mechanical stages. They can be obtained either separtely or built into the object stage.

Observation System

It has become general practice to classify the ranges of magnification as follows:

low power (requiring objectives from 40 to 16mm focal length)
medium power (requiring objectives from 10-4mm focal length)
high power (requiring objectives of less than 4mm focal length).

For high power microscopy a type of objective is used which is known as *immersion system*. Regarding further details about objectives the reader is referred to the current literature of microscope manufacturers.

The microscope may be equipped with a revolving nosepiece accommodating either two, three or four objectives. The objectives of 16mm and 4mm are most popular. For higher magnifications oil immersions of about 2mm are generally used whereas for the lowest magnifications objectives of 40mm, 32mm, 24mm or thereabout are almost equally popular.

Contrary to general opinion it is **not** necessary that a microscope for photomicrography be equipped with a tube of large diameter. A wide tube may only be of advantage if it is intended to use a microscope for that type of photography (not photomicrography) which the Leica user can do with the sliding focusing attachment and the regular Leica lenses. In this type of work an eyepiece is not required.

It may also be mentioned that it is not advantageous to take **photomicrographs** without the eyepiece. Sometimes one meets with the erroneous opinion that under such conditions sharper images can be obtained. This is not true. The apparently greater sharpness is simply due to the lower magnification. Actually such pictures lack in sharpness because the objective is not used at the correct tube-length and thus a certain amount of spherical aberration is introduced.

As to the magnification of the ocular, it has been mentioned before that for general purposes an eyepiece of 10x magnification is most satisfactory. Variation of magnification in the final print can always be obtained by varying the ratio of enlargement of the negative. Only in the case of photomicrography with the micro adapter ring may an eyepiece of 12x magnification be recommended.

For Amateur Photomicrography

The rules given for the selection of a microscope for general photomicrography or that of living object can likewise be applied to amateur work. Only in this latter case a simpler microscope will often be fully satisfactory. In this case it is best to see what the manufacturer has to offer.

Magnification and Resolving Power

It was explained at the beginning of this chapter that the objective of the microscope alone is responsible for the revelation of minute detail and that the eyepiece simply stretches this detail to occupy a larger area. The power of the objective to reveal detail is called *resolving power and is limited.* It is possible to determine for each objective the magnitude of the finest detail which it is capable of revealing. And since we can also determine the total magnification of the image in the negative, we are able to find out how much space the smallest revealable detail will occupy in the plane of the negative. This information is important because, as we know from the chapter about Leica lenses, the human eye can only distinguish detail if it is at least 1/100th inch apart (provided we refer to detail in a photograph which we view at a distance of 10 inches). Thus we will finally be able to answer the question: How much can we enlarge the negative of a photomicrograph taken with the Leica camera without creating the impression that the enlargement will lack in sharpness?

The maximum resolving power of the objective can easily be expressed quantitatively by the magnitude of the smallest detail which the objective can *resolve*. But in practical photomicrography this maximum resolving power can seldom if ever be verified, because it requires certain optical conditions for the illumination of the object which are detrimental in other respects. Therefore in practice the obtainable resolving power will mostly remain below this maximum value.

In the books about microscopy we find that the resolving power depends upon the light collecting power of the objective and the wavelength of the light with which the specimen is illuminated. The light collecting power is generally expressed by a term *numerical aperture*. Its meaning is not identical to the *relative aperture* or *speed* of a photographic lens, but has close relation to it. We need not go into detail about the correct interpretation of the term *numerical aperture* because its actual magnitude is generally engraved upon the mount of the objective and is also listed in the catalogs of the manufacturers. We only have to realize that **the higher the numerical aperture of an objective, the better is its resolving power.**

As to the wavelength of the light, we know that in the spectrum of visible light, the colors toward the violet end of this *rainbow* have the shortest wavelength. But whether we can use these rays for the illumination of the object, depends entirely upon the colors of its structures. Further information about the color of the light to illuminate the object can be obtained in publications regarding the application of light filters for photomicrography. For the present we must only realize that the relation between the resolving power and wavelength of the light is such that **an objective of a certain aperture will yield the best resolving power if the wavelength of the light which illuminates the object is as short as possible.**

But there is a third factor which influences the resolving power and which is often neglected in consideration. It refers to the direction of the light which illuminates the object. As you know, the intensity of the light which passes through a **photographic lens** is regulated by opening or closing the iris diaphragm with which these lenses are equipped. In a microscopic objective there is no iris diaphragm. But we find this iris in the substage of the microscope, directly below the condenser. If we close this iris diaphragm the object will be illuminated only with a small central beam of light. By opening it, the intensity of the illumination increases. But at the same time the resolving power of the objective also increases.

Still, the resolving power may be increased without opening the iris diaphragm. We only have to displace it laterally so that the small beam which illuminates the specimen will not pass through it centrally, that means, in the direction of the optical axis, but obliquely.

When to increase the resolving power by opening the iris and when to displace the iris laterally depends entirely upon the nature of the structures of the specimen and upon the quality of the objective. An objective of good quality can be used with the iris diaphragm comparatively far open whereas in an objective of inferior quality those misbehaviors of light about which we learned in the chapter on lenses will make themselves felt too much.

By opening the iris diaphragm we render the illumination more diffuse and there may be detail which with such illumination will be obliterated. The surface of a piece of paper may appear smooth in diffuse light, but hold it in the beam of a powerful searchlight so that the direction of this light meets the paper surface at grazing incidence, very obliquely. Every little unevenness in the surface will throw a deep shadow and the little *hills and valleys* will appear most strikingly.

These few remarks should indicate that the method of illumination has a great influence, not only upon the visibility of detail which may be so small that the highest possible resolving power is necessary to reveal it, but also because this detail may be of such shape or nature that special tricks must be applied to render them visible even if they are large enough to require only little resolving power.

To summarize we may say that under normal conditions the iris diaphragm of the substage should rarely be opened more than ¼ to ½ of its greatest opening and as to the color of the light we shall learn presently why a green filter will find most frequent application. Under such conditions it is safe to assume that the magnification required to separate the detail until it is about 1/100th inch apart, is about equal to 600 times the value of the numerical aperture of the objective used.

From the catalogs of the manufacturers we learn the initial magnifications and numerical apertures of the current objectives. We know that the eyepiece 10x yields about 1/3 of its full magnifying power when used with the Leica camera as described before and with this information on hand we can determine how much the Leica negative of a photomicrograph can be magnified without losing the aspect of a sharp picture. The following table contains these values for some of the most popular objectives and may be of help in photomicrography.

This table has been prepared for Leitz objectives but by comparing the figures for focal length, initial magnification and numerical aperture with those constants of the objectives of other manufacturers it will become evident that the figures can be helpful also to users of other objectives.

Type of objective	Focal length	Initial Magnification of objective	Numerical Aperture	Magnification on Leica negative	Enlargement possible to separate detail 1/100″
Achromat (dry)	40mm	3.2x	0.08	10.5x	4.6 x
"	32mm	4.3x	0.15	14.3x	6.3 x
"	24mm	6 x	0.20	20.0x	6.0 x
"	16mm	10 x	0.25	33 x	4.5 x
Apochromat (dry)	16mm	12 x	0.30	40 x	4.5 x
Achromat (dry)	13mm	14 x	0.40	46.5x	5.1 x
"	9mm	20 x	0.45	66 x	4.1 x
Apochromat (dry)	8mm	23 x	0.65	71.5x	5.5 x
Achromat (dry)	4mm	45 x	0.85	150 x	3.4 x
Apochromat (dry)	4mm	46 x	0.95	153 x	3.8 x
Apochromat (oil immersion)	3mm	65 x	1.32	216 x	3.66x
Achromat (oil immersion)	2mm	100 x	1.30	333 x	2.35x
Apochromat (oil immersion)	2mm	92 x	1.32	306 x	2.6 x
"	2mm	92 x	1.40	306 x	2.75x

Thus we should conclude our chapter on photomicrography because the problems pertaining specifically to the miniature camera have been covered. But there are so many questions pertaining to microscopy which the miniature camera owner would like to have answered that at least some of them shall be briefly discussed.

Light Sources

It is difficult to recommend one definite light source because so many different types are suitable and yet each of them has special advantages, depending upon the work which has to be done.

For photomicrography of living objects, for instance, a great deal of light is required because the image is formed only by that small portion which is reflected from the surfaces of the object. The effective intensity of light sources for microscopy, however, is not measured in terms of total candlepower and it is very important for the microscopist to understand why we need another measure. Actually we can compare the power of microscope lamps only in regard to their intrinsic intensities. This will become evident if we compare a lamp for 110 volts and 550-watts with one for 6 volts and 30-watts. The only difference is to be found in the length of the filament, that of the lamp for 110 volts being about 18 times as long as that of the lamp for 6 volts. In both cases, however, the filament is fed by a current of 5 amperes and pieces of equal length of the two filaments emit the same amounts of light. Of course with the 110 volt lamp we could illuminate an area having 18 times the square contents of that which, with the same condenser system the 6 volt lamp will illuminate. But the condenser systems are designed for rather small light emitting units because it happens that among these we find the light sources of greatest intrinsic intensity.

Of the two light sources mentioned above the one for 6 volts should of course be preferred because, although it offers the same intrinsic and therefore effective intensity, it consumes only 1/18th of the amount of energy. The fact that these lamps must be used with a transformer (or a rheostat, if d. c. is available) should not be considered as a disadvantage because the lamp fulfills an optical purpose and its performance in this respect is the only important thing.

The intrinsic intensity of a light source increases in proportion to the temperature of the light emitting area. A filament, heated to incandescence can never become as hot as, for instance the crater of an arc lamp where the carbon is heated beyond the point of incandescence so that it is actually consumed. Arc lamps have a comparatively small sized crater and in order to enable the microscopist to take full advantage of this important type of lamp, the condenser systems of microscopes are so arranged that this small light emitting unit will illuminate the entire field under observation. These arc lamps are often the only type of light source which will make instantaneous photomicrography of opaque living objects possible, even with the small Leica.

For photomicrography in transmitted light we may not require these strong light sources. In the first place, the entire amount of light which is concentrated by the condenser, passes through the microscope and is only partly absorbed by the structures of the object which in the photograph will appear darker than the background. Furthermore, these objects are generally not moving and longer exposures are permissible. In these cases a regular desk lamp with an inside frosted bulb, possibly a photoflood bulb, will give satisfactory illumination. Clear glass bulbs, showing the filament, should not be used, unless a ground glass is interposed.

It is not possible to explain here, how, for every magnification, uniform illumination can be obtained. The reader must try to obtain such information from microscope manufacturers or text books. He will find, that by following definite rules he can avoid the rather uncertain method of trial and error, but these methods would require too much space in this chapter.

Light Filters

The application of light filters in photomicrography is another problem which requires thorough study. The reader is referred to current literature. The Eastman Kodak Co. published a booklet, entitled "Photomicrography" from which valuable information can be derived.

In the vast majority of cases where stained preparations are to be photographed, a green filter, such as the Wratten B filter will be of great help. Not only are most of the stains, used in practice, of such color that a green filter will produce the best contrast and differentiation, but the light transmitted by this filter is of that range of wavelengths for which the correction of microscope objectives is most favorable.

As to the best place to insert the filter, no special advice is necessary since it can be inserted at any place between the lamp and the microscope. It may happen however, that the filter is at a place where any dust spots or impurities on its surface would show in the field under observation because the condenser may form an image of the filter in the plane of the object. If such dark spots are visible, it is easy to find out whether they are produced by the filter or by impurities on the lenses of the eyepiece. Suppose we move the filter laterally and the spots follow the motion, they are caused by dust on the surface of the filter. But if, upon rotation of the eyepiece in the microscope tube, the spots follow this rotation, they are due to impurities on the lenses of the ocular. In both cases, the surfaces should be cleaned, but if the filter gave the cause, it can also be moved closer to the condenser.

Films

In photomicrography it is often not necessary and even detrimental to use panchromatic film of high sensitiveness. The panchromatism of the film is not required when a green filter is used. As you know, the only difference between orthochromatic and panchromatic film lies in fact that the latter is **also** sensitive to red light. But if the filter has prevented all red light from passing through the microscope, this extra sensitiveness is of no value. On the other hand, panchromatic films are generally less sensitive for green light (that is why green safelights can be used in the darkroom for their development) so that their general high speed does not exist for that range of light color which is transmitted by the filter.

Finally we must realize that these superspeed films really do not yield that same fine detail which we obtain with slower films. It is true that the development can hold the grain size down but for reasons which are too involved to permit explanation at this place, it is really true that the slower films with inherently finer grain produce finer detail.

To sum up, any modern orthochromatic film is perhaps most suitable for photomicrography. Where speed is essential, the faster emulsions are to be preferred, where detail rendition is of primary importance, the slower emulsions are better. Only in cases where living objects are photographed with the Ultropak or a darkfield condenser and if in these cases no filter is used, a fast panchromatic film will have its place.

In exceptional cases positive film may be used. But we must not forget that this film is not sensitive to green light. Used when the Wratten B filter has been interposed in the course of rays, a photomicrograph on positive film would only yield a blank space. Without a filter, the positive film in itself will perform what a blue filter would have done with orthochromatic film. This fact may be helpful in photomicrography of diatoms where the utmost in detail rendition is aimed for. But this task is perhaps one of the very few, where the miniature camera actually does not offer anything but disadvantages over the larger size cameras.

Exposure

Help in gauging the exposure for a photomicrograph is perhaps most urgently needed and it is unfortunate that just in this respect it can hardly be given. The exposure depends upon too many different factors. There is the intrinsic intensity of the lamp, the size of the filament, the opening of the iris diaphragm in the substage, the magnification of objective and eyepiece, the numerical aperture of the objective, the color of the light filter, the density of the specimen, the sensitiveness of the film to the color which the filter transmits and there are many other factors.

The best way out of the difficulty is to take test photos under standard conditions, varying the actual time of exposure. After development of a test film and if the exact data for each exposure have been recorded, the correct time can easily be determined.

Place the light source at a definite distance from the microscope, select the filter, record the position of the iris diaphragm in the substage of the microscope, the magnification and numerical aperture of the objective, the color and density of the specimen, the magnifying power of the eyepiece, the type of film used and then take several exposures, varying the time in wide limits. You can easily find the best negative. Now maintain these standard conditions for this objective and only if a specimen of great density is under observation, lengthen the exposure. Of course, if a different filter is used, new tests have to be made, unless you know the relative filter factor for the particular film brand used.

This standardization will undoubtedly be the shortest way to success and since a microscope equipment will generally not contain more than three or four objectives and, at the most two or three filters, the work involved is really negligible, not to speak of the value of having gone through an experience of this type.

Fig. 332 Dental Operating Room of A. Laurence Dunn, D. D. S., Santa Barbara, California. Photographed by J. Walter Collinge
(Dr. Dunn is left-handed and the equipment is arranged accordingly)

DENTAL PHOTOGRAPHY

A. LAURENCE DUNN, D.D.S. **CHAPTER 22**

Dentistry offers one of the finest fields for the Leica camera in scientific work. With it the general practitioner, the specialist, and the research worker alike will find the opportunity to make records of a remarkable quality.

To show the many uses in dentistry and in photography of all small objects, and to explain how the pictures may be obtained with a minimum of trouble, a simplified yet highly efficient technique is being offered. The work is divided into three sections dealing first with the equipment necessary, second the photography itself, and third a system of records.

Equipment Required

1. Leica camera of any of the later models, and one of the 50mm lenses such as the Elmar f:3.5, Hektor f:2.5, or Summar f:2 and a cable release.
2. Fuldy sliding focusing copy attachment.
3. Camera support and reflecting board.
4. Magnifying viewer.
5. Two extension tubes, 12mm and 22mm.
6. Photoflood lamp in reflector.
7. Leicameter.
8. Yard stick.
9. Cardboard backgrounds (black, gray, white, etc.).
10. Record pad and pencil.

One piece of apparatus that greatly simplifies photography at the dental chair is the camera support, a home-made device. The one shown in figure 333 may serve as a suggestion of what can be constructed to meet individual needs. Roughly, it consists of a pipe welded onto an old automobile fly wheel. Being mounted on casters, it is moved easily, yet stays in position solidly. It is rolled in place by hand and minor adjustments for position are made by foot, with one foot on the base.

As the photograph shows, the apparatus is adjustable for every height and position. The horizontal arm can slide freely on the upright pipe and is controlled by a thumb screw.

To overcome vibration there are three upright rods welded both to the flywheel and the upright pipe. The reflecting board is made of an aluminum

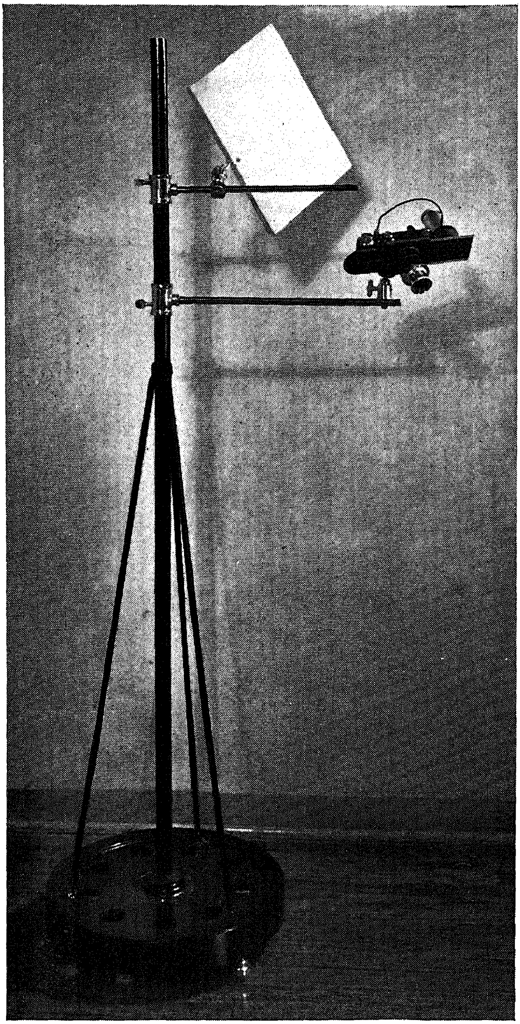


Fig. 333 Home-made Portable Camera Stand supporting Leica camera with Sliding Focusing Attachment and Reflector. The outfit is readily available for use at the dental chair. Both Camera and Reflector are easily adjustable, providing exceptional flexibility and rigidity.

cookie sheet. One side of it is kept with a high polish for strong reflections while the other is dulled slightly by a very fine sand paper or by sand blasting.

The camera is attached to the horizontal arm by a Leica Ball Jointed Tripod head. I have found nothing that will take the place of this device in holding the camera solidly in all positions. Figure 333 shows the construction of the entire support. It can be made very simply and inexpensively.

The Fuldy copying attachment is described in Chapter 11. It is the ideal piece of apparatus for accurate viewing and focusing in close work. The proposed image is seen very clearly on the ground glass back. However, for the most careful focusing, I strongly urge the addition of the 5x magnifier and viewer.

For close-up work at least one and preferably two extension tubes are needed. A serviceable arrangement is to have the 12mm and the 22mm tubes.

Needless to say, the Weston Leicameter is indispensable. To attempt to photograph numerous objects under varying light conditions is too hazardous without some means of measuring the light value scientifically.

The Photoflood lamp should be mounted in some handy holder and reflector. If possible it should be set up close by, to be swung into position on a moment's notice. At least one spare bulb should be in reserve at all times. One ingenious way of saving the Photoflood, which burns only two hours, is to wire it through a Leitz Illumination Control which has seven degrees of measured light intensity. Thus the light can be reduced to mild brightness for focusing and brought to the desired degree of intensity for the actual exposure.

Finally, with a yardstick, pencil, and the record pad described in the third section of this chapter the equipment is ready for use.

A picture of the apparatus set in position is shown in figure 332. When not in use the outfit is pushed back to the wall and the lamp swung to the side of the unit. Notice particularly how the camera support with its camera and reflecting board, and the lamp, are all adjusted in working position with no interference to the operator. For work in the laboratory or elsewhere in the room the camera support can easily be rolled into any position desired.

Making the Photographs

To illustrate the diversity of uses of photography in dentistry we start first with a series of pictures at the chair, then a series taken in the laboratory, in research, and in the preparation of papers or clinics. Many of the ideas presented in this chapter apply equally well to medicine and surgery and to the photography of all small objects.

The largest object photographed at the chair is the patient's face, both front view and profile. This provides a general record, particularly where any change is to be made in the front of the mouth. The main uses are in the young and the old, the children needing orthodontia and the elderly patients requiring full dentures. Such

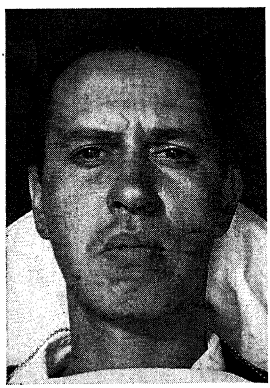


Fig. 334 *(left)* Full face view, made with Fuldy C. A. at 22″, one second at f:18

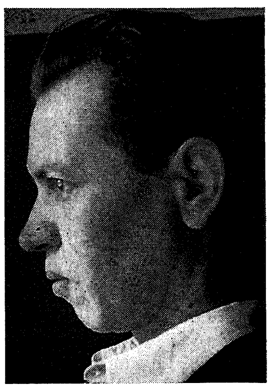


Fig. 335 Profile, same case, data as above

a picture will give an accurate record of the conditions to be reproduced or eliminated and will serve as a means of comparing the finished results with the original. Moreover, I feel it to be a very wise procedure, in this age when so many faces are disfigured in automobile accidents, to take full face and profile photographs of all patients.

For these pictures the ideal distance of the camera from the subject is 30 inches, using the 50mm lens. For orthodontic purposes, however, the 90mm lens is to be preferred.

In most offices the full face picture (fig. 334) can be taken without electric illumination, daylight being sufficient. Formerly, I used one Photoflood with a reflecting board but now seldom use either in the full face picture. In the profile, help the lighting with one Photoflood and use a black cardboard to serve as a background (fig. 335). Whenever using the aluminum reflecting board, adjust first the Photoflood light and then the reflecting board. Place the latter in position to reflect the rays from the Photoflood so that this secondary illumination will brighten the surfaces not struck directly by the Photoflood. The technique of adjusting the board is exactly the same that a small boy uses in annoying the neighbors with a penny mirror on a sunny day.

The Fuldy copying attachment is indispensable for work in dentistry and close-up photography. In using the Fuldy copying attachment at a distance beyond 37½ inches, difficulty will be encountered from interference of the collapsible lens mount. This can be overcome as follows: With the focus lever set at infinity, work the lens into precise focus by sliding it in and out. Then swing the focus lever down to the opposite limit, 3.5 for instance. Next slide the camera across, swing the lever back to infinity, and all will be in proper focus and adjustment.

The next closest picture is that of the anterior teeth (figs. 336-339). For this put on the 12mm extension tube and bring the camera up to approximately nine and a half inches. The distance from the subject always means the distance measured from the subject to the back of the camera or the film, and not to the lens. In this and closer work on patients the Photoflood should be used. Figure 336 shows a picture in stronger lights and shadows, while figure 337 smoother lighting and less contrast.

A handy retracting device is shown in figures 337, 338. It is first formed as desired in wax and then converted into vulcanite. The method of use for the molar region is shown in figure 338.

Finally where a single tooth, or a group of two or three is desired, use the 12mm and 22mm together, obtaining a 34mm extension tube. Place the camera approximately eight and one-half inches from the subject. Study page 231 on the decrease in light value with the use of extension tubes and plan your timing accordingly.

Focusing for Close-Up Objects

Figure 339 is an example of close-up photography. Notice not only the form and detail of the tooth as reproduced here, but also the bit of gauze pressed against the right central incisor. Here is an example of how a great deal of time and tension can be saved in the

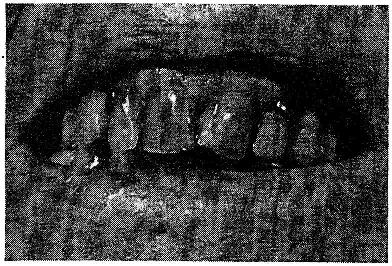


Fig. 336 22mm Tube at 9½", one second at f:12.5

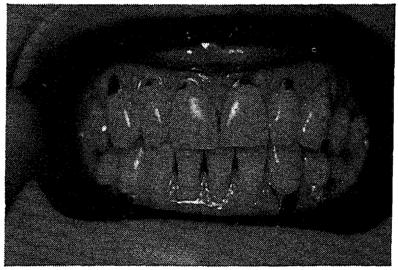


Fig. 337 22mm Tube at 9", one second at f:18

careful focusing for close-up work. First cut a small square of gauze from a dental napkin or other loose fabric material. Next select that position of the field most desired to be in accurate focus. If the field is flat it will be simpler. If it has considerable depth, and you have computed what can be gotten into focus, locate a spot which will be two-fifths of the way from the front limit toward the back limit. Place the square of gauze on the selected spot, wherever it may be, and focus on the gauze instead of any other object in the field. You will then be focusing on a hair-line instead of a flat surface.

The preceding pictures have shown how the field can be progressively diminished and the size of the teeth relatively increased. Study the usual attachments, distances and lighting for each type of picture, and with but little practice you will soon develop a standard routine for each.

Placing Light and Developing Form

Lighting of small objects can be controlled by using one main source of illumination and a hand mirror, as shown in figures 340 to 342. Shadows can be placed and form developed through proper directing of this supplementary light. However, a larger mirror than that shown should be used.

Fig. 338 12mm Tube at 12", one second at f:18

Fig. 339 12 and 22mm Tubes at 8¼", one second at f:18

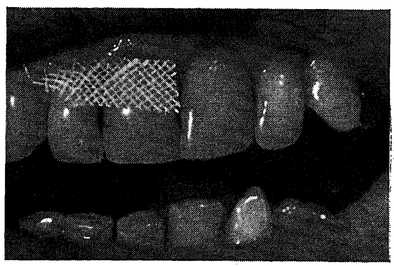


Fig. 340 12mm tube at 10″, 5 seconds at f:18

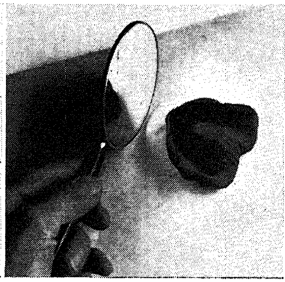


Fig. 341 12mm tube at 24″, 3 seconds at f:18

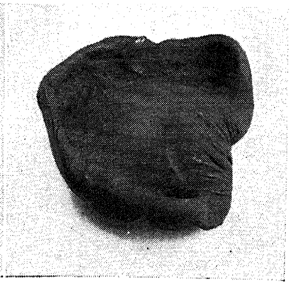


Fig. 342 12mm tube at 10″, 5 seconds at f:18

Transillumination of Teeth

Figures 343 and 344 show the effect of transillumination of an anterior tooth. Here we are confronted with the double problem of two lighting systems in use simultaneously. This should not be attempted until you have established a standard system of lighting 337 and 339. When that has been worked out to your satisfaction you are ready to run a series to determine the correct strength for the trans-illuminating light. First, reduce the main or standard lighting approximately 30 per cent below normal. I use the Ritter transilluminating lamp of the antrum type, as pictured in figure 356. Adjust it so that it has mild brightness and place it as shown behind the tooth. Record all factors, and particularly the number shown on the Ritter rheostat. Then photograph. Next increase the light of the Ritter lamp by one point and take the next picture. Keep increasing the voltage one point at a time for approximately five pictures, being certain to keep accurate records. From the finished results you can select the one which is to serve as your standard for future pictures. for your own office which will give you results such as in figures

Fig. 343 12mm Tube at 17″, half second at f:18

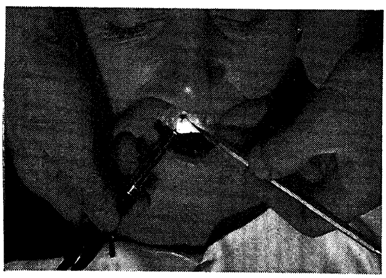


Fig. 344 22 and 12mm Tubes at 10″, 1 second at f:18

Fig. 345 12mm Tube at 17″, 1/20 second at f:5.6

Fig. 346 22mm Tube at 10½″, half second at f:18

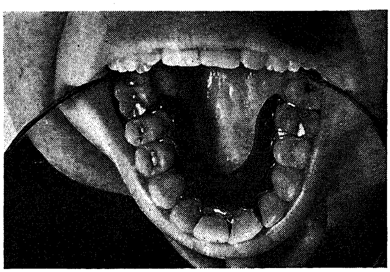
The next two pictures, figures 345 and 346 are also examples of double lighting, although in these cases the transilluminating light is not shining through the teeth to be operated on but upon them, a distant view and a close-up. Here again the same routine must be worked out as in the preceding paragraph, a series run to determine the correct balance of lights.

The main thing to bear in mind here is that it must be the Ritter light and not the standard light that has the correct brilliance. In other words, the transilluminating light must be such that it will neither over-expose nor under-expose the negative, while the standard lighting must definitely under-expose. And let me save time and money for you by again repeating that effects like these can be obtained only by running a series of exposures and keeping records.

The extent to which the depth of focus can be increased by stopping down to a small aperture is shown in figures 343 and 345. The former was taken with the diaphragm closed to f:18, while the latter was opened to f:5.6. Notice particularly the clearness of the fingers. It is because of the increase of precise focusing on unimportant details that I prefer to close the aperture as much as possible. Having selected 18 as my standard aperture for most work, I can focus through the Fuldy attachment with the diaphragm wide open at 3.5, then swing the lever to the opposite extreme, or 18, entirely by the sense of touch. Eliminating the necessity of getting around and viewing the diaphragm reading in close quarters is a great convenience, and obtaining greater depth of focus is an advantage not to be overlooked.

Fig. 347 12mm Tube at 10″, half second at f:18

Fig. 348 22mm Tube at 11″, 1 second at f:18



Photographing Reflected Images

Another variation from the usual photograph is the one taken in the mirror. Figures 347 and 348 are two examples. The first is a picture of the entire vault of the mouth, with an inflamed mucosa irritated by a full vulcanite denture. The second shows by direct view and reflection the application of a temporary appliance. There are two precautions for this type of picture. First, the lighting must be studied very carefully to make sure that the area reflected in the mirror is as well illuminated as the surrounding non-reflected areas. It is the latter rather than the former that will determine the light value reading, so be careful. Second, the focusing must be done on the reflected image. It must not be done on the non-reflected front surface of the object, nor on the glass of the mirror, but on the image shown in the mirror. With careful holding of the mirror this can be done as accurately as in the usual pictures.

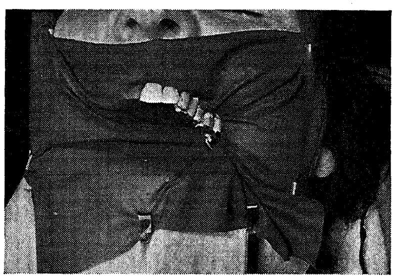
There is nothing that will take the place of the photograph in explaining the technique of many operations. Where subject matter is being prepared for lecture or publication, visual education should be the first considered. An example of this is shown in the two pictures, figures 349 and 350, where a fixed bridge is being seated with a rubber dam in position, showing the case before and after the operation.

In figure 351 an interesting method of eliminating background shadows is shown. Apparently the vulcanite bridge, a Dunn Temporary Partial Denture, is suspended in mid-air. The effect is obtained by supporting the object on plate glass and placing the cardboard background six inches or more below the glass.

At this point it might be well to refer to backgrounds. Strong cardboards should be on hand for use at all times, including black, dark gray, light gray, and white surfaces. Often the background

Fig. 349 12mm Tube at 13″, one second at f:18

Fig. 350 12mm Tube at 13″, one second at f:18



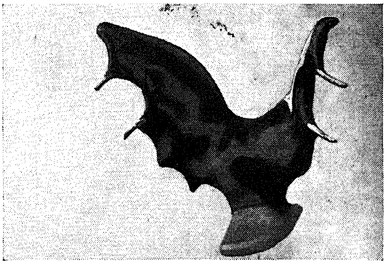


Fig. 351 12mm Tube at 9″, four seconds at f:18

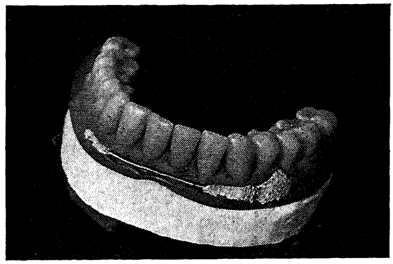


Fig. 352 22mm Tube at 10″, four seconds at f:18

proves to be the salvation of the picture, especially with the smaller objects.

Other types of cases are illustrated in succeeding pictures. An unusual emergency denture repair is pictured in figure 352. Here the points of significance from a photographic standpoint are the reproduction of the roundness of the porcelain teeth, obtained by a proper lighting, and the great depth of field, obtained by stopping down to a small diaphragm and timing accordingly.

Figure 353 illustrates how photography is an aid in the instruction of cavity preparation. Figure 354 shows plaster models of a case before and after orthodontic treatment.

Determining Exposures

One is likely to be deceived as to the true light value of small objects, particularly where they are very light in color. This is well demonstrated in the case of these three plaster models. Placed on a black background, the greatest light value they would record was slightly toward 0 from 1. With the Leicameter set for a film with a speed of 23, the correct camera adjustments were shown to be 13 seconds at aperture 18. However, this was felt to be far beyond the correct timing.

To determine the correct exposure a large white card of approxi-

Fig. 353 12mm Tube at 12″, two seconds at f:18

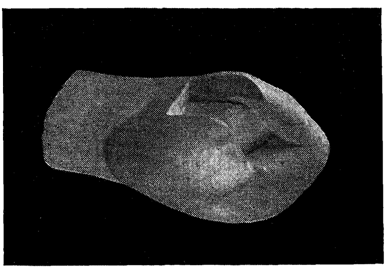


Fig. 354 12mm Tube at 17″, two seconds at f:18

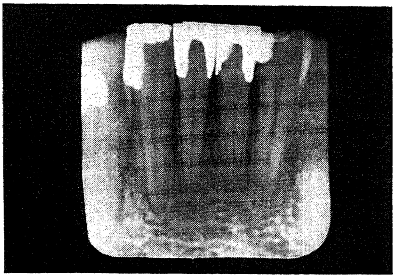


Fig. 355 22mm Tube at 10″, four seconds at f:18

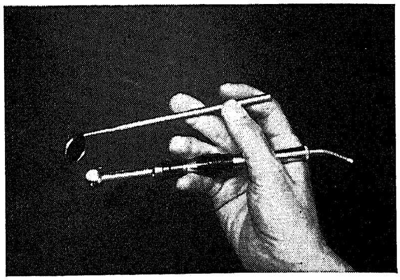


Fig. 356 22mm Tube at 12″, one second at f:18

mately the same degree of brilliance as the plaster was held in place just in front of the models and a reading taken of the card. Instead of slightly less than one, the light value now proved to be 1/6 and the adjustments this time were changed from 13 seconds at 18, to 1½ seconds at 18. The picture as shown was made with the latter adjustments.

In your initial work on each new type of case, you will save time by running a series of pictures, all of the same subject. For instance, figure 353 was obtained first by finding that the light value was probably 1/6. Then a small diaphragm, f:18, was chosen in order to have maximum depth of focus. Finally a series was run starting at 1 second, then 2, 3, 4, 5, and ending with 6 seconds, but without the series of pictures I could not have been certain. As originally computed with the aid of the Leicameter reading of the white card, the 2 second exposure proved to be ideal. Again let me urge you always to run a series of exposures in undertaking a new type of work, then select the best and use that as standard from then on.

Occasionally there will be a case where the arranging of objects and studying their most desirable positions is difficult. All of the plaster models were such examples. The slight turning of one would throw certain lines in and others out, and the reduced image as viewed on the ground glass of the Fuldy attachment made adjustment difficult. In such a case place the object in general focus and approximate arrangement, then slip the camera off of the copy attachment, quickly unscrew the lens and you have an open hole through which to view. Using it as a frame for your picture, do the final arranging of the object, then replace the lens and camera and complete the photography. This aid is seldom needed but can be of great help in studying arrangement in difficult cases.

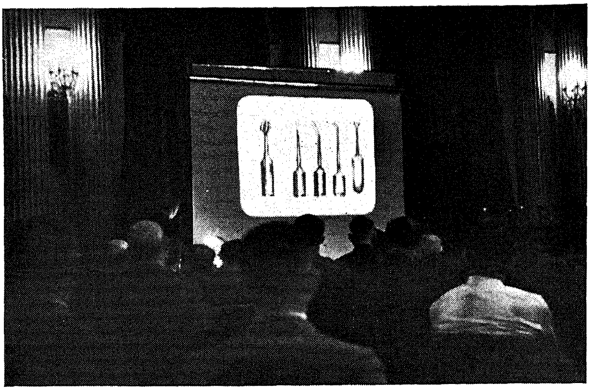


Fig. 357 Photograph of a slide shown during a scientific meeting
1 second at f:3.5

Photographing Photographs

At conventions many of the finest ideas presented to dentists are in the form of pictures projected on the screen. These can be carried home as more than hazy recollections by photographing them, whether they be still pictures or motion pictures in black and white or in natural color. Figure 357 portrays such an example. For best results sit in the front row and directly in front of the screen, and in general give the limit of exposure.

Putting Movies on Paper

Leica shots can be made concurrently with the creations of a professional motion picture whether dental or medical. If made

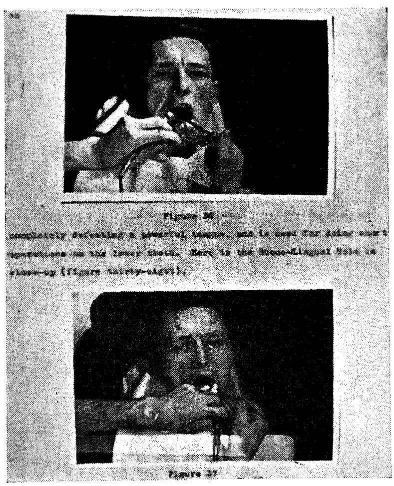


Fig. 358 Step-by-step views of a procedure, used to illustrate a scientific paper

purely as a movie the film cannot be successfully published or viewed other than by projection. If however, the important step-by-step shots are caught with a Leica they can be used to accompany the text of the scientific paper, thereby spreading its usefulness beyond the confines of the projection hall, as well as creating a permanent record (figure 358).

In lecture work, if planning to project from glass slides, by all means refer to Chapter 11 on Making Leica Positives for Projection and discard the old fashioned method of using the so-called "standard slides."

Other objects which can be photographed are such things as radiographs (Fig. 355), collections of interesting dental appliances, the operator's hand demonstrating a certain technique (fig. 356), and so forth.

The high magnification that can be obtained by the use of extension tubes is shown in the typondont of gold foil work (figs. 359-360, typodont by Dr. E. D. Shooshan, Pasadena, Calif.). The picture of the gold foils in the upper right first molar, the single tooth and the typodont, are all enlarged to the same degree from their original pictures. The relative enlarging was done in the photography by means of the tubes, and not in the printing.

The color record of the light pink of condensite material is shown in this typodont. The color record which vulcanite will give is shown in figure 352. The anterior portion was gum pink and the posterior portion maroon. Figure 351 also shows maroon vulcanite. No color filters were used.

In the photographing of small inanimate objects I prefer the soft light of daylight rather than the artificial illumination of electricity. Figures 351, 353, 354, 361, 359 and 360 were all made without artificial illumination. The objects were placed on a small stand close to one window. There was one other window in the room which was used to help modify the shadows.

Some objects, however, require stronger highlights and shadows. These can be illuminated best with a Photoflood serving as the spotlight, and daylight providing the floodlight. Figures 352 and 356 are examples of this type. The lighting of figure 355 was obtained by placing the radiographic film on a radiographic viewing box.

Fig. 359 12 and 22mm Tubes at 8¼", six seconds at f:18

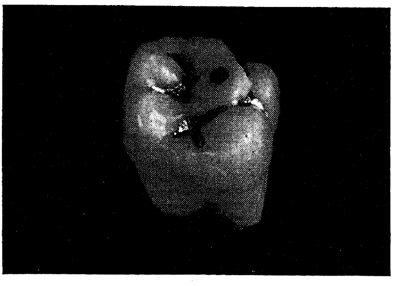
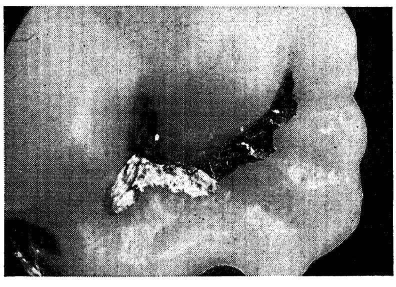


Fig. 360 90, 60, 22 and 12mm Tubes at 12½", twelve seconds at f:22



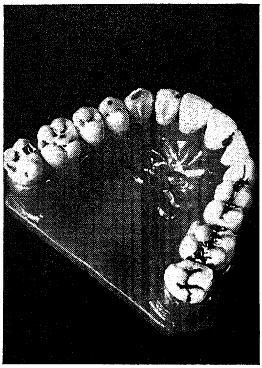


Fig. 361 12mm Tube at 9", four seconds at f:18

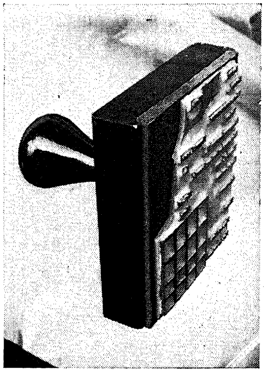


Fig. 362 Record stamp

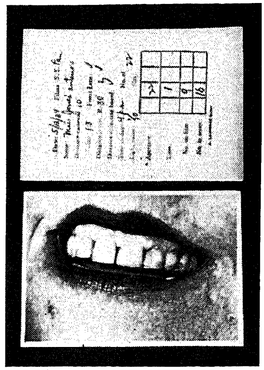


Fig. 363 Print with record on back

Importance of Keeping Accurate Records

The photographer who is interested in reproducing rapidly any type of scene must work out a systematic routine based on accurate records. This is particularly true of photography in any phase of science, where close-up apparatus is used and slight variations are of great importance. Here the subject is frequently a patient and time must be conserved for all involved.

Following is a routine which will permit check-up and reference:

1. Prepare a pad of paper. With a record stamp (fig. 362), stamp all sheets on the pad.
2. Place subjects as desired, adjust camera and lighting.
3. Use Leicameter. Determine light value and select correct aperture and time.
4. Now — — — — — — — — — **STOP** — — — — — — — — — — and

RECORD EVERYTHING

5. If planning to take more than one shot of this subject (possibly experimenting with varying apertures and timing) record (on chart fig. 363) EVERY shot in that series, BEFORE TAKING A SINGLE PICTURE.
6. Then photograph AS PLANNED.

Following the development of the film, study it through the Leica film viewer and marker. By means of this device clip a notch on the border of the film to designate each picture to be enlarged.

Another method of choosing the pictures to be enlarged is to make strip prints from the entire film and then make your selection. If you use this routine be sure to mark the small prints in some suitable manner and in addition return to the film and clip the notches. This is particularly important where you have taken a number of test exposures of the same subject.

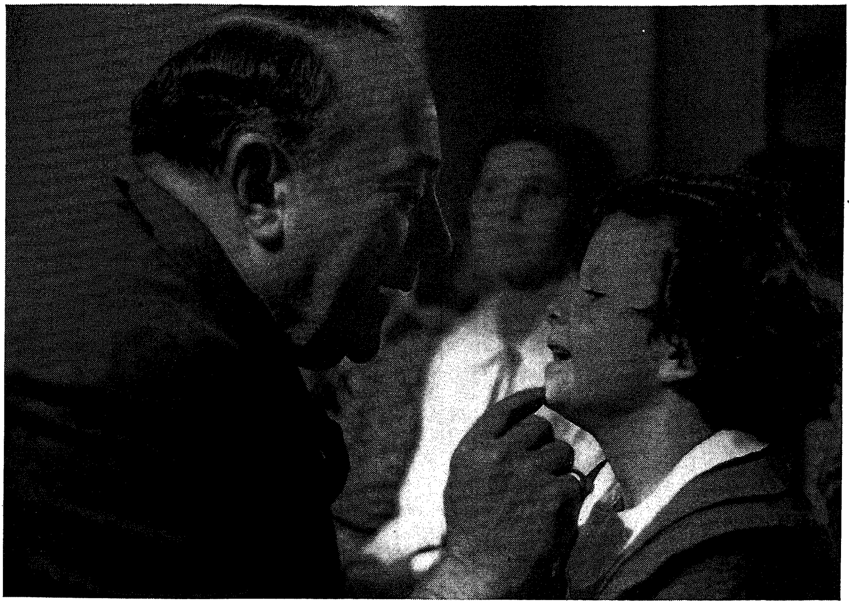
Numbers are to be found marking each picture on some brands of film, while others are blank. Those that are blank should now be numbered on the film in ink to correspond with the numbers on the last line of the record chart. Those films which have numbers on the border, will seldom be found labeled 1-36, but are more apt to be numbered 22-36, 1-21, or 14-36, 1-13, etc. Therefore, these numbers which appear on the film must be recorded on the next to bottom line on chart.

Now, devise some filing system for both the contact prints and enlargements as well as the films. For mine I have chosen to paste all pictures on 9 x 12 inch sheets of heavy yellow paper that is supplied with a Wilson-Jones sectional post binder, top locking, number 24140. I have strip (contact) prints made of the entire film and paste those for one film on one piece of paper. For quick reference they are printed with the margins broad enough to expose the individual frame numbers. Any picture selected for enlargement may there be checked. Any enlargement when pasted in the album may have its individual data recorded beneath it.

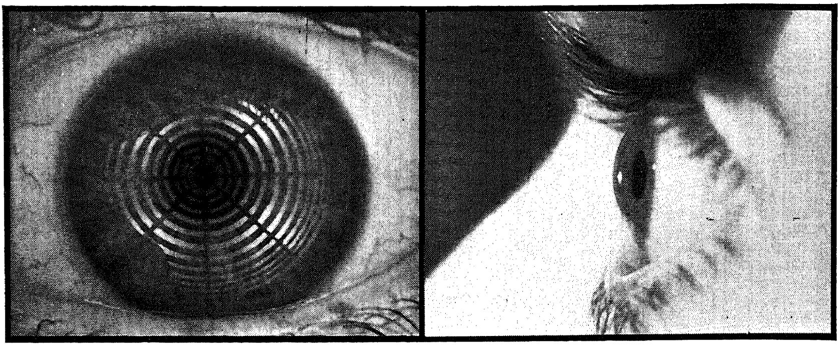
It seems a bit safer not to cut the negatives but to store them in the metal film box. Here they are ready for instant use by referring to the strip prints.

The result of the above will be a systematic record of all factors involved in obtaining every photograph. When you have a new photograph to take you can very readily pick out from your file the print most closely resembling it and proceed by duplicating the recorded factors.

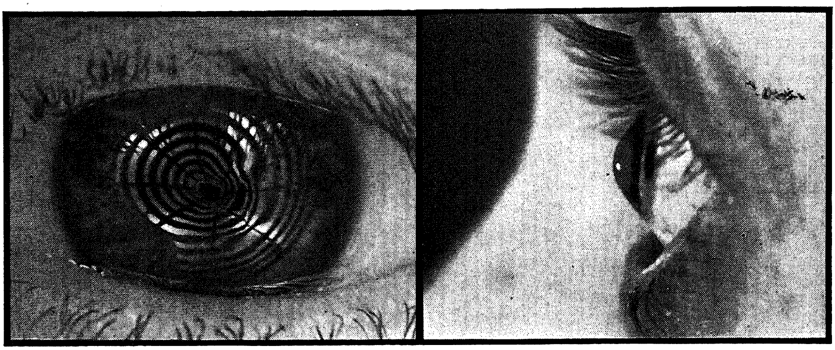
Above all, remember this: Any record routine that is developed along systematic lines will prove invaluable to anyone anxious for scientific results. It can be a routine very different from the above and still be a system. It is not important to copy this one, which I know works in a highly satisfactory manner and saves time and money. It is important, however, to develop some routine which is systematic, accurate and complete.



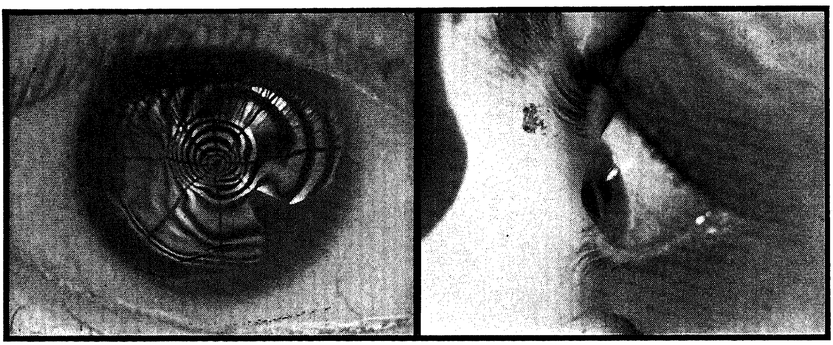
Teaching the Deaf to Speak J. Winton Lemen
Summar 50mm lens, f:2.2, 1/3, E. K. Super X film.



Normal Eye



Keratoconus
(Conical Cornea)



Keratoconus
(Conical Cornea)

Fig. 364. Placido Disc Reflections in Normal and Abnormal Eyes. A. Marfaing

Courtesy Institute of Ophthalmology, New York City.

LEICA AS AN OPTHALMIC CAMERA

HENRY M. LESTER **CHAPTER 23**

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Photography of anterior segments of the human eye for scientific and medical purposes presents problems peculiarly its own. A photographic camera directed at an eye actually faces another camera, and a well designed one too, to say the least. Besides this our camera faces one of the most sensitive and delicate centers of the nerve system, a very delicate and accurate optical organ and a convex mirror, photographically speaking: a wide-angle reflecting surface.

Eyes that come before an ophthalmic camera are usually diseased or abnormal; they are frequently extremely sensitive to light, easily irritated by prolonged exposure to air. Often they are in almost constant motion and, were it even possible to immobilize them for a moment—the iris would never remain unchanged: the movement of this remarkable living diaphragm cannot be controlled at will, the size of the aperture, the pupil, is constantly changing as the iris contracts or distends. Strong light, such as is required for short exposures is almost invariably unbearable to the eye, causing irritation accompanied by lacrimation, nervous movements of the eyeball and of the entire head.

To produce photographs of an eye one needs a good camera with an optical system as flexible as possible. One needs suitable illumination capable of delivering the light required for short exposures without unnecessary strain to the eye. One needs fast films with broad latitude of emulsion and with a full color correction.

An Outfit for Ophthalmic Photography

It is essential that equipment for photography of anterior segments of the human eye possess definite features which would qualify it for this exacting work. Flexibility coupled with simplicity of operation and certainty of results should be its keynote. The Leica camera has always been an excellent instrument for ophthalmic photography. But only since an accessory, known as the Mirror Reflex Housing became available for it—did the camera develop into a full fledged outfit for the photography of the human eye. The Mirror Reflex Housing is actually a part of Leica's latest lens, the 200mm Telyt Telephoto. Disconnected from its original lens, and placed between a 73mm or a 50mm lens it converts the camera into a real reflex camera which permits observation of the subject through the actual "taking" lens up to the very moment of the exposure. The advantages of this arrangement are so important that all previously developed methods were immediately abandoned in favor of this new one.

A Leica was mounted upon a heavy compound base of a binocular ophthalmic microscope. The base, equipped with cross-slide adjustable movement was particularly well adapted as a support for the camera; while extremely rigid it permitted free and fully controlled

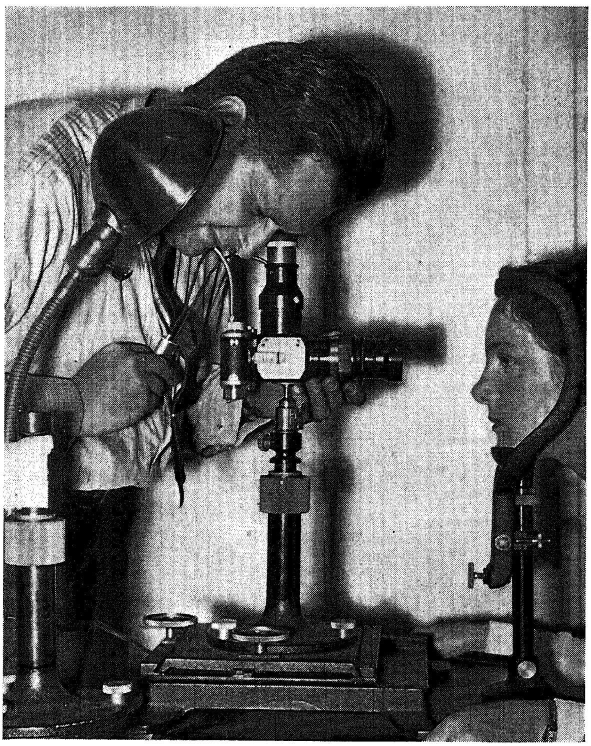


Fig. 365 Using the Leica as an Ophthalmic Camera — Henry M. Lester

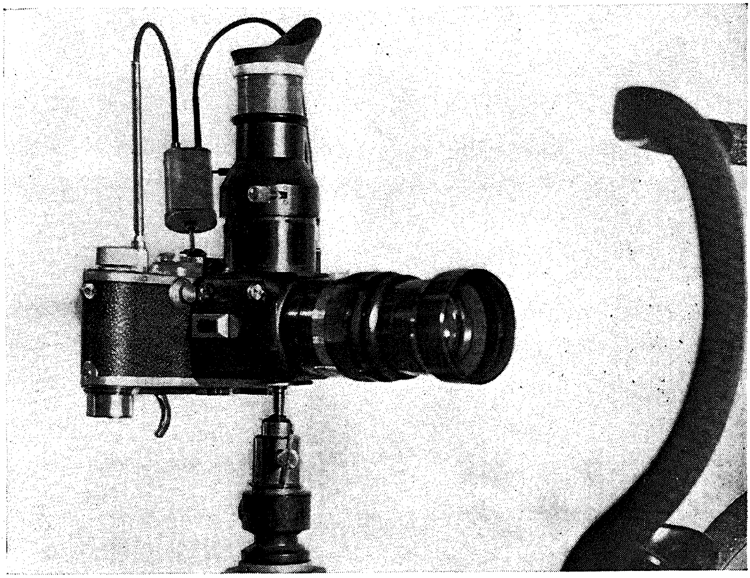


Fig. 366 Details of the outfit assembled from Standard parts and accessories — Henry M. Lester

movement of the camera in every desired direction for adjustment and focusing. Thus mounted upon the base the camera was placed on a heavy adjustable instrument table equipped with an elevating gear and an adjustable head-and-chin rest. The entire outfit, very heavy and rigid, permitted accurate and dependable control of the equipment at all times without being subject to vibrations. The illustrations show the arrangement as used in detail.

The photographic outfit as shown in figures 365 and 366 was assembled from the following units:

1. Leica Camera, Model G.
2. Rapid Winder (SCNOO), replacing the camera's standard base plate.
3. Mirror Reflex Housing with the double cable release.
4. Hektor 73mm f:1.9 lens with its own sunshade.
5. Ball Jointed Tripod Head.
6. Compound Binocular Microscope Base.
7. Instrument Table with Adjustable Head and Chin Rest.

A Spirit Level was used to obtain better alignment of the camera with the optical axis of the eye to avoid distortion.

The Ball Jointed Tripod Head was connected to the compound base by means of a brass key which fitted into a groove in the head of the base. A set screw tightened the connection rigidly. This arrangement rendered the camera outfit easily interchangeable with the microscope, thus permitting the use of either at will. It also assured utmost rigidity and freedom from play and vibration, the importance of which cannot be over-emphasized.

The Hektor 73mm f:1.9 lens was deliberately chosen for this work because of its speed, its excellent color correction, definition and resolving power. Its focal length is such that at the close range at which this work is being done it offered better depth of focus, and a more convenient working distance than the 50mm lens. The Reflex Mirror Housing used with the 73mm lens converts the unit into a real reflex camera, where focusing and adjustment of the fully visible image are accomplished under actual observation until the very moment of exposure. The 5x Magnifier of the Mirror Reflex Housing renders a conveniently enlarged view of the image, at all times screened from extraneous light.

The Mirror Reflex Housing, when placed between the camera and the 73mm lens becomes an extension tube of 62mm, an ideal length for this lens. With it an image of almost normal size is projected upon the film plane, the ratio of the size of the object to that of the image being 1: .85, if the lens is set at the infinity mark, or 1: .9 if the lens is set to the 5 foot mark.

The use of the 73mm lens is also advantageous because the working distance between the lens and the eye is very convenient, ranging from 10.5cm to 11.5cm, when measured from the eye to the edge of the lens shade.

Exposure Factor and New f: Values

It must be remembered that by interposing an extension of 62mm between camera and lens the f: values of the latter are no longer the same. The factor of increased exposure for an extension of 62mm for a 73mm lens is approximately 3.5x, which means that exposures indicated by an exposure meter must be increased 3.5 times. This increase can be effected either by a suitable adjustment of the shutter, or by a correspondingly larger diaphragm opening. The f: values of the 73mm lens, as marked on the lens mount, assume approximately the values indicated below, when the lens is used in connection with the Mirror Reflex Housing (with the lens set at infinity):

When the 73mm Hektor lens is set to:

f:	1.9	2.2	3.2	4.5	6.3	9.0	12.5
	a 62mm extension changes its f: value to						
f:	3.2	4.0	5.6	9.0	12.5	18	22

The new f: value should be applied only as a factor in determining correct exposure, and it is not to be assumed that it imparts either greater sharpness or greater depth of focus. Thus, for instance, if the lens is set to f:4.5—its light transmitting value will be that of f:9 but its depth of focus will remain that of f:4.5.

Factors of film, lens, extension, tube, and illumination being known, it is a simple matter to arrive at the correct exposure by means of a reliable photoelectric exposure meter, like the Weston. The lens stop should be decided upon first, depending upon the depth of focus required. This can be either calculated (see tables in chapter 11), or, which is more practical, and made possible by the use of the Mirror Reflex Housing, determined visually, by stopping down the lens while looking through the Reflex until every part of the picture seen is sufficiently sharp. The stop upon the lens mount is then converted to its actual value (see table above) and the proper exposure obtained from the exposure meter scale.

Illuminating the Eye

The eye acts as a wide angle mirror-like reflecting surface (convex). Not only will it reflect the light source, but, under certain conditions, the camera and its operator as well. Photographs of the eye, therefore, should be made in a room free from illuminated objects or light sources other than those used for the direct illumination of the eye. There should be no light entering through the windows, no skylights, nor ceiling lights. Lights used for illumination should be placed as far as possible from the eye to render their reflections small and inconspicuous. Total lack of reflection in the eye is not desirable, because these reflections lend the picture of the eye that spark of life, that roundness and fullness which distinguishes it from a dead eye.

It is difficult to illuminate a normal eye sufficiently for an instantaneous exposure of a small lens aperture. Prolonged exposures are not desirable because of the ever-present possibility of movement of the eye. But there are abnormal, diseased eyes, with all kinds of lenticular, retinal, corneal involvements, which actually abhor light. There are cases of Photophobia (which does not mean that they abhor photographers, although they actually do!); light, even daylight, hurts them. Their eyes must be shielded, protected from light, and not exposed to it.

Thus, although the entire process of photographing anterior segments is sufficiently standardized to a sort of routine, the matter of handling, selecting and arranging lights has to be treated differently in each and every individual case. It has to be made to suit not only every patient, but the condition of each eye as well; for there are cases where one eye is entirely different from the other. Before the patient is placed before the camera, the reaction of his eyes to light has to be definitely and carefully determined by the attending physician.

Illumination of eyes not over-sensitive to light is easily accomplished with one or two photoflood lamps in reflectors mounted on goose-neck supports. Exposures of fractions of second are easily possible both for black-and-white and color photography. Where one lamp would suffice for black-and-white photography . . . two may be required for short exposures of color photographs. Whenever one lamp is used, a white reflecting surface should be provided for the opposite side of the patient to produce a better roundness and modeling of the subject. Frequently, if the outfit is used near a light wall, it will act satisfactorily as a reflector.

For continuous work it is suggested to connect two photoflood lamps through a switch which will permit their operation either in a "series" or "parallel" connection. The connection "in series" is recommended for focusing and adjustment of patient and camera, with the lights at half their intensity, while the connection "in parallel," giving maximum illumination, may be established for brief moments of the exposure. Such arrangement is extremely practical because it is much easier on the eyes of the patient as well as the operator, and will extend considerably the useful life of the photoflood lamps.

Flashlight Eye Exposures

In the case of eyes particularly sensitive to light, the most satisfactory source of illumination is the Photoflash bulb. The bulb should be placed in the reflector of a goose-neck type floor lamp. A diffusion or glass screen should be placed before the photoflash bulb, because these bulbs occasionally crack or break when flashed. The tiny, thin fragments of glass would be dangerous to the eye of the patient, and one cannot be too careful in protecting it. The reflector should be placed some two to six feet away from the eye, slightly above its level and to one side of it. On the other side of the eye a white reflecting surface should be provided for even illumination, thus imparting roundness to the picture. Actual focusing can be done with the light of a 15-watt bulb, placed conveniently near the camera. The shutter of the camera should be synchronized with the switch of the bulb.

In most instances the patient is barely aware of any light sensation in connection with the flash, which lasts only about 1/50th to 1/75th of a second—too short to register any intensity upon the

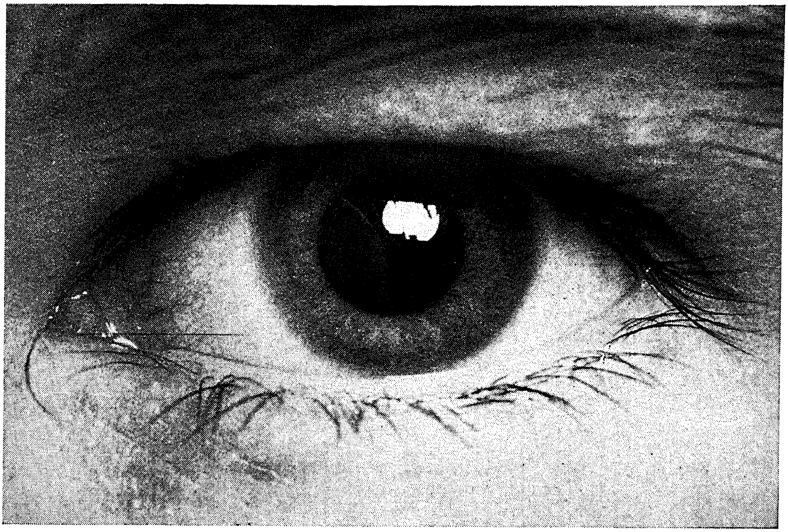


Fig. 367 Ectopia of crystalline lens Henry M. Lester

retina of the eye. To be sure of critical focus, it is at times necessary to use a special head-and-chin rest for the patient. The rest is provided with a small piece of flat wood, attached crosswise. The patient is asked to hold the wood firmly between his teenth during focusing, retaining the assumed position for the exposure.

The Photoflash bulb was used successfully not only to illuminate eyes affected with Photophobia, but in some cases where great intensity of light was required from a certain direction. There was one patient with the rare case of ectopia of the crystalline lens (dislocation of the inner lens). The edge of the lens was plainly visible, appearing like a crescent across the pupil when the iris was distended in the dark, but only when the angle of incidence of the light illuminating it was approximately the same as the angle of reflection. The best way to observe it was in the light of a match, with all other lights out. But you could not photograph it in that light! In bright light, the iris contracted so much that the edge of the lens inside of it ceased to be visible. A photoflash bulb in a reflector, shielded with tracing cloth, was held in the hand about two feet away from the eye. The room was darkened entirely, except for the faint glow of a flashlight bulb with its battery run down. A red filter was placed over the lens to cut down the light intensity. With the camera focused, and the lens stopped to f:12.5, the correct location for the Photoflash was determined by illuminating the edge of the crystalline lens with the weak light of the flash-light. The reflector was moved into position and the bulb flashed. The accompanying illustration, figure 367 shows the photograph that was thus secured. In order to obtain a faint outline of the crescent-like edge of the crystalline lens inside the pupil, the remainder of the eye had to be overexposed.

The technique of illuminating the human eye may have to be varied depending on conditions, type of patient, and frequency with which photographic records are required. Thus for instance, the illumination methods outlined above may be substituted by a standard surgical spotlight equipped with a 1000-watt bulb placed behind the patient and directed upon the photographer's head. The person operating the camera may wear a head mirror of the kind used by nose and throat specialists, and the beam of light from the spotlight can be directed upon the eye of the patient for the brief moments required for the exposure.

Then again the same spotlight could be provided with a compur shutter, placed opposite the patient's eye and the exposure could be made, with the camera shutter open and the spotlight opened and closed for any length of time required for a full exposure. Compur shutters are available for spotlights, permitting exposures of 1/50, 1/25, 1/5 or any other portion of a second.

Color Filters

Unless there is a specific need for a color filter its use should be avoided as much as possible in ophthalmic photography. Modern panchromatic emulsions used with artificial illumination, such as photoflood lamps, will give very satisfactory monochromatic rendering of average ophthalmic subjects. Only where definite color conditions call for it, should color filters be used. An example of such condition is offered in figure 368. This photograph showing a case of a congenital coloboma of an eye was made with a Wratten (A) Red Filter to increase the contrast between the dark brown iris and the black pupil. The same photograph made without this filter showed no appreciable difference between these two parts of the eye.

The selection and use of filters should be governed by actual requirements, and never by a general impression that a filter will improve a photograph. The nearer the color of the subject to that of the filter used, the lighter will that color appear in the photograph. Thus, for instance a photograph of an eye reddened by external hemorrhage taken through a reddish filter, like the No. 23A will render the sclera white and clear. Not only will the reddening of the

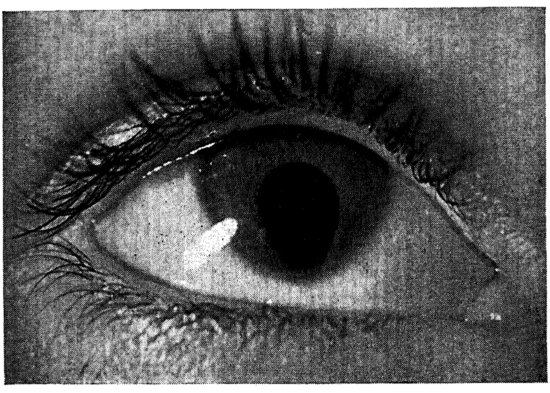


Fig. 368 Congenital Coloboma

Henry M. Lester

Elmar 50mm, 30mm Tube. Photoflash exposure at f:12.5, Du Pont Superior film. Red (A) filter sclera be absent in the photograph, but every dark part of the eye will stand out better and clearer. However with the reddening of the sclera the entire structure of capillary blood vessels, which are red too, will also disappear. If one wishes to secure a particularly good and contrasty outline of the capillary blood vessels upon the sclera the use of a blue-green filter is recommended, which, being "complementary" to red, will bring out best the contrast between the red lines upon the light ground of the sclera.

Natural Color Photographs of the Eye

While appropriate use of color filters has its definite place in Ophthalmic Photography their application should be held to the minimum. Instead, fullest advantage should be taken of all possibilities offered by the Kodachrome Film for direct photography in natural colors. Its speed having been increased to the point where it requires but a little more light than is necessary for black-and-white photography, its price having reached a reasonable level—it has the added advantage of being available in two types, one for photography in daylight, another with artificial illumination, rendering the use of filters quite unnecessary.

Dr. Ramon Castroviejo of the Institute of Ophthalmology, Columbia Presbyterian Medical Center, New York, whose cooperation with the author made this chapter possible, has developed an interesting technique of recording photographically his work and research in the field of surgery of the eye. Using the outfit previously described he confines himself exclusively to photography of the eye in natural color on Kodachrome Film. His finished color transparencies serve many purposes. Bound between glass . . . they grew into a priceless collection of lantern slides for lectures, demonstrations and teaching. A black-and-white negative is made from each by the simple and easy method described below. From these black-and-white prints are made as required to be used as illustrations for scientific papers, as case-history records, etc. Black-and-white lantern slides, either of standard size (3¼″ x 4¼″) or of the "miniature" size (2″ x 2″), which are rapidly gaining in popularity, are also being made as, when, and if required.

The advantages of concentrating upon natural color photography are many. Broadly speaking Kodachrome transparencies will give everything black-and-white photographs will, in addition to brilliant color—which is so invaluable in medical photography. Moreover color photography renders unnecessary the use of color filters, because correctly exposed Kodachrome transparencies give excellent and natural rendering of colors. These, in turn, when properly used for making of black-and-white negatives will give excellent monochromatic rendering of all color values involved.

Figures 369-380 were made from black-and-white prints made from Kodachrome transparencies by way of an intermediate negative. The excellent color correction which can be secured by this method can be seen by comparing figures 369 and 370 one of which is a photograph of a normal brown eye, the other of a normal blue eye. The difference is striking and very instructive.

Exposures for natural color photography on Kodachrome Film are not difficult to adjust. The only requirements for correct color rendering being that the light be placed as flatly in front of the subject as possible and not to one side of it. This requirement can be readily met if the one light used be placed directly above the lens facing the subject, or if two lamps are used, that they be placed at equal distances from camera and eye on both sides of the camera. While the use of exposure meters will greatly facilitate standardization of exposures, one should definitely follow suggestions for correct exposure of Kodachrome Film outlined on page 297.

Making Black-and-White Negatives From Kodachrome Transparencies

Black-and-white negatives can readily be made from Kodachrome transparencies by projection or by contact. However in order to secure best possible color correction upon the black-and-white negative as well as fullest gradation of detail only high-speed panchromatic negative should be used for this purpose. This requirement makes the production of black-and-white negatives by means of an enlarger or contact printer somewhat difficult because high speed panchromatic material must be handled in complete darkness with all extraneous light carefully excluded throughout all operations.

The most satisfactory method of producing black-and-white negatives from Kodachrome transparencies quickly and efficiently is by simply copying them with the aid of the well-known BELUN (Fig. 381) Auxiliary Reproduction Device, which is the ideal outfit for copying things in actual size (1:1). With it, it is extremely easy to copy frame by frame of Kodachrome transparencies either in strip form or mounted between glass. All that is necessary to make any number of black and white negatives from Kodachrome transparencies is to load the Leica with some Supersensitive Panchromatic Film, attach to it the BELUN device and placing the Kodachrome transparencies upon a transilluminating device, similar to an X-Ray viewing light, arranged in a horizontal plane, and after making a number of test shots—determine the correct exposure. If all data pertaining to the exposure can be recorded, subsequent production of additional black-and-white negatives should be very simple and easy. After exposure the film is developed as usual in a fine-grain developer, and becomes a black-and-white negative like any other.

Frequently it may be found that copying Kodachrome transparencies will give more satisfactory results if they are photographed through a suitable filter. Little experimentation will yield surprisingly interesting results. Sometimes a monochromatic rendering of a Kodachrome may be

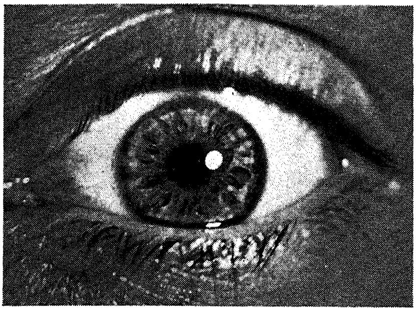


Fig. 369 Normal Blue Eye
From a Kodachrome Leica Transparency.

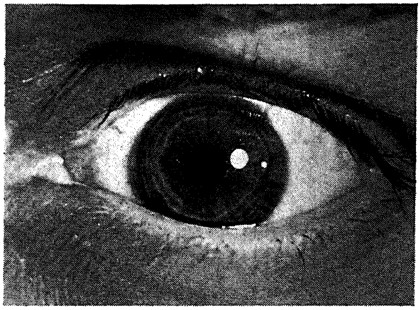


Fig. 370 Normal Brown Eye
Ramon Castroviejo, M.D.

made better, or more interesting through the use of a filter. Filters can be used for correction of the original for over or under correction. The same principles govern the use of a filter for copying Kodachrome transparencies as that for ordinary photography. If the transparency has a reddish cast, or if the light source is reddish—a pale red, or orange filter will correct that defect very easily. If the case be purplish, or bluish—a light or dark blue filter should be used to lighten the general effect. If the slide is too pale, tending to be somewhat flat as a result of overexposure its contrast can be improved by one of the yellow or green filters.

Photomicrography in Ophthalmology

It is frequently desired to secure an extreme close-up of a portion of the eyeball, such as a portion of the iris, or details of the capillary blood vessels of the sclera. Visual inspection of such portions of the exterior aspect of the eye are usually made through the binocular ophthalmic microscope, which gives a stereoscopic aspect of the area under observation. It is upon the compound base of this instrument that the previously described outfit is mounted.

To secure Photomicrographs of anterior segments of the eye the binocular microscope is mounted upon its base and a Leica camera is

Fig. 371 Corneal Opacity
From a Kodachrome Leica Transparency.

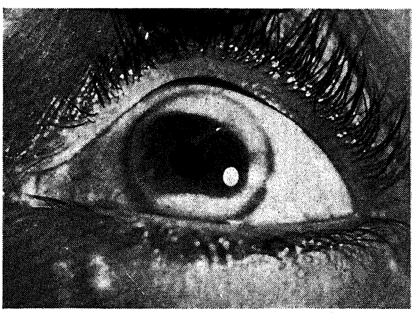
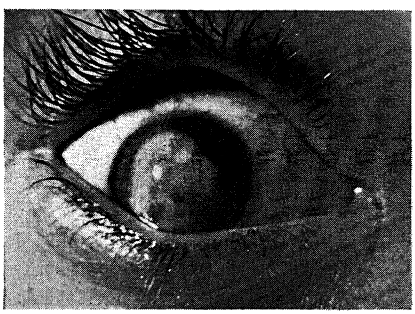
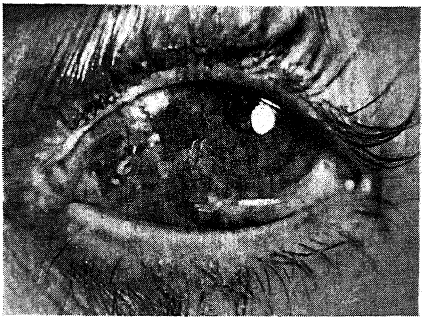


Fig. 372 Corneal Opacity
Ramon Castroviejo, M.D.





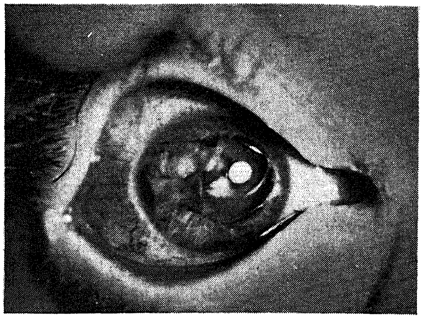


Fig. 373 Extraocular Injury
From a Kodachrome Leica Transparency.

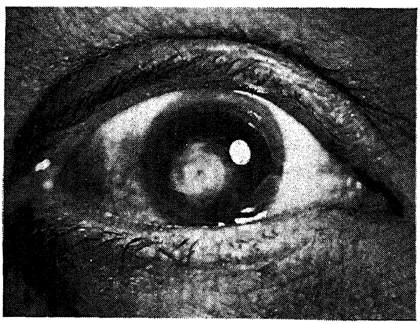
Fig. 374 Intraocular Injury
Ramon Castroviejo, M.D.

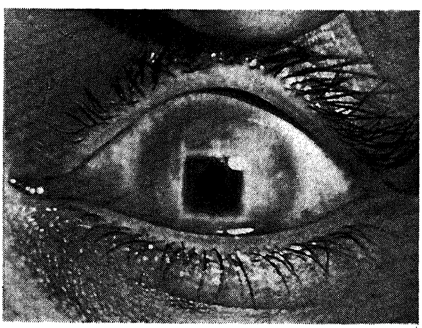
connected to one of its eye pieces through the Micro Ibso Attachment (MIKAS), a device which is so useful and handy for standard photomicrophy (see Chapter 21). The Micro Ibso Attachment gives an initial magnification of 1/3 on film, and depending upon the combination of eye-piece and ocular chosen it will give magnifications on film from 10x to 50x. Figure 382 shows such a photographic outfit in use, figure 383 a closeup of its details, and figure 380 a photograph showing a 24x magnification of portion of the sclera with its capillary blood vessels upon it.

The illumination for this unit is supplied by a small lamp, appearing as a long tube mounted by means of a ball-and-clamp connection to the binocular microscope. This small lamp emits an intense beam of light of a ''spotlight'' character. It is known as Shahan's Slit Lamp (Dr. W. E. Shahan, St. Louis, Mo.), and represents an inexpensive, yet entirely practical instrument for the examination of the cornea, lens and anterior vitreous. The closer to the eye, the

Fig. 375 Corneal Opacity
From a Kodachrome Leica Transparency.

Fig. 376 Transparent Corneal Graft in an opaque cornea
Ramon Castroviejo, M.D.





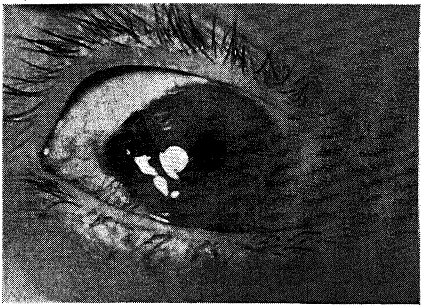


Fig. 377 Tumor of the Eye
From a Kodachrome Leica Transparency.

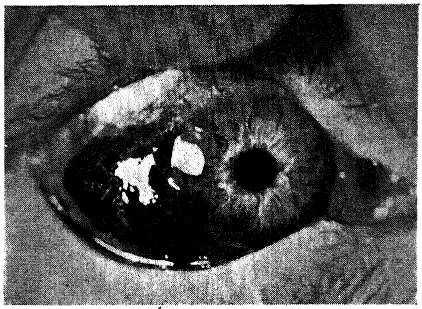


Fig. 378 Tumor of the Eye
Ramon Castroviejo, M.D.

smaller field its beam of light will cover, and the more intense its luminosity. The bulb in the lamp is of the inexpensive 6 volt variety, easily available from any automobile supply source. The Slit Lamp should be connected through a suitable resistance or rheostat to make the intensity of its light independent of the distance from the eye.

The binocular microscope outfit with the Slit Lamp attached to it as shown in figure 383 is also used for the photography of the angle of the anterior chamber. For this type of photography a special contact glass is applied to the eye to get the angle into view. Without this contact glass the angle would be hidden by the opaque structure of the eye. Both black-an-white and natural color photographs had been obtained with the aid of this outfit.

Infra Red Photography

Photographs of certain aspects of the anterior segments of the eye by infra-red radiation made on Infra-Red Film will present detail which escapes ordinary photographic emulsions. If the iris is ob-

Fig. 379 Pterygium
From a Kodachrome Leica Transparency.

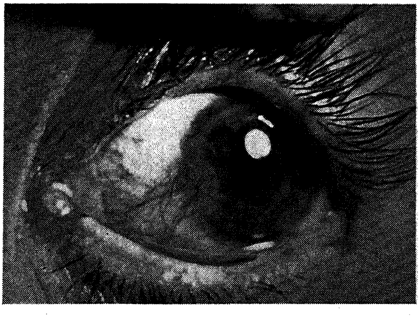


Fig. 380 Vessels of the eyeball magnified 24x (on film)
Ramon Castroviejo, M.D.

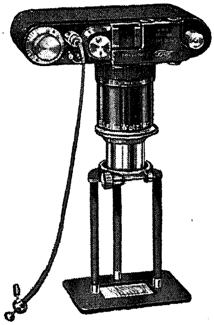
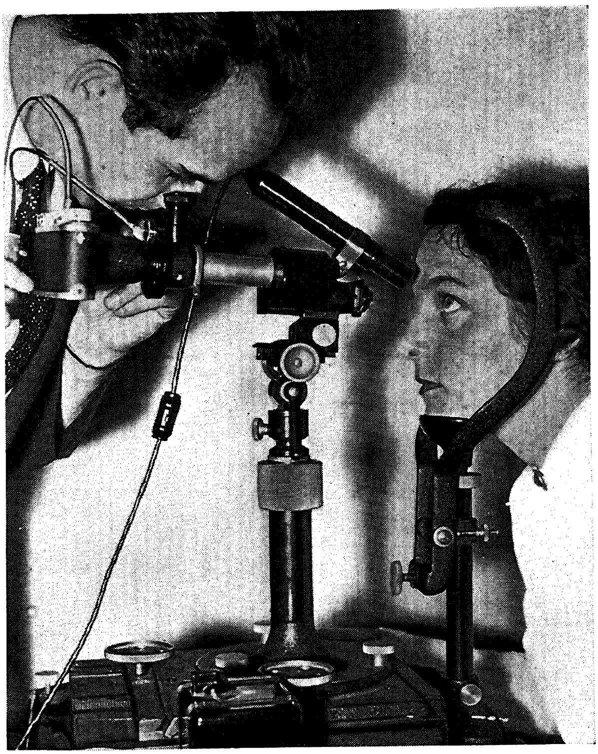


Fig. 381 BELUN Auxiliary Reproduction Device for copying Kodachrome Leica Transparencies . . . making of Black-and-White Negatives (1:1)

scured by a leucomatous cornea, its aspect will reveal itself clearly in an infra-red photograph. Most tissues transmit infra-red radiation more freely than visible light. This ability of infra-red rays to penetrate tissues is extremely useful when visual examination of an iris is rendered impossible by the turbidity of the cornea.

Fig. 382 Using the Leica for Photomicrography of the Eye

Henry M. Lester



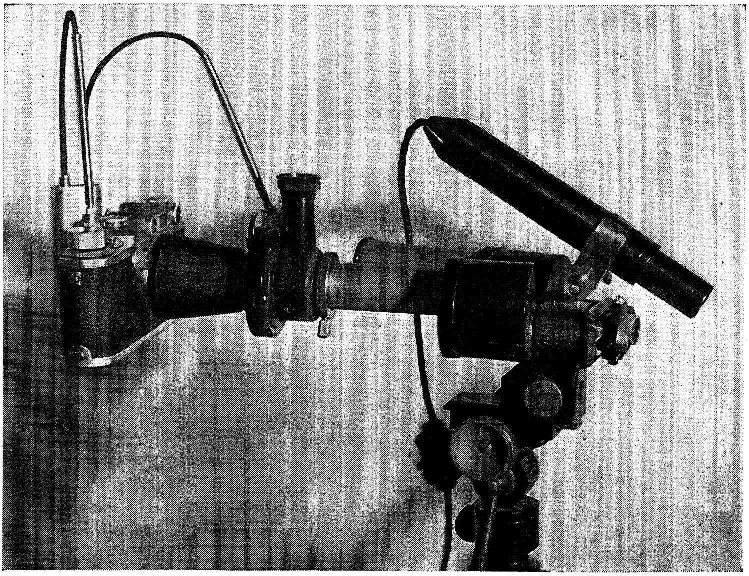


Fig. 383 Arrangement of the Leica camera in connection with a Binocular Microscope for Photomicrography of anterior segments of the eye — Henry M. Lester

It should be remembered, when taking infra-red photographs with the Leica that most of its lenses have a focusing mark (R) engraved upon it to provide for the difference of focus resulting from the exclusion of visual light. This mark, and not the regular indicator mark should be used after focus is established visually; all focusing must be done before the red filter is put over the lens, as the true Infra Red Filter excludes all visible portion of the light, rendering visual focusing impossible.

The most satisfactory light source for Infra-Red photography is offered in the 500-watt bulb, one or two of which will have to be placed in reflectors to provide adequate illumination. No definite indication of exposure can be given, except that, depending upon the type of film and filter used an increase of from 16 to 64 times the exposure required without the filter will have to be given.

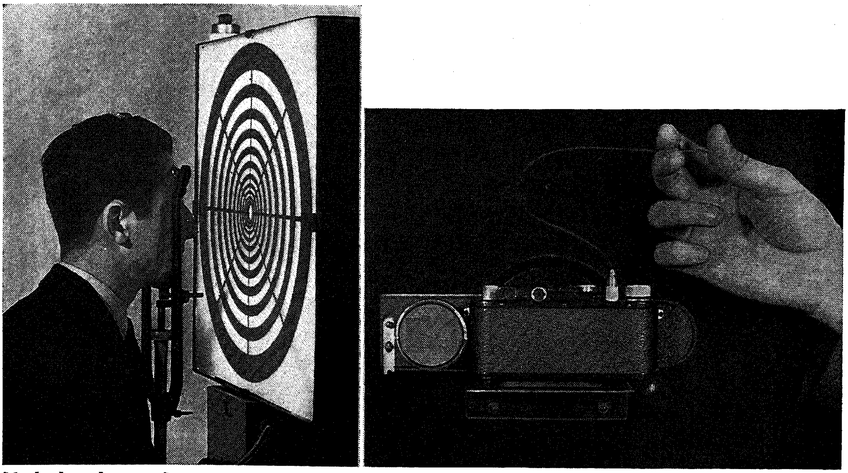
Use of the Placido Disc

Photographs are frequently required of eyes with deformities of the cornea. The cornea (the outer transparent part of the eye-ball) of a normal eye is spherical, forming a segment of a sphere slightly smaller in diameter than that of the eye-ball itself. It is smooth and glossy. Its roundness and smoothness enable it to act as a convex reflecting surface. In some cases the cornea assumes shapes different from normal, sometimes resembling a cone, in other cases it develops deformities of the outer surface, irregularities of the curvature, wrinkles, etc. All of these deformities result in distorted and defective vision. Some of them are very slight, however, barely visible to the eye. The fact that a normal cornea acts as a convex mirror had been utilized in the detection of these irregularities and in their accurate measurement. A white disc (known as the Placido Disc), some 18 to 24 inches in diameter, upon which are drawn concentric black circles about 1 inch wide and about 1 inch apart, is placed in front of the eye. Through an aperture in the center of the disc one can observe the reflection of this disc in the eye. A normal cornea will reflect a true reduced image of these concentric black and white circles, rendering fully their roundness, relative spacing and concentricity. A malformed cornea will reflect a distorted image, from the nature, shape and direction of which the character of the malformation can be diagnosed and measured.

To obtain photographs of corneal reflections of Placido Disc in normal and anomalous eyes the same Leica outfit can be used as shown in Fig. 366, or one which is based on the use of the Sliding Copying Attachment (FULDY), a useful accessory which is described in chapter 11. The illumination, however must be different. Two 500-watt lamps or two Photoflood lamps in reflectors are placed slightly behind the patient, their light being directed at the Placido Disc. The light reflected by the white portions of the disc serve to illuminate the eye. The lights must be so arranged with respect to the camera that no direct rays of light strike any elements of its lens.

The series of photographs shown as figure 364 represent an outstanding and striking example of photography of corneal reflections of Placido Disc. They are the work of Mr. A. Marfaing of the Institute of Ophthalmology, Columbia-Presbyterian Medical Center, New York City, where an ingenious and efficient unit was developed and assembled for this purpose. The outfit is shown in figure 384. Its most notable feature is that it is self contained as to illumination. Instead of having the concentric circles drawn upon a white card, which could be illuminated as previously described, this Placido Disc is painted upon a large sheet of opal glass, which is mounted over a vertical light box, containing a number of lamps, emitting uniform and diffused light.

An opening is provided through the center of the glass panel and the light box, through which the camera lens obtains complete cov-



Method and procedure developed at The Institute of Ophthalmology, New York City.

Fig. 384 Arrangement of Patient, Placido Disc and Leica Camera for photography of Corneal Anomalies — A. Marfaing

erage of the eye under observation. Figure 384 shows the arrangement of the front as well as of the rear of the panel, a Leica camera being used for this particular purpose in connection with the Sliding Copying Attachment. Regardless of the method used or photographic outfit preferred it is important to remember that to secure any degree of accuracy in the finished photograph the center of the Placido Disc should coincide with the optical axis of the eye as well as that of the camera lens.

Portraits of Patients

The flexibility of this Leica outfit makes it possible to use it still for another purpose. By simply removing the Mirror Reflex Housing from between the camera and lens, and by placing the 73mm Hektor lens directly onto the camera—the outfit is converted into a portrait camera. Portraits of patients are wanted for case histories and other records. Progressive stages of conditions under treatment or before and after surgery make almost invaluable material. It is frequently of interest to show the marked difference of facial expressions resulting from improved or restored vision. The tired, haggard and tense expression, typical of a patient during early examinations is usually superseded by an expression of ease and contentment after successful treatment. For such purposes photographs are wanted which include the head and a portion of the shoulders. The 73mm lens is ideally suited for this work.

Smoke Box Photography

The usefulness of this Leica outfit does not end after the completion of photographs of anterior segments and portraits of patients. In explaining the principles underlying the construction and design of various spectacles used as aids to eyes affected with subnormal vision it may be desired to show how a beam of light is refracted in passing through the medium of a lens, what happens to it when it enters the eye, and how the path of this beam of light can be controlled to produce an image upon the retina by making it pass through certain media before entering the eye. One aspect of such procedure is outlined in the hope that it may suggest analogous solution when required.

A schematic model of the eye was built of glass. Also a special "smoke box", consisting of a wooden box, painted with dead black coating inside. One of the sides of the box was fitted with plate glass, which enabled observation from the outside. At one of the ends an

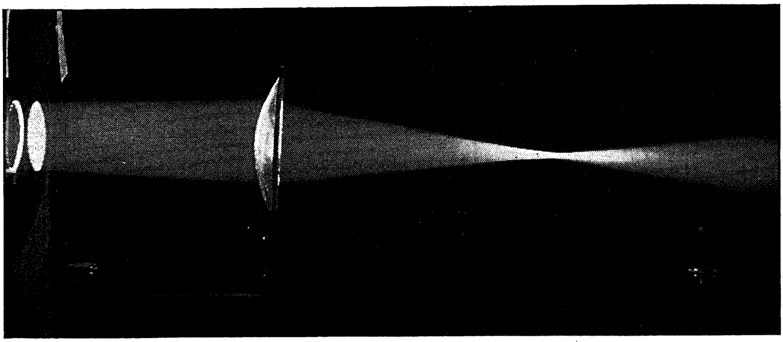


Fig. 385 Smoke Box photograph — Henry M. Lester
showing behavior of bundle of rays after passing through convex lens. Elmar 50mm lens. Three minutes at f:18. DuPont Superior film. Red (A) filter

opening was made through which a beam of light could be admitted. An optical bench was placed inside the box, and various lenses, slits, prisms, pin-holes and similar media were mounted upon it aligned along the same optical axis. A strong source of light was placed on the outside of the box with the beam of light entering the box through the side opening. The bunch of rays entering the box was made as nearly parallel as possible. When the box was filled with smoke the path of rays became plainly visible in a darkened room. The rays were made to pass through lenses, prisms, slits, pin-holes, etc. and as a result were made to converge, disperse, change direction, intensity, etc. At the end of considerable experimentation to produce

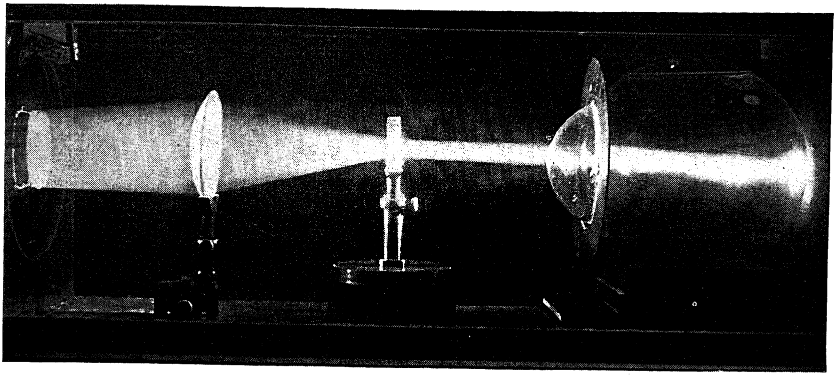
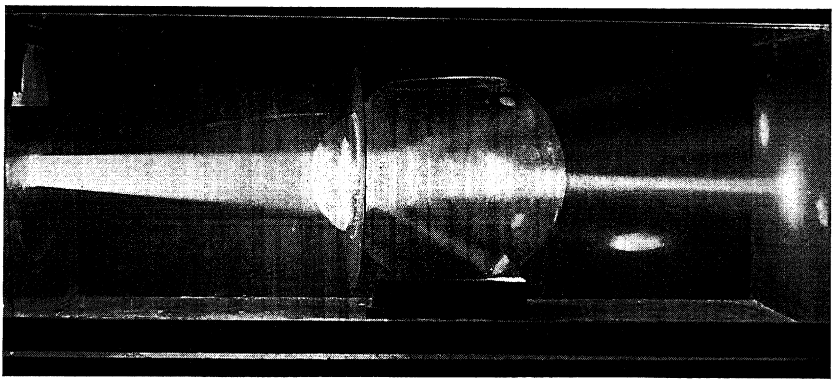


Fig. 386 Smoke Box photograph Henry M. Lester
showing behavior of bundle of rays after passing through simple "telescope", entering model of eye and forming image upon retina. Exposure as in Fig. 385

the desired results this turned out to be an interesting and quite a dramatic spectacle. Although a very strong source of light was used, its actinic value was slight. Because what we saw was, of course, not light itself, but merely the illuminated minute particles of smoke, which reflected less light the farther away they were from its source. To intensify these illuminated particles, a bit of powdered chalk was shaken into the smoke box just before each exposure was made.

The Leica was used to photograph these set-ups. The camera mounted upon its rigid support described previously was as free from vibration as possible. This was important because very long exposures were required: with the lens stopped down to f:18 and with a red (A) filter used to retard the brightest light, and to bring out some detail in the shadows of the set-up and equipment inside the smoke

Fig. 387 Smoke Box photograph Henry M. Lester
showing bundle of rays entering model of eye rendered defective by simulated corneal opacities. No image formed upon retina. Exposure as in Fig. 385



box—the exposures ranged from 2 to 5 minutes! The following illustrations show these actual photographs obtained in this manner.

These photographs had to be made in a darkened room. All those present in the room had to remain motionless throughout the long exposures. To prevent vibration caused by street traffic and subways the actual exposures were made between 2 A.M. and 5 A.M.

Correct exposures for these photographs were obtained by the tedious but infallible method of trial and error. Exposures varied with every set-up because of various light intensities resulting from the use of various media through which the light was made to pass. The preparation of each set-up was so tedious that some three to six shots of each were made: just to play safely.

Many other applications can be found for the various possible arrangements of the Leica camera and its accessories. New achievements of the miniature camera in the field of science are being constantly reported. A book could be written on the various useful applications of the small camera in ophthalmology, clinical photography etc. It is hoped that these few examples of the camera's usefulness will suggest new regions for photographic explorations.

The series of photographs on the opposite page (Fig. 388), is shown here as an example of usefulness of the MIRROR REFLEX HOUSING. All these photographs, except the two Microphotographs were taken with the 135mm Hektor lens (in short focusing mount) and the Mirror Reflex Housing. They were made during the actual performance of the biopsy. Exposure: 1/30 second at f:4.5. Dupont Superior Film.

The two Microphotographs too were made with the aid of the Mirror Reflex Housing. A 60mm extension tube was connected to the lens end of the Housing and slipped over the ocular of the microscope. A piece of black cloth served to make a light-tight connection. Exposure: ½ and 1 second on Eastman Kodak Panatomic Film.

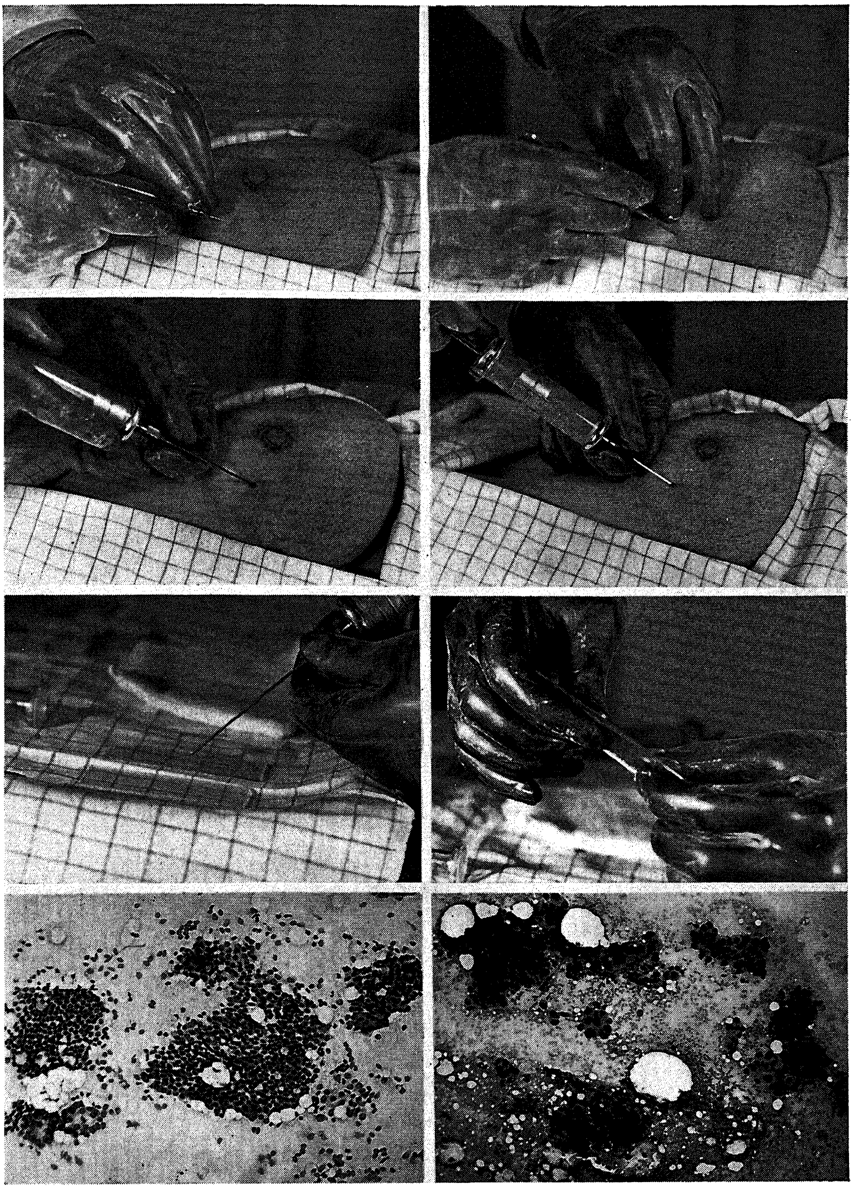
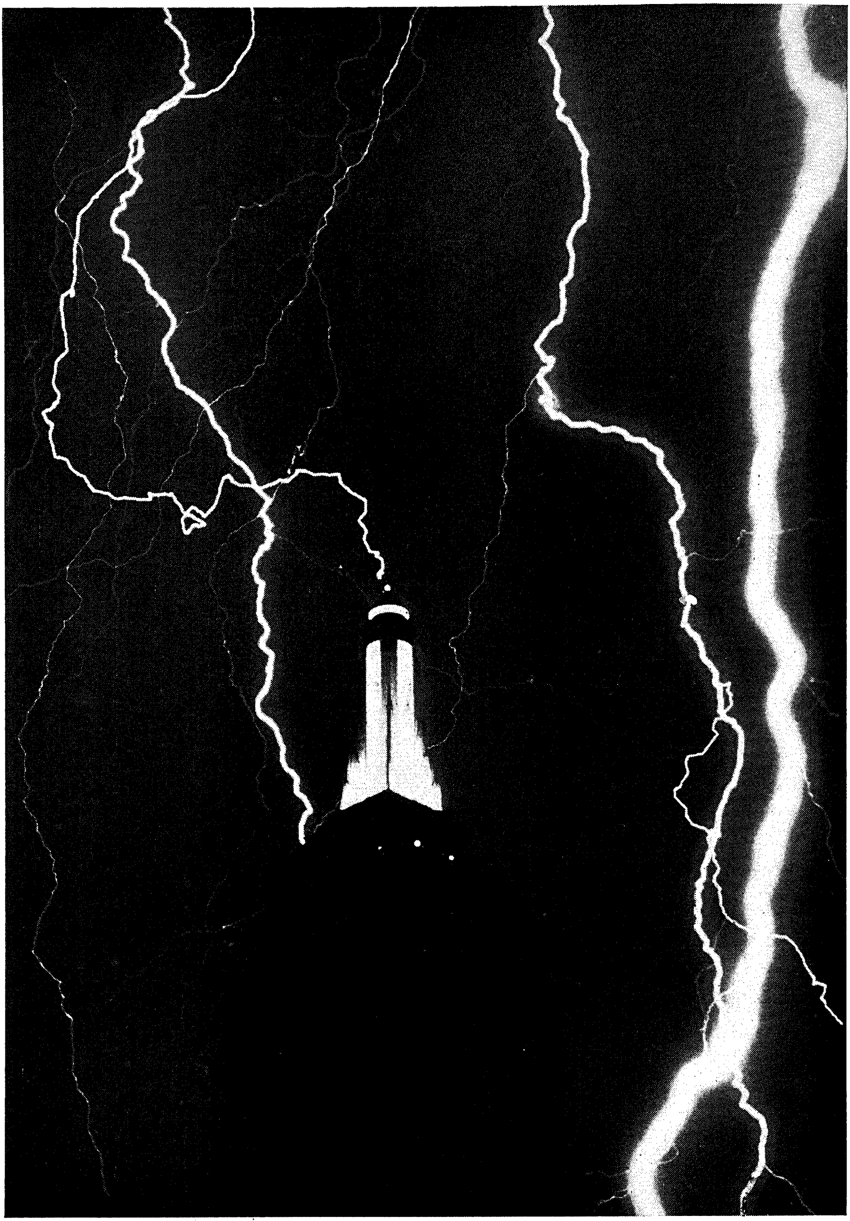


Fig. 388 Aspiration Biopsy upon Breast — Henry M. Lester

Courtesy of Dr. Hayes E. Martin and Edward B. Ellis, Memorial Hospital, New York City

1. Anaesthesia (Novocaine in skin)
2. Nick skin with scalpel
3. Insertion of needle
4. Aspiration of tissue under negative pressure
5. Ejection of tissue upon glass slide
6. Producing 'smear'' by firm pressure of two slides
7. Non-malignant tumor (Fibro-adenoma)
8. Malignant tumor (Carcinoma)



Lightning Striking Empire State — John P. Gaty

Elmar 90mm,—Time Exposure, f:4, DuPont Infra-D film, Wratten C and F filters

INFRA-RED PHOTOGRAPHY

JOHN P. GATY

CHAPTER 24

Photography by means of light beyond the ends of the visible spectrum offers many interesting possibilities to the experimenter. Ultra-violet photography, using shorter wave lengths than those transmitted by optical glass, requires expensive quartz lenses and filters which are not available to the average photographer. The invisible light of the extreme red and infra-red region, which consists of longer wave lengths than the visible red light, can be utilized for photography without the aid of expensive auxiliary equipment. A minimum investment in this type of experiment would be the purchase of a roll of infra-red sensitive film and a red gelatin filter. The ordinary Leica lens of any type will work perfectly, although the Elmar series should be set at a scale reading of 100 feet in order to focus the infra-red rays from distant objects. The Hektor series requires slightly less compensation, while the latest Summar lens is provided with a special index mark on the mount for the purpose of focusing with infra-red.

If close-ups are required, adjust the lens to the true distance and then subtract the same amount of angular rotation as was required to move the lens from the true infinity position to the selected infra-red infinity position. This amount of angular rotation is measured on the circular edge of the focusing ring. In all cases the infra-red scale-reading will be less than the panchromatic scale-reading, by a very slight amount. Images formed by infra-red rays focus slightly further back of the focal plane formed by visible light. To compensate for this generally slight difference, the lens should be racked out by something like 1/200 of its focal length. Thus, if a 50mm lens is used for infra-red photography, it should be racked out about ¼mm. In most cases the correction for close-ups is unnecessary, due to the depth of focus of the lens.

It is rather difficult to visualize the nature of infra-red rays. The fact that the word *red* is made part of its name should not be taken to imply that these rays are colored red. The name of these rays implies merely that they can be located in the spectroscope in the region adjoining red. Because the human eye is not sensitive to infra-red rays it should not be even taken as *light.* They can be most accurately described as invisible rays. It is quite possible to describe infra-red rays as heat rays.

The use of infra-red light for photography is not new. Almost one hundred years ago Herschel made infra-red photographs by indirect methods which are still used to explore the infra-red regions beyond the range of response of our most modern emulsions. Herschel discovered that an emulsion which has been exposed to blue light will show a diminution of exposure wherever it is exposed to red or infra-red rays. A film which has been uniformly fogged by blue light will then show a *positive image* of a subsequently made infra-red exposure, when it is developed. Patience and careful control are required to make this system work effectively, but it offers great possibilities for research in regions otherwise beyond the reach of photography.

Infra-Red Films

Modern infra-red photography dates from about 1910 when the experiments of Professor R. W. Wood were announced to world famous scientific organizations. For a time popular interest lagged, due to the difficulty of obtaining suitable emulsions. Recently, great progress toward perfection of infra-red sensitive materials has brought the amateur photographer stable and fairly sensitive emulsions suitable for the purpose. **Those available for the Leica are Agfa Infra-Red film, DuPont Infra-D film and Eastman K film.** The DuPont Infra-D and the Agfa Infra-Red films are especially spooled for the Leica and are available from all dealers. It is extremely important to use, whenever possible, extremely fresh material that is sensitized to infra-red light. Fresh films will be found more sensitive than old.

The special applications of infra-red photography depend on two main characteristics of infra-red light. *First:* it has unusual power of penetration of atmospheric haze and certain materials which are opaque to visible light. *Second:* many substances show a reflective power to infra-red light which has no apparent relation to their relative power to visible light. The full range of wave lengths of infra-red light is considered to be about *three thousand times* as great as the full range of the total visible spectrum from violet to deep red. In other words, if the total visible color spectrum were considered as a piano keyboard, with each note representing a different wavelength band, or color, it would take a piano with three thousand progressively arranged keyboards to contain all the notes or colors in the infra-red spectrum. Photographically, only the very beginning of this composite *keyboard* has been explored to date, since most experimenters have failed to reach further than the top of the fourth standard *keyboard* length above the visible spectrum. The films already listed reach approximately to the top of the first standard *keyboard* length above the end of the visible spectrum, but in this region alone there lies a complete gamut of invisible colors (if such a thing can be). Since these cannot be seen, their effect on the infra-red sensitive film must be determined by experiment.

For illustration: some black, green, olive, blue, and violet dyes will photograph as light gray or almost white under certain wavelengths of infra-red light. Other dyes matching exactly in *visible color* will photograph by the same light as dead black or dark gray. This fact may lead to adoption of specialized infra-red and heat reflecting dyes for summer clothing. The cloth would appear to be dark to the eye and would not soil readily, but would be as cool to wear as a white garment.

Differences in Infra-Red Values

These two fundamental characteristics of atmospheric penetration and unusual tonal response are the causes of the peculiar effects depicted in landscapes when they are photographed by infra-red light. On a clear day there is a total lack of *atmospheric perspective,* or the demarcation of various planes in the distance due to the separation of tones by atmospheric haze. The foliage of most trees reflects infra-red light perfectly and the sunlit trees appear in the photograph to be covered with silver leaves. This effect is greater in the case of broad-leaved trees than it is with the firs, pine trees and hemlocks. Since the infra-red light penetrates the atmosphere without much scattering, that part of the spectrum comes directly down from the sun without illuminating the sky by diffusion. The sky shows a total lack of scattered infra-red light and thus appears as dead black unless it contains clouds or atmospheric vapor of a tangible kind. Since the sky is free of diffused infra-red light it cannot act as a source of light to illuminate the shadows of the scene. The shadows will therefore photograph as dead black, unless some object on the ground acts as a reflector. White sand or a green lawn will do this, and the point should be remembered when attempting to compose a landscape. The infra-red pictorialist must think in infra-red photographic values only. Otherwise, his pictures will provide surprises continually.

The haze penetrating power of infra-red light has produced some remarkable results in aerial photography, but a distinction should be drawn between atmospheric haze, or intangible particles of moisture suspended in air, and actual clouds composed of water drops large enough to wet a surface passing through them. Clouds perfectly reflect all the photographically available wave lengths of infra-red light and it is obvious therefore that photographs cannot be made *through* clouds by infra-red light. It is unsafe to say that at some future time an emulsion will not be produced to record spectrums of unknown bands of infra-red and thus perform accomplishments now impossible. Present research, however, has shown that the first *keyboard* of the infra-red above the visible spectrum is the most useful for haze penetration. At the lower end of this range, near the visible light, a 1½ inch layer of distilled water is almost completely transparent, while at the upper end it absorbs about 90 per cent of the light directed upon it. There is a slight decrease in absorption of light near the beginning of the second *keyboard* and then a rapid increase, until at the upper end and thenceforth to the limits of exploration the water is completely opaque. This interesting fact explains the surface heating of large bodies of water in summer since the longer wave lengths of infra-red are intimately associated with heat. It also explains why a drop in temperature is felt when a cloud passes across the face of the sun. The infra-red and heat waves are reflected back into space or absorbed by the cloud and cannot reach the earth. Since heavy fogs are simply clouds at rest on the ground, there does not seem to be much hope for the so-called *fog cameras.* The type of atmospheric haze and light mist penetrable by photographically available infra-red light hardly offers a serious menace to navigation.

The penetrating power of infra-red light is selective. Some woods such as certain pines, sycamore, balsa and beech transmit infra-red freely through layers up to ⅛ inch. Other woods of the same thickness, such as teak, oak and walnut transmit little or no infra-red light. Rubber is a material that is a good transmitter of infra-red.

Human skin transmits infra-red light to such an extent that certain limited medical applications have been found for this type of photography. Subsurface details that are invisible to the eye sometimes can be seen in an infra-red photograph. This fact makes infra-red portraiture disappointing, since the subject always appears unnatural. A man's clean-shaven face often photographs as though heavily bearded with stubble, and the natural facial contours are changed in appearance.

Infra-red photography is very effectively being employed in the field of medical research. Remarkably clear images of subcutaneous structures of blood vessels appear clearly when photographed upon infra-red film either through a filter placed upon a lens or with filters placed upon the light source. Very interesting photographs have been made of the development of varicose veins long before they were apparent to the naked eye. In the field of dematology the application of infra-red photography should be of particularly great interest: certain skin diseases result in a crust-like coating of the skin which does not permit an observation of the condition of tissues beneath the crust. Photographs on infra-red film would reveal the condition of tissues and cells beneath that crust with comparative simplicity.

Infra-red portraiture sometimes can be applied to people with unusual skin defects which may actually disappear in the photograph. Deeply pigmented skin often appears white when taken upon infra-red film.

In the field of criminology infra-red photography repeatedly has proved its ability to differentiate between pigments which were visually the same in altered documents or forgeries. There also have been cases where paintings photographed by infra-red light revealed the presence of lower layers of paint constituting a different picture. Extremely interesting results had been obtained by the use of infra-red photography for revealing detail in old documents, which were either stained or deliberately deleted by censors with black inks. The same applies to faded inks, fabrics, records or parchment, wood and leather. One of the many available methods of examining and testing paintings of old masters consists of photographing those paintings on infra-red film, which will reveal the slightest traces of lower layers of paint. It is sometimes possible to read a letter in a sealed envelope by photographing it on infra-red film through the envelope from both sides and subsequently arranging the different aspects for legibility.

In photomicrography interesting experiments have shown that infra-red light is capable of revealing hidden details of structure. This application is a recent one and offers considerable possibilities for experimentation. It depends on the property of infra-red rays to penetrate certain substances while being reflected by others, quite at variance with the action of visible light. It is successfully employed in rendering invisible details of cell structures beneath the outer covering of insects' bodies which is composed of a substance known as chitin. It is frequently found that a black or dark colored beetle or insect just as easily can be *trans-illuminated* with the aid of infra-red rays as a wing of a grasshopper with ordinary light.

Infra-red photographs through a miscroscope are not by any means easy or simple because of the extremely small depth of focus available at such great magnifications. The infra-red rays focus in a different plane from that of visible light, and it is almost impossible to make the two foci coincide. One has to take several exposures with different settings of the indicator of the micrometric adjustment of the microscope and after developing and examining the film determine which is the correct setting for a given exposure.

Celestial photographs by the aid of infra-red have shown details of planets which otherwise were veiled by the planets' own atmosphere, and have depicted stars beyond some of the nebulae. Here, again, the exceptional penetrating power of the rays is of advantage.

One of the most popular applications of infra-red photography was developed in the Hollywood studios for securing night scenes and moonlight effects in broad daylight. As previously mentioned, blue skies are rendered black when photographed on infra-red film. Thus, if a photograph be taken on a clear, cloudless day, the landscape would show a black sky. Considerable experimentation must precede any definite application of infra-red film to such effects.

Exposure and Filters

The standard exposure with the Leica and the films mentioned in this article should be from 1/10 to 1/20 at f:3.5, when using a filter of a density approximately a Wratten No. 25 (cherry red). These exposures are for a bright, clear day in full sunlight. It is impossible to set up a standard for a cloudy day, since experiments have shown that the infra-red light intensity seems to have little relation to the intensity of the visible light, as measured by an ordinary photometer. It may be proportionally more or less, perhaps

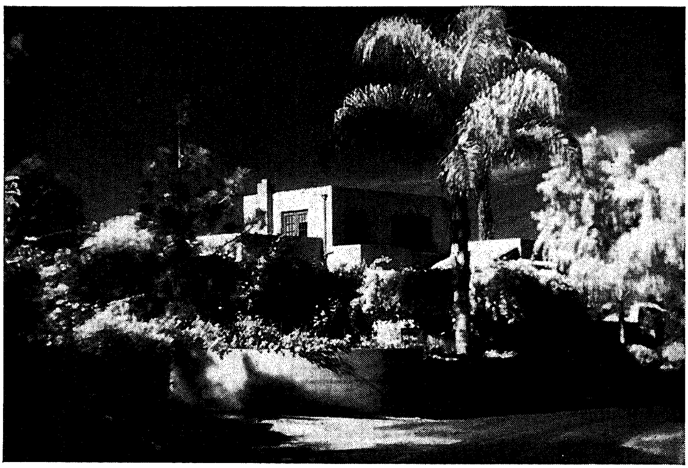


Fig. 390 California Sunshine John P. Gaty

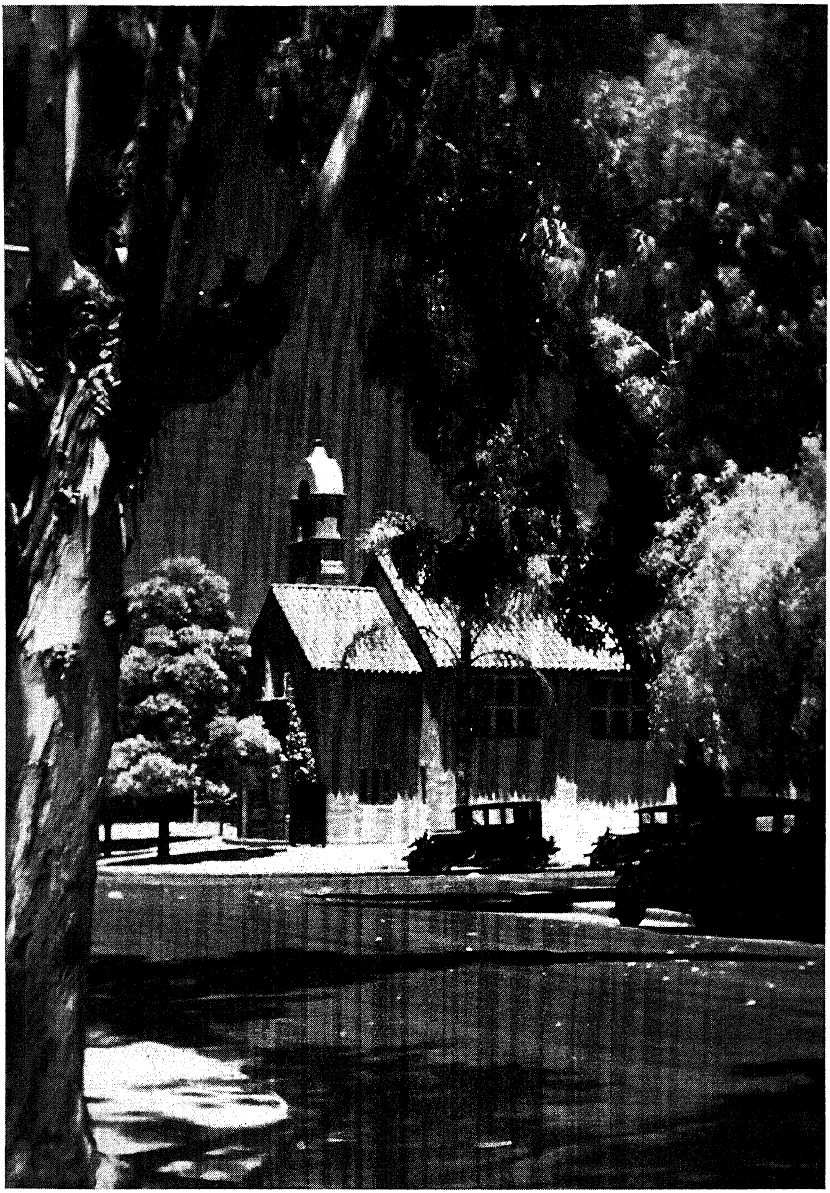
Hektor 50mm lens, 1/20 second at f:2.5. DuPont Infra-D film. F Filter (Note reflection into shadows of upper part of house from roof below) depending on the *wetness* or particle size of the water vapor in the clouds. The only method of determining proper exposures under artificial lighting is by experimenting with the light source used. Under-exposures should be avoided at all times. It is best to always give a full exposure and thus provide a margin of safety for low density development. The resulting negative will show less grain and will possess better shadow detail, although the shadows must depend for their illumination upon reflective surfaces.

Fig. 391 California Landscape — John P. Gaty

Summar 50mm lens, 1/20 second at f:2.2, DuPont, Infra-D film, Wratten F filter (Clouds are not printed in nor retouched. Infra-Red always renders clouds unusually well)

Combinations of gelatin filters can be used for selecting the longer wave lengths of infra-red and the exclusion of most of the extreme visible red. Such combinations could be a No. 29 (F) Wratten gelatin plus either a No. 45H, a No. 46, or any of the C series of blue Wratten gelatines. Study of the absorption curves in the Wratten filter book will suggest other combinations.

A very interesting special application of infra-red to landscape photography is to enlarge the photograph and tone the enlargement blue. If properly composed and toned, the photograph will then show white clouds against a deep blue sky, white trees and grass, and various gray tones for buildings and pavements. The addition of oil coloring to the trees and grass and other parts of the picture will produce a surprisingly good imitation of a natural color photograph. The light tones of the foliage and buildings allow the colors to stand out with a brilliance never found on an ordinary oil tinted photograph where the colors must be laid over fairly dark gray areas. The sky is natural and the clouds possess all the detail that they should, and not the unnatural indefinite appearance found in the



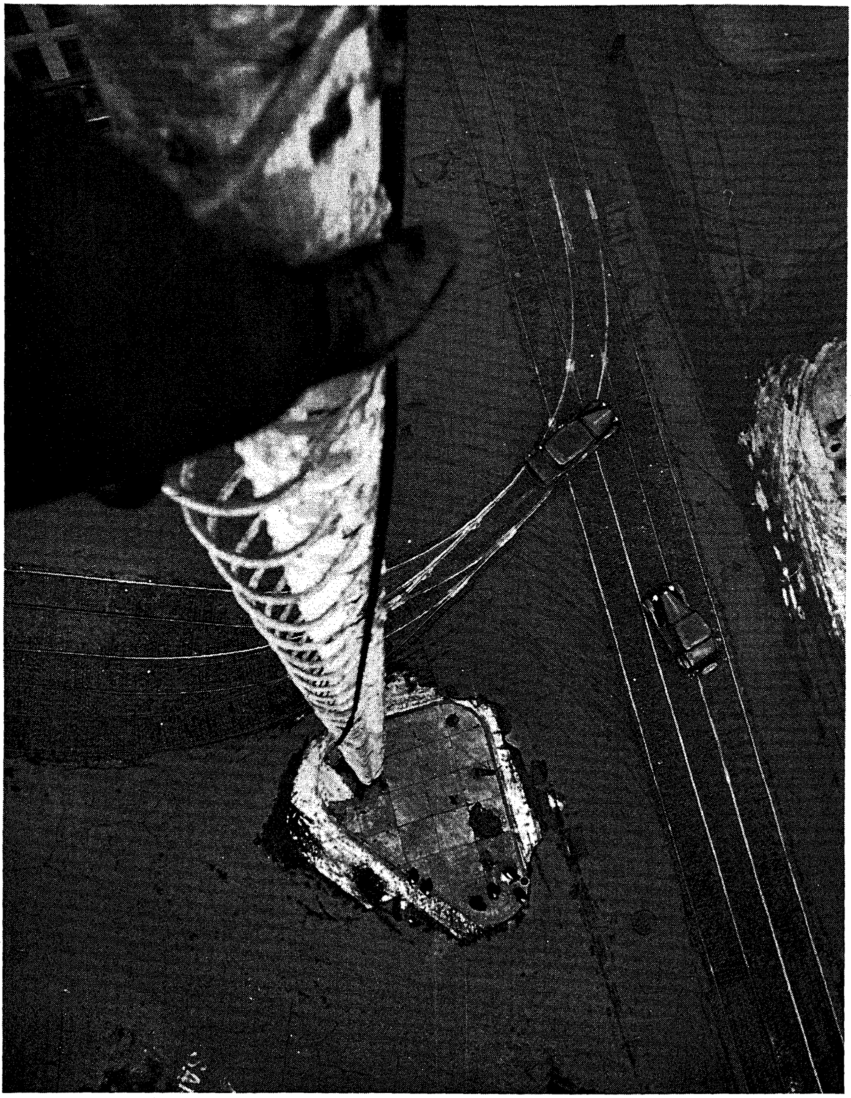
California Church John P. Gaty

Summar 50mm lens, 1/20 second at f:2.3, DuPont Infra-D film, Wratten F filter. (Note shadow detail, aided by reflection from sidewalk) usual tinted photograph. The shadows must be selected carefully in the composition and if not too deep, their bluish tone will add naturalness to the result. The stunt is well worth trying.

If the film is too slow for action photographs it can be speeded up by hypersensitizing by mercury vapor treatment fully described in chapter six. An increase of 50 to 100% in speed can be expected.

It should be stated at this time that some of the effects obtainable with infra-red filters are not confined to film specially sensitized to infra-red rays such as were mentioned before. Any good panchromatic (red sensitive) film will in a greater or lesser degree enable the application of a red filter and sometimes will yield results comparable to those confined to pure infra-red photography.

The field of infra-red photography lies open, with boundless possibilities for original experimentation. There are chances to do serious investigation as well as to produce interesting and striking photographs. They constitute a challenge to the inquisitive and original photographer.



Bird's Eye View J. Winton Lemen

This picture can be classed as a stunt or angle shot, and is good because of the novelty of the viewpoint. It was made from the top of a 225 foot flagpole. The Elmar 35mm lens was used, focused at 30 feet and stopped to f:6.3. In the upper left corner my own legs and feet are seen. The camera was held and shot with one hand only—I was holding on with the other hand

Elmar 35mm, 1/100, f:6.3, Agfa Superpan Courtesy Life Magazine

CANDID, STAGE, AND NEWS PHOTOGRAPHY

J. WINTON LEMEN

CHAPTER 25

CANDID is the biggest word in photography today . . . CANDID is the everlasting cry of editors, photographers and camera makers. Get on the band wagon and make your pictures the CANDID way if you want to keep up with the parade. Candid pictures have invaded every field of photography with the possible exception of Photomicrography. The candid way has so completely invaded the field of news and stage photography that we are covering all three branches under this one heading.

Candid pictures, in the very meaning of the term, are true to life; they are in step with the tempo of our time; they are full of expression, spirit and verve. Their interpretation of life today is of such widespread appeal that candid pictures are sweeping the entire field of topical illustration, magazine covers, society pictures, scientific assignments, and sports jobs. Even the usual carefully posed, lighted and retouched fashion illustrations have succumbed to the lure of the free, natural, and spontaneous style known as candid.

Candid pictures are the end . . . not the means. The subject matter is candid or it is not candid. The camera that makes the negative is not the determining factor. This is somewhat contrary to the claims made by some manufacturers that their camera is a candid camera . . . actually any camera may be used in a candid manner.

Some cameras are eminently suitable for producing this popular type of picture, while others are not. After twelve years' experience photographing with all kinds of equipment, from vantage points as unstable as a 225 foot flag pole and the brink of Niagara Falls, I have been forced to the conclusion that the qualifications for candid photography are compactness, ability to make many photos in rapid succession, the availability of ultra speed and long focus lenses, and range finder focusing. These features come complete only in the miniature camera.

The Sequence Picture

In current demand by the "Press," are pictures in strip form which tell a story in four or more shots giving a time element to still photographs. Photographs of this sort fall into two classes. First, those telling a story over a long period of time; as the eviction of tenants, where we show the arrival of the sheriff, the piling of the furniture on the sidewalk, with a closing picture of the family's complete distress. The second type analyzes a single action; for instance, a handball pitcher winding up, a high jumper or vaulter going over the bar, etc. Here the miniature camera offers the possibility of a large number of shots from which the most effective may be chosen. And with the rapid winder we get the fast action necessary to catch the story-moment . . . that fleeting second when the whole action is dramatized, for instance that split fraction when the ball leaves the pitcher's hand . . . only in cameras of this type can we get the wind-up and delivery of the pitcher. An accident in an auto race only happens once but the editor wants to see why it happened . . . how the driver skidded and where he hit. Get it!

The production of pictures for a daily newspaper and for the syndicates requires the turning out of pictures in the quickest possible time. We must be economical and above all, our quality must be as near perfection as conditions will permit.

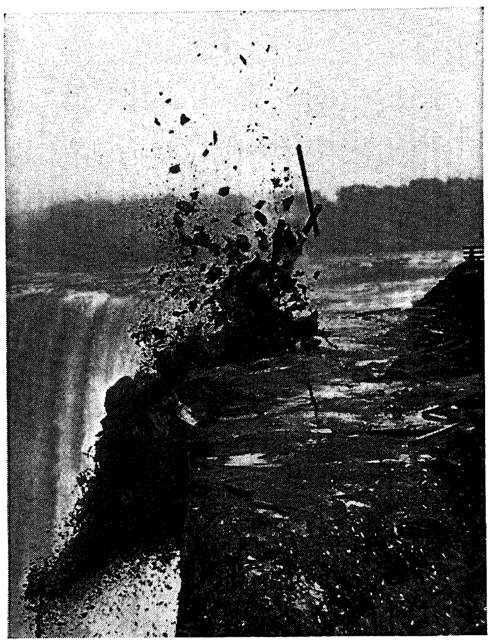


Fig. 394 Blasting at Niagara Falls

J. Winton Lemen

Summar 50mm, 1/1000, f:3.5, Panatomic Film. When making pictures of blasts, don't press the release the instant of the explosion, but wait a fraction of a second until some of the loose material gets into the air

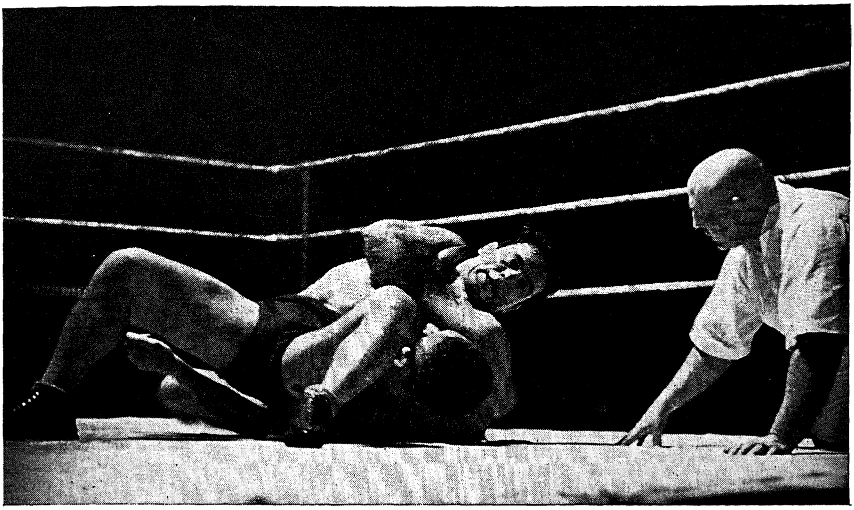


Fig. 395 Jim Londos, world's champion wrestler with head lock on Dick Steele (Pete Sauer) at the Auditorium, Memphis, Tenn. on December 23, 1934, Charlie Pentrop, referee. Photo by Joseph J. Steinmetz
Summar 50mm, 1/20, f:2, Agfa Superpan film

During the past two years, our editors have marked an ever-increasing number of our assignments, "candid pix," or, "use the candid camera." Such notations are not always quite accurate, and cannot always be followed to the letter, because some assignments just aren't the kind where candid pictures can be made—but it means that editors definitely are leaning toward the informal, and unposed-appearing, off-guard photos. Miniature camera pictures taken with fast lenses can present a scene in its natural surroundings, whereas the flashlight photo invariably produces black, empty backgrounds. The fast miniature camera without a photoflash will present the main subject against its real background and in all its rich tonal quality, and thereby depict the scene with its proper depth and perspective.

On the other hand, many of our assignments, as a result of public acceptance of the miniature camera, specifically state: "Use the Leica—flashes not allowed." This brings to mind another thought . . . the photoflash lamp has permitted photographers to enter many places from which they were previously barred, such as hospital wards, weddings, and court proceedings, and other similar events. But even with such improvements, the blinding flash of light is frequently annoying, disturbing, and otherwise out of place at dignified and orderly ceremonies. Yet it is really rare that any objection whatever is raised against the use of the miniature camera without flashlamps . . . more and more frequently this camera is welcomed so that the event may be fully recorded in a pleasing pictorial manner.

Our audiences of newspaper and magazine readers are curious to know what is going on in the world, and just as curious to SEE how these things look. Consequently, candid and truthful photography is highly important today, and is putting camera reporting on an even more accurate and therefore more important basis in the topical press.

My News Photo Technique

My methods of working are not particularly unusual. For the most part, I follow those rules which have been laid down as standard practice, though there are a few short cuts which I have found helpful. These short cuts are not necessarily considered good "form" but are necessary to us who are producing news photos under the pressure of time limitations, and I pass them along for whatever they may be worth to others.

I am a firm believer that the candid or news photographer is not, for the most part, a thief. He should not, excepting under certain conditions, "steal" pictures. Consider your circumstances and the rights of others. Obtain permission to take the pictures you want, but take them while the subject is not especially aware of being photographed.

Don't be a nuisance; don't get in the way any more than is necessary, and don't make a spectacle of yourself . . . you will defeat your own purpose if you attract too much attention. Avoid having cumbersome equipment which looks ludicrous and consequently draws unwanted attention.

At the Office

If you want candid pictures of an individual in his office or home, here is a method that will frequently help you to obtain natural and unposed results: get someone to accompany you, preferably someone known to the subject, to engage him in conversation. Try to get the subject to do a lot of talking by plying him with questions in which he is interested. While the questions are being answered, go ahead and shoot. Change your position to get a variety of angles. At first, the subject will be just a little conscious of the fact that you are shooting him, but I usually have found that after about fifteen exposures have been made, he will relax, and from then on you will get really swell shots. I have followed this method on many occasions and have obtained many fine character-portraying photographs.

Weddings and Churches

In the case of a society wedding, contact the family of the bride, explain what you want. They will usually be so pleased to be able to have the actual ceremony recorded that little further trouble will be encountered. Then, if possible, attend the rehearsal so that you will be familiar with everything that goes on and will be able to locate a suitable spot to shoot from. Sometimes you may find a place at the side of the altar where you will be out of sight; at other times, it may be necessary to be seated in the family pew in the front row of the church. Find out how the families are dressing so that you may dress accordingly and not appear out of place.

Churches are usually so dark that it will be necessary to use the slow speeds of 1/4 to one full second in conjunction with either the f:1.5 or the f:2 lens at full opening and the fastest pan film. This is a case where hypersensitizing (see chapter 6) the film would help to shorten the necessary exposure. Many times you will be able to get some shots during the rehearsal which will suggest correct exposures for the actual ceremony. If possible, use some sort of an inconspicuous tripod so that the camera will be steady. By all means, don't create a scene or make undue noise.

Recently a new Roman Catholic bishop was installed in the local diocese. This ceremony was considered big news and was played up in all the local newspapers. The installation ceremonies attended by nationally-known dignitaries were very colorful. We had to get complete coverage of the procession going into the cathedral as well as a full set of pictures of

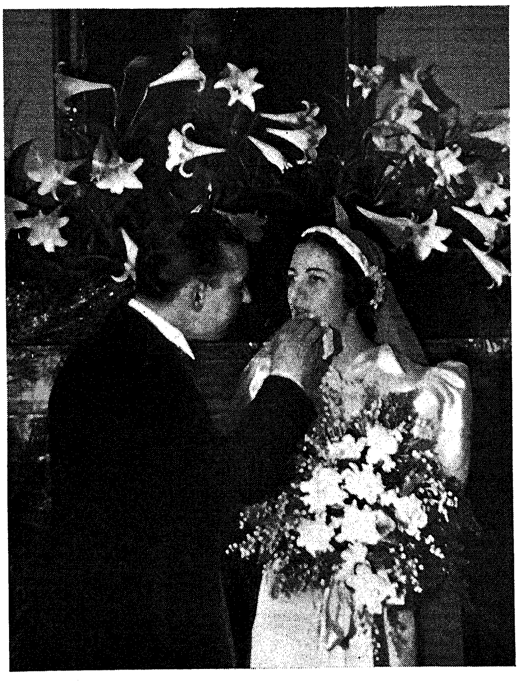


Fig. 396 Wedding Reception

Photo by Morgan Perlette

A candid picture of the groom wiping smeared lipstick from his bride's mouth.

Summar 50mm, 1/4 sec., f:2, Super-X Film, No Artificial Lighting

Fig. 397 Consecration of the Mass J. Winton Leme

Summar 50mm, ¼ sec., f:2.2, Super-X Film

the actual mass and the installation ceremony. Naturally, the outdoor pictures of the procession could be made with any camera, but the pictures of the mass, the celebrities attending, and other highlights were perfect material for the miniature. Because of the importance of the occasion and the tremendous public interest, the news photographers were allowed to shoot a few flashes, but the very nature of the ceremonies made the cameramen use their flashes sparingly. On several occasions a priest specifically requested photographers not to use flashes, but turning to me he would say: "You can go ahead—you have a candid camera!" As a result, I shot four rolls of film and got a much more complete picture story of this historic event for publication in our paper than the opposition was able to get with their larger cameras.

Such important and solemn parts as the "consecration of the mass" were all recorded on my film. The flashlight pictures that were made with larger cameras could not compare with the Leica shots. In the flashlights all the background of the church and beautiful altar were lost in inky blackness where the flash didn't penetrate, while the Leica pictures preserved the rich tonal values from foreground to background and thereby told a more complete and accurate story.

The light in the cathedral was quite dull and my average exposures were ¼ second at about f:2.2. On two occasions, during the "installation" when the principals were moving I had to use a speed flash; it was the only way these particular shots could be secured.

Covering Conventions

Conventions frequently offer great possibilities for true candid pictures. Usually the delegates are very much at ease and while they are listening to the program or looking at the various exhibits you will be able to get many interesting candid shots. Again I should like to repeat that you should work in an unostentatious manner, so that you will not draw undue attention to yourself and thereby defeat your purpose. If you should find that you have been spotted by your subject, move along to another part of the room and work on somebody else, then return to the first subject. You will be repaid for your trouble with good, interesting and natural facial expressions.

Most national organizations have trade publications which would pay quite well for a good set of candids made around the convention. Contact the editor in advance, if possible, and you can be even more certain of a sale for your pictures.

Fig. 398 Mass — J. Winton Lemen

Patrick, Cardinal Hayes, kneeling before the High Altar of St. Joseph's Cathedral, Buffalo, N. Y.

Summar 50mm, ½ sec., f:3.2, Super-X Film

Artificial Illumination

Photoflood lamps can be used very profitably on some occasions. Look over the situation and determine if you need more light; if it can be used without creating a disturbance, go ahead and place your lamp or lamps where they will be most useful. I have found that there are few occasions when flood lamps can be used while making candid photos. Photographing a man in his office, or some similar subject, may, of course, be an exception and then flood lamps can be located to be used in addition to any available daylight. Interesting and brilliant lighting effects frequently result from lights originating at different angles.

I have found good use for a pair of the number 2 flood lamps in reflectors when covering play rehearsals and similar events. Two lamps will give ample light, even in a fairly large place, so that you will be able to shoot fast enough to stop average action.

Fig. 399 Faust — Frank Marshall Moore

Summar 50mm, 1/20, f:2, Super-X Film

Films and Exposures

I have found that the Agfa, DuPont, and Eastman fast pan films are suitable for all candid, stage and general news photography with the miniature camera. We have not used any of the slower fine-grained films for several years because we obtain a sufficient fineness of grain in the ultra speed films to allow us to make clean 16 x 20 or larger glossy prints, and more than that we cannot ask for. We usually need all the speed we can get so we use developers that give full emulsion speed.

The new DuPont Superior film seems particularly good; its speed is certainly as fast, if not a little faster than anything previously available, and the gradation is quite soft, a feature that will be useful when working under trying conditions, and one that will help pick up detail 'way down the scale in the shadows. The Eastman Super-X film works just a little more brilliantly than the Superior and will be useful when this characteristic is desirable. The Agfa Superpan seems to have even more snap than either of the other two, and is slightly finer grained, although it is a trifle slower than the others mentioned.

In candid work you will often find light so dim that a photo-electric exposure meter won't even show a reading. But I highly recommend the use of an exposure meter, such as the Weston, whenever possible. Develop your ability to estimate the exposure, however, because often you may not have the opportunity to use the meter. Sometimes, in dark interiors where the meter will not record the dim light, it is possible to get some idea of the light strength by holding a piece of white paper in your hand and aiming the meter at this paper held a few inches away. If you can get a reading in this manner you will at least know how much light is being reflected from pure white, and you will be able to get some idea of an exposure.

Normally, I hold the meter about six inches away from and pointed at the back of my hand to take a reading; this method seems to be less awkward than poking the meter almost in the face of the subject. However, your hand should be illuminated in the same manner as the face of the subject.

Fig. 400 Actual Stage Performance Photograph

Summar 50mm, 1/30, f:2.2, Agfa Superpan

Fig. 401 Fiddles—Please *(left)*
J. Winton Lemen

The two photoflood lamps used on this picture were too close to the camera to give any modeling to the lighting, but nevertheless the pose and expression of the subject made an excellent candid picture. Photograph made during a symphony rehearsal. Conductor Lajos Shuk.

Summar 50mm, 1/100, f:3.2, Super-X Film

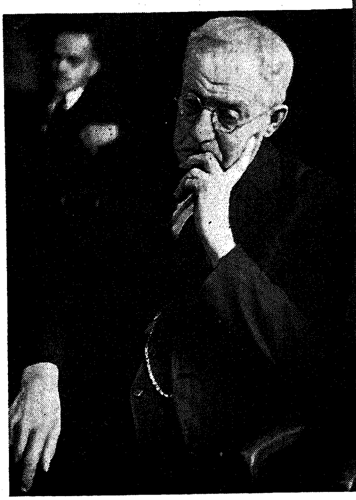


Fig. 401a Courtroom Scene *(lower left)* Mark Palmer

A remarkable candid study made under difficult courtroom conditions.
Summar 50mm, 1/20, f:2, Super-X Film

Fig. 402 City Councilman *(top right)* J. Winton Lemen

This action shot taken during a debate was made by the natural lighting within the City Council Chambers. Summar 50mm, 1/20, f:2, Super-X Film

Fig. 403 Charity Director *(lower right)* J. Winton Lemen

A "candid interview" picture of Rev. William Meegan, Director of Catholic Charities.
Summar 50mm, 1/30, f:2.8, DuPont Superior Film, Photoflood lamp in ceiling fixture

Film Development

The developer we use is one known as a compromise type and contains paraphenylene-diamine, glycin, metol and sulphite. The formula for this developer can be found on page 146 of this volume. I prepare the developer with distilled water, a gallon at a time, Usually it is mixed six weeks to two months before it is used. For development, I keep a 32 ounce bottle composed of 8 ounces of used developer and 24 ounces of fresh developer, mixed and filtered through cotton into the 32 ounce bottle. This 32 ounces is used on the average for developing five or six and never more than seven full rolls of film, then a new batch is mixed. Finer grain can be attained after several rolls have been developed, but even with an increase in development time, we seem to loose some of the finer shadow details so I do not overwork the developer.

Another consideration with us is speed and any prolonged development time works to our disadvantage. I find that with a fresh bottle of developer an average time of 16 minutes at 65 degrees gives a negative of normal density on the high speed pan films and all the contrast I want. The average negatives from this development will enlarge nicely on medium papers, thus saving the harder papers for poor or flat negatives. Speaking of short-cuts, here is one: our developer, rinse, and fixing solutions are filtered only once rather than each time used and that is at the time that the fresh 32 ounce bottle is mixed. I don't necessarily recommend this as the best practice, but I have never noticed any spotted or marked negatives or other bad effects from following this time-saving step.

A chrome alum and bisulphite rinse, formula on page 149, is used between developing and fixing. We consider the use of this rinse indispensable. This solution is mixed fresh every day and 32 ounces seems to work satisfactorily on six to ten rolls of film. The fixing bath is the usual Eastman F-5 formula (see page 149) and 32 ounces of this fixer will do a good job on five or six rolls of film. I throw away the fixer and renew it just as soon as its action appears to be slowing up.

Speed Gained by Enlarging Wet Films

Naturally, time saving and speed are important in news photography: frequently the film is washed only for one minute after it is fixed, then its surface is dried with a viscose sponge, and if time permits, is hung in the breeze of a fan for about two minutes, then directly into the enlarger.

Here is a place where the simplicity of design of the Valoy or Focomat enlarger will be fully appreciated. The wet film can be handled almost the same as though it were dry, and can be inserted in the enlarger with the emulsion side down as usual, or, if reversed prints are required, as they frequently are in a newspaper plant to save time in the engraving department, insert the film with the emulsion side upward against the condenser lens.

There is no need, when using the Valoy Enlarger, to go to the trouble or the mess of making glycerine sandwiches (the method of placing a film covered with glycerine between two glass plates) when you want to print from the wet film. The prints made from wet film in the manner I have described are much cleaner than the glycerine method, and certainly less trouble to make. Naturally, you must work quickly, not keep the light on too long when focusing, so that the enlarger head and condenser won't get too hot and injure the film. Rarely have I damaged a film by this method. The Valoy lamphouse is well ventilated, and on many occasions I have printed as many as a dozen different negatives in rapid succession without overheating the enlarger to the point of damaging the wet negatives.

Printing and developing by this method will turn out finished enlargements in about thirty minutes from the time you reach the dark room.

We have found that the Valoy with the regular 75-watt Nitra opal lamp gives ample printing speed even for 11 x 14 and 16 x 20 inch enlargements. Our enlarger is fitted with a 120cm upright column and an offset arm. This latter accessory is the only one that we have found necessary. A bolt fastens the baseboard of the enlarger to the bench, and the extreme top of the column is braced to the wall to help eliminate any possible vibration, particularly when the enlarger head is placed high up on the column.

With the 120cm upright and the offset arm which gives a little additional height we are able to make enlargements 26 x 39 inches with the regular 50mm enlarging lens. Of course, we don't use paper larger than 16 x 20 for our prints, but we do often want a small portion of the negative blown up to 16 x 20 and this equipment allows us to do this easily.

Glossy paper is almost universally used when making prints for reproduction. I make use of two brands of bromide paper in order to get five varying degrees of contrast. I have found Eastman News Bromide, Normal, to have the softest emulsion of any bromide paper that I have tried, so I use this grade in conjunction with the four regular grades of Agfa Brovira. The Brovira Extra Hard is a paper of extreme contrast and will yield prints from many a negative that really looks hopeless. I find it to be very convenient to have five grades of paper to choose from. It makes it possible to produce a set of evenly balanced prints even though the negatives may have been made under varying conditions. Naturally, we aim to develop most of our negatives to fit either the soft or medium Brovira leaving the other degrees of contrast to take care of the negatives which are either too contrasty or too flat.

Film Development Enroute

Another short cut that I have found to be quite a time saver is developing and fixing the film enroute from the assignment to the office. This can only be done, of course, when you are prepared in advance, but it does save many minutes. It is useful anytime when your assignment is at least 25 or 30 minutes away from the dark room.

I have a small case in which I put a Reelo tank, a changing bag, and three one-pint size vacuum bottles. Before leaving the dark room I fill the three bottles with developer, rinse, and hypo, all at proper temperature; a few degrees warmer in cold weather and a few degrees cooler in hot weather. Then when I have finished making the pictures I open out the changing bag on the shelf in the trunk of my car or any other convenient place, transfer the film to the reel, close the tank and take it out of the changing bag.

Then . . . in goes the developer which has been keep at approximately correct temperature in the vacuum bottle; a couple of shakes and the tank goes on the floor of the auto as I drive to the office. Occasional hand agitation along with the rocking motion of the machine produces very evenly developed negatives in normal time. When the time is up I pull over to the curb, pour the developer off, pour the rinse in, let this stand a minute or two, drain it off and pour the fixing solution in. Then I continue to the office, and the rush film will be ready for a quick wash as soon as I arrive and then into the enlarger. Usually, finished enlargements can be ready within seven to ten minutes from the time I reach the office . . . much greater speed than could be ordinarily expected.

The Miniature Camera in the Courtroom

Courtroom photography will call for a considerable amount of cleverness on the part of the photographer, particularly when the subjects are unwilling, or when the judge has issued orders that no photos are to be made. In either case it will be well to go into the courtroom with the Leica in your pocket or suspended by the neck strap beneath your coat under the pit of your arm. You may or may not be able to use the range finder to check the focus, because to do so might disclose you to the subjects or the court officers. If you can't use the range finder then you will have to estimate the distance to the subject. Exposure also may have to be estimated . . . shoot at as high speed as the light will allow.

Courtroom exposures will vary all the way from ½ to 1/60 second at f:2. You may have to keep the camera resting in your lap—hidden under your hat until just the moment when everyone is interested in the proceedings, and then carefully raise your hat enough to uncover the lens, trip the shutter and hope that your lens was pointed in approximately the right direction to get the subject on the negative without cutting off his or her head, or something equally bad. Just about this time you will be very thankful that your Leica shutter is very quiet. Even as quiet as the shutter is, it will probably sound like a trip hammer to you under these conditions.

If you get away with the first shot alright, then, keeping the camera concealed as well as possible, try to make a duplicate or two as

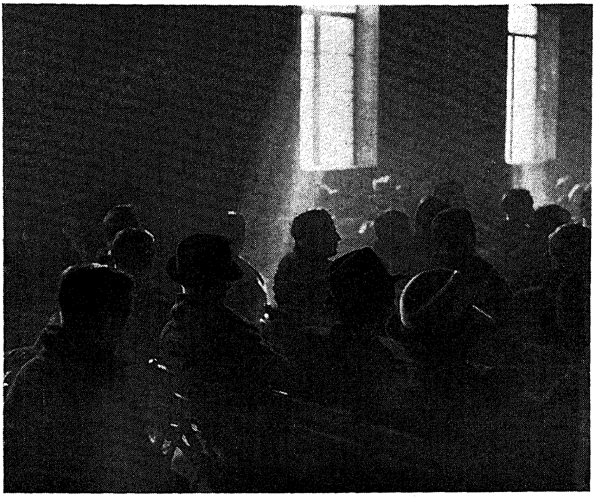


Fig. 404 Strikers Meeting
by J. Winton Lemen
The sun rays streaming through the smoke filled atmosphere lends a pictorial quality to this otherwise ordinary picture

Summar 50mm, 1/20, f:3.2. Super-X Film

a matter of protection against subject or camera movement and incorrect focus. Sometimes courtroom pictures are somewhat simpler to get than this, but it will always pay you to know how to get them the hard way if it really becomes necessary.

Where to Find Picture Subjects

Candid possibilities will really be found all around you, but some of the outstanding opportunities for good candid pictures will be found in club gatherings, theater stages and dressing rooms, night clubs, school functions, street cars, department stores, busses, trains, railroad stations, boxing and wrestling bouts, other form of athletic contests such as baseball, football, tennis, the zoo, the city council meeting, in fact any place where people gather, where things are doing or where history is being made. One thing to remember is that frequently the main action of an event will not provide you with your best pictures. More often the best shots will be made of the people on the sidelines, those watching and getting excited or falling asleep or being amazed or thrilled.

The candid photographer in school will find excellent material in graduations, registrations, class shots, in the library, at dances, play rehearsals, locker rooms, gym classes, club, fraternity meetings and all such similar events. Always try to get pictures of the spectators too . . . they furnish the really interesting shots that will make your set of pictures of the event complete.

Department stores, particularly during the holiday season, will give you a lot of excellent material. The shoppers looking at the merchandise, the kids with their rapt expressions watching the electric trains, talking to Santa Claus; the tired shop girls, the floor men and maybe youngsters pressing their faces against the toy display windows. Usually department stores have quite uniform illumination, bright enough for about 1/8 second exposure at f:2.

At athletic contests of all sorts, the spectators' faces showing excitement, pleasure, thrills, disgust will make many good candid shots. At wrestling and boxing matches, if you are down front near the ringside, you can get both the spectators and some shots of the battle of the century or whatever it may be. If you can "chisel" a working press ticket from one of the newspapers you will be in the press row and then you will be able to get real closeups of the expressions on the faces of the fighters, and don't forget to get a shot or two of the seconds as they are cheering and giving instructions from the corner of the ring. Most rings are well enough lighted so that you can shoot action at 1/60 or faster at f:2. Some rings in bigger cities are lighted well enough to shoot as fast as 1/200 at f:2.

When you are looking for candid material don't forget the kids at the zoo, and their parents too. Expressions on the young and old will be quite a study in contrasts. Speaking of the zoo brings to mind the circus, and remember, that lots of oldsters are just as interesting subjects as the kids are. Shots of the performers can easily be made from most any seat under the "big top."

Then, the politicians, or city fathers, at the city council meeting will make excellent subjects if you can get a seat somewhere near to the member who is most likely to blow up . . . get the camera set and wait for him to blow off then start to crank the old camera for a set of good action candids.

Big Personalities: while doing something out of ordinary, or during their off-guard moments.

Major Catastrophies: train wrecks, airplane crashes, building explosions where a loss of life occurs, shipwrecks, fires and other similar types

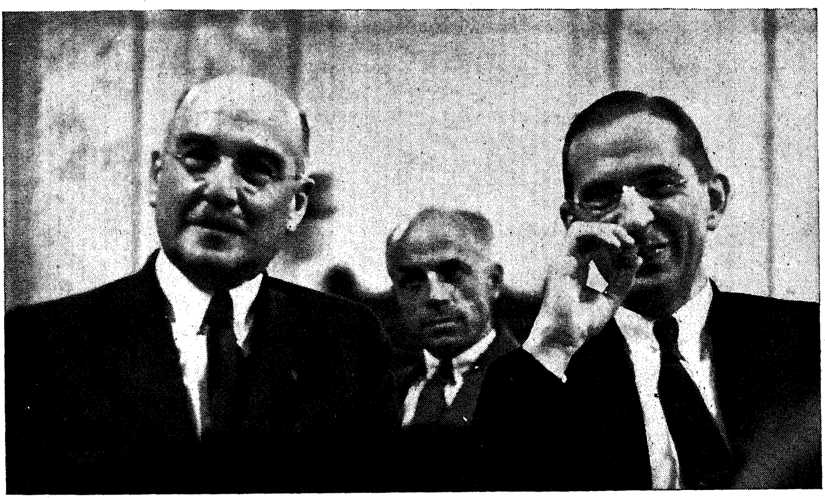


Fig. 405 Pierre and Lamont DuPont at the Senate Munitions Hearing. Photograph by Thos. D. McAvoy, Summar 50mm lens at f:2.2, DuPont Superior film

of tragedies. Concerning fires and auto accidents: most of them aren't even worth opening up your camera, unless they are quite out of the ordinary. A fire, unless there is a considerable volume of smoke, or a lot of flames which will show in your negative, is usually quite worthless from the standpoint of a newspicture.

Auto accidents are usually worth only about a dime a dozen, unless you are right on the spot in time to get the car or cars in the exact position where the accident occurred, and then only if the cars show considerable damage or are in an unusual position, as on their top or side, or hanging over the edge of a bridge, or some similar position.

Acts of God: tornadoes, floods, earthquakes are always in great demand by the press.

Violence: strikes with their attending riots; murders, particularly those arising from sex motive, and other like types are much in demand by the press of today.

Action: most any type of action picture, provided that it is unusual, is quite acceptable to the editors in general. It is worth considerably more if the subject is one that is "in the news."

Speed is most essential in the delivery of prints to editors. Just remember that a picture which is **"Spot News"** today is only **"History"** tomorrow. Use the fastest means of submitting pictures to editors if you wish to make a sale. When possible use the air mail, special delivery; or air express which is even faster than air mail.

Print Quality desired for reproduction by either the halftone or the rotogravure process is not what you have always heard about. Many editors, and even some photo-engravers will tell you that they want contrasty, black and white prints—this is not so.

Make your prints clean and brilliant, but not contrasty. Make them with a nice even, full scale of tones ranging from deep black, which should not be "inky" to the pure highlight, which should not give a "whitewash" effect. Remember that a photo-engraver can't put detail into a print that isn't there. By this, I don't intend to infer that your prints should be soft and mushy.

Stage and Action Photography

Theatre and stage photography offer many opportunities for interesting photos. Theatrical photography can be a most fascinating hobby or a profitable sideline for many an amateur. Many lovers of the theater will want to capture the high spots of their favorite plays or actors for their own albums, and for the sheer pleasure of making these interesting pictures under the somewhat difficult conditions encountered with action and stage lighting. Others of you may want to commercialize this new aspect of candid photography and sell your pictures to the local newspapers, national magazines, or to the performers themselves. A number of theaters in the metropolitan sections are using candid pictures exclusively for lobby display rather than the stiffly posed studio still pictures previously used for lack of anything better.

The stage of an average good motion picture theater where stage shows and revues are presented is usually well lighted. The footlight illumination bolstered up by the light from the high intensity arc spotlights in the booth above will usually allow you to make exposures as fast as 1/200 second at f:2 when all the white lights are on. Even pale pink and yellow lights don't materially slow up the light. Other colors such as greens, reds, blues may require you to shoot as slow as 1/40 second.

Best position for photographing this type of stage performance is usually from the front row just a little off center so that you will not be working with all the light directly in back of you, but will get just a little shadow relief which will give character and modeling to your picture. One difficulty encountered in this type of stage photography is a featured player in a brilliant spot and the other actors less brilliantly illuminated. The alternative under the circumstances is either to sacrifice completely the secondary players and shoot fast enough to get correct exposure on the principal actor, or to compromise on the exposure and allow the bright part to be almost over-exposed, then correct the balance of the negative by local control in printing.

Fig. 406 Katharine Cornell in "St. Joan" J. Winton Lemen
Summar 50mm, 1/20, f:2, Super-X Film

Along this same line, because stage lighting is usually very contrasty, figure to give your negatives only normal development, because to prolong development will usually increase the contrast so much as to make the negatives practically useless.

The legitimate stage, where dramas are offered, is for the most part poorly lighted as compared with the vaudeville stage. However, even here you will usually find enough light on the average to shoot at 1/20 to 1/30 with the lens at f:2. Variations in the lighting will vary your exposures all the way from ¼ second to 1/40 second. The best location will depend upon the layout of the theater. I have found that either a front row seat to one side of the center, or an upper front box seat are excellent locations to shoot from.

When you find it necessary to shoot at slow speeds, be sure to brace

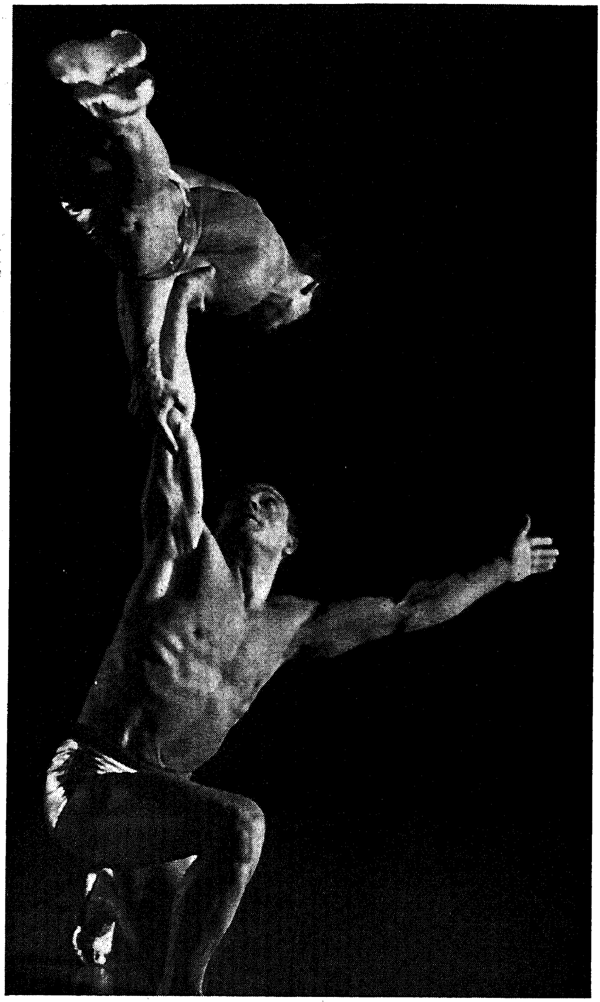


Fig. 407 Candid Camera Night at College Inn

by Frank Marshall Moore

Summar 50mm, 1/40, f:2.2, Super-X

your elbows on the arm rests of the seat so that the camera will be steady. Watch for those momentary pauses in the action of the play before you shoot, thereby giving yourself a higher percentage of good negatives. Be sure to shoot enough film, because there will be many negatives spoiled by movement. Always take an extra magazine or two of film along . . . chances are that you will need it before the second act is over.

Night clubs are usually poorly illuminated. The floor show will probably be lighted brightly enough so that you can get some action shots, but the cash customers at the tables will often present a problem because of the dim illumination. Sometimes the flare of a match lighting a cigarette will help a lot and you can get a shot of the faces close by at ¼ or ⅛ second at f:2.

Interesting night club shots can often be taken at the bar . . . but be careful who you shoot, the wrong husband might be out with the wrong wife or some such embarrassing situation.

Some night take a ride around town on some of the owl cars, you will be repaid with a series of good candid pictures of late workers, stay-outs, and similar characters. Exposures will vary from ⅛ to 1/20 at f:2.

Equipment Recommended

The equipment that I would recommend for these three closely allied branches of miniature photography would be a Model F or Model G Leica, preferably the Model G because it has the fastest and quietest shutter. Remember, though, that most of the time the slow speeds will be of more use to you than the fast speeds. For the tough spots and for all general work choose either the Xenon f:1.5 lens or the Summar f:2 lens; both are excellent 50mm focus lenses and will be the backbone of your lens equipment.

A wide angle lens such as the 35mm will find a lot of use for getting angle shots and for work in crowded quarters. Choose one or more of the telephotos to complete your battery of lenses. The 73mm Hektor is a great lens for stage and for a lot of candid work where speed is essential and yet you can't approach your subject as closely as you would like to. A general purpose telephoto is the Hektor 135mm. This lens cuts the distance to your subject about two-thirds and is a fine lens for bridging long gaps of space, as well as getting sports pictures and candid closeups from about a distance of 20 feet.

Include a Vidom View Finder and a sport finder—you will find many uses for both, but if you must confine yourself to one, then make it the Vidom. Also the Angle View Finder will be handy on occasions when taking candid pictures where the camera is held at right angles. Don't neglect to add a good substantial tripod to your equipment, you can use it on many occasions. Intelligent use of a tripod will raise the average of your good negatives considerably. Choose a tripod that is compact, rigid and high enough so that it is near eye-level when fully extended. A built-in tilting and panorama head is a decided convenience on the tripod and well worth the investment.

Standardizing Your Methods

One important thing that will help you materially toward getting first-class results with your camera is to standardize on one film, one developer and one kind of printing paper. Let the laboratories and the experts do most of the proving with emulsions and chemicals.

When you start, use one type film until you are thoroughly familiar with the possibilities of that particular emulsion . . . then, and only then, should you try a different type; and when you do, make a comparative test between the film you have been using and the newer type you are trying out.

Make identical exposures on both films of various type subjects, such as open landscapes, scenes in bright sunshine, portraits in the sun and the shade and some shots under artificial light. Also be sure to make some known over-and under-exposures on each film. Then develop each film correctly in the same type of developer (if they both have the same development speed you can develop them simultaneously by putting them back to back in the Reelo tank) then you will be certain that each has had identical processing. After the films have dried you can inspect them visually for differences of contrast and speed. But don't make your final judgment on a visual inspection alone—choose a couple of average negatives from each film, and put them in the enlarger. Push the lamphousing up near the top of the column so that you will be getting at least a 10 to 15 diameter enlargement. Then make prints of each of the selected negatives on the same grade of paper. From this test you will be able to more accurately judge speed, contrast, and grain size of the two films and consequently you will be able to make a choice as to which film gives you the quality that you most desire.

If you want to test a developer, do it in much the same way I have described for film. However, in this case it will only be necessary to expose one roll of film. Make a series of similar exposures the entire length of the film. Then, in the dark room, you can cut the film in half and develop one piece in your regular developer and the other piece in the developer you are testing. Again make both the visual and enlarging tests and you will certainly be able to arrive at a correct conclusion as to which developer gives the greater density or the smaller grain or any other feature you might find desirable.

Once you have made comparative tests of this sort on different films and different developers you will be better able to choose the combination that exactly fits your needs, and also when you have occasional special requirements you will know from this experience just what materials will do the job best.

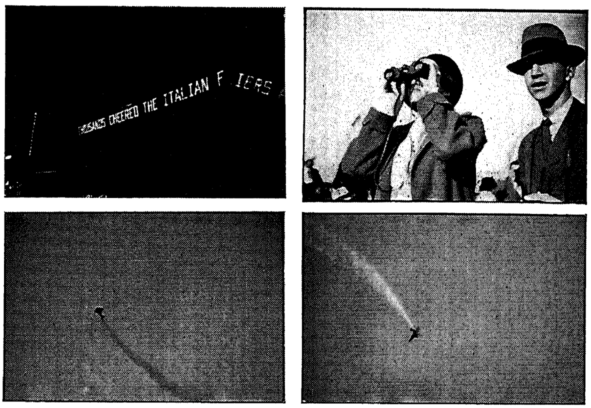
Hypersensitizing is often useful for either candid, news or stage photography. You will find full instructions on various processes in another part of this manual, (see page 159). At the present moment the Agfa method of mercury vapor hypersensitizing seems to offer great possibilities. Strangely enough, this new method seems to take us back to the first principles of photography. You probably know that the first method of development of a latent image as discovered by Daguerre was by the vapor given off from mercury.

Be methodical, know your camera and its accessories, use a photoelectric type exposure meter whenever you can, learn to depend on one type

Fig. 408 Kompa Sisters Willard D. Morgan
Summar 50mm, 1/500, f:3.5, Dupont Superior film

of film (don't overburden yourself with too many films, solution, or useless accessories), and **work quietly**—now go out and get some candid pictures; there are possibilities all around you right now.

The modern miniature camera with its agility, its speedy lenses, the emulsion makers with their fast films, and the chemical manufacturers with their fine grain developing solutions have all opened up the way to the new day of candid pictures. Without such an ideal combination, candid pictures would be, for the most part, beyond the ability of the average man. We, of course, still have much to hope for and to expect from the research chemists, for it is from their laboratories that our faster emulsions and finer grain chemicals will come; and as they do, newer fields will continue to open up before the eye of our Leica.



The Fliers
A Four-Negative Photo-Montage

John T. Moss, Jr.

AERIAL PHOTOGRAPHY

JOHN P. GATY

CHAPTER 26

Aerial photography is one of the most fascinating of all the many and varied branches of the art. It permits the capture of scenes of grandeur and beauty observed only by the airman, and their preservation to the end that they may delight his friends and acquaintances. Whether or not those who view the result are airminded, it will be found that aerial photographs possess interest for almost everyone. To the timid, they offer a glimpse of the aerial world denied them by their timidity. Others will look upon them with longing and recall memories of similar scenes witnessed for some brief moment in the past; or will project their imaginations forward to the day when they also will leave the earth below and take to the aerial heights.

This universal interest is heightened if the photographer selects his subjects with an eye to the dramatic and impressive effects that are recurrently produced by the forces of the atmosphere. With Nature's moods constantly changing, and with the vast expanses of far flung vistas of land, sea, mountains, and sky as his subject matter, it would be a dull photographer indeed who did not respond with his best efforts. The resulting print may carry the menace and threat of the towering black and silver ramparts of a thunderstorm as it sweeps down on the diminutive homes of a city, or it may render the light and gay mood of a cloud feathered summer sky above a peaceful countryside. The opportunities for expression exist in abundant measure.

The aerial photographer soon discovers an interesting peculiarity about his work, in that his photographs always show more details than his eye can grasp at the moment of exposure. He thus finds out many interesting facts about apparently familiar territory. On cross country trips by air, a series of photographs will record more than the unaided memory. Before the human eye can possibly scan an entire vista for small details and compare the relationship of all objects to each other, the airplane has moved on to an entirely new location. But the camera possesses the ability to record everything within its field of coverage instantly and preserve it for leisured study. Even local areas reveal surprising facts to those who are apparently perfectly familiar with them, when photographed from the air.

The Leica camera possesses an important advantage for aerial use in that a single turn of the winding knob sets the shutter and simultaneously changes the film. This feature is very desirable; especially when a quick series of exposures must be made while flying over an objective. All professional and military aerial cameras of the highest class are equipped with similar winding arrangements for hand operation, even when their principal function is that of fully automatic electric operation.

Aerial Compared to Ground Photography

Successful and interesting air views demand a somewhat different technique from that required for ground pictorial photography. Less opportunity is presented for study of the subject and careful selection of a camera location with reference to the objects to be photographed. The ground photographer can select his viewpoint and putter around while weighing the balance of his composition in the finder or ground glass, and after several changes and

Fig. 410 A Summer Storm over the Catskills — John P. Gaty
Altitude 1200 feet, Elmar 50mm, 1/200, f:4, No. 2 Filter, DuPont Pan Film

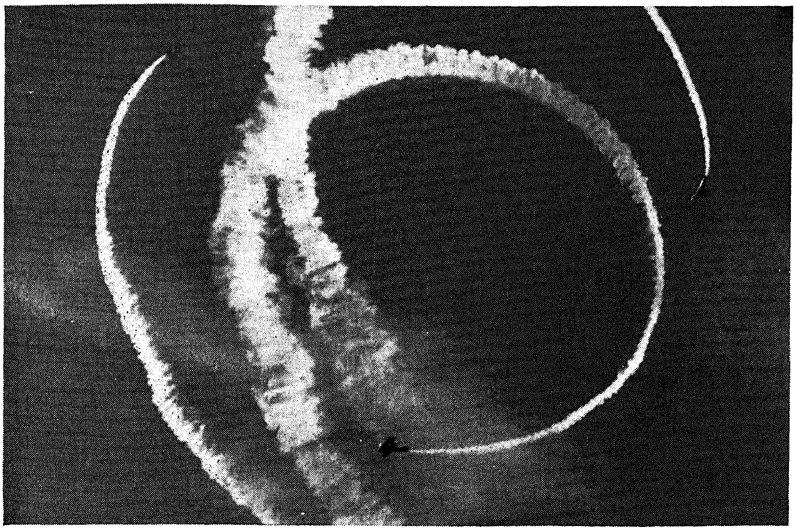


Fig. 411 Sky Writers Clarence Slifer
Elmar 90mm, 1/500, f:4.5, DuPont Superior film

prolonged cogitation decide not to take the picture at all! The aerial photographer actually must anticipate his composition and expose it at the split second that it is best. There is no time for prolonged decisions. At a speed of one hundred miles or more per hour, the opportunity is almost fantastically short.

Another advantage possessed by the ground photographer is the presence of foreground objects of appropriate nature to aid in balancing the composition. The aerial photographer usually is deprived of these, because the only near objects ordinarily are the parts comprising the structure of his own airplane. It is most unusual to find such things an aid to composition, for they are seldom in sharp focus and almost always angular and intrusive into the frame line. Even if they happened to add to the composition pattern, there is the unfavorable factor of great separation of image planes between the structural objects and the nearest objects on the grounds. There is no possibility of gradually leading the observer's eye into the distance by a succession of gradually removed planes, hence his reaction to the abrupt mental jump from near object to the ground is unpleasant. This effect is decreased if the airplane is flying at low altitudes or just over a cloudbank. Every rule has its exceptions and in certain cases some advantage may be gained from including part of the airplane in the view. For the ordinary picture the photographer must form his composition from patterns on the ground and in the sky, using large masses for the high altitude views; and buildings, fields, roads, rivers, or what not for the low altitude views.

Leica As a Profitable Aerial Camera

Those who wish to put their aerial photography on a self-supporting or profitable basis must remember that quality is the touchstone of success in this field. While there is a certain limited market for conventional stereotyped airviews, lacking composition and originality, the sales effort necessary in the disposal of this type of product is at least disheartening. Those photographers who possess imagination and good judgment will find a ready market for their air views, providing that the technical details of developing and enlarging are given the same careful consideration as their camera work.

Scientific, topographic, and mapping aerial photography are highly specialized arts which require long training and intricate cameras and apparatus. The only type of aerial photography to be considered here is "oblique photography". In aerial parlance, an "oblique" photograph is one made by a camera pointing to-

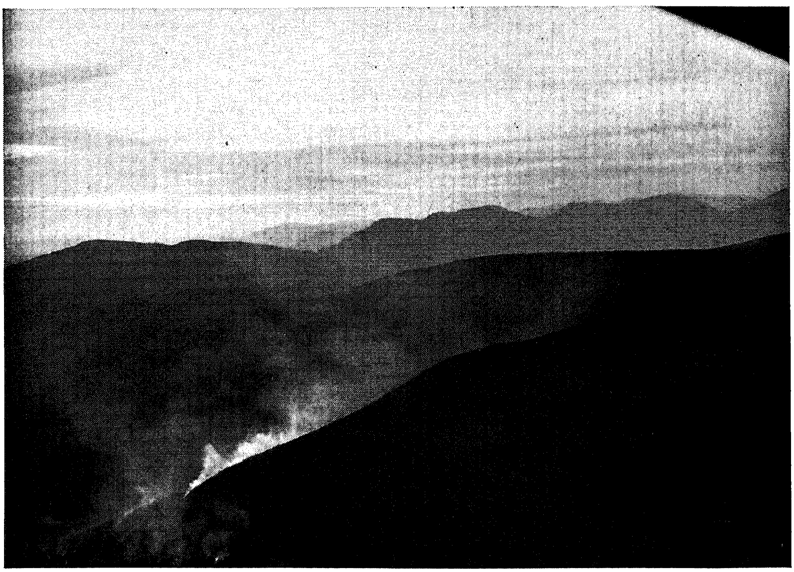


Fig. 412 Fire on the Ridges — John P. Gaty

Altitude 5500 feet, Elmar 50mm lens, 1/200 second at f:4, No. 2 Leitz Filter, DuPont Special Panchromatic film. In this case aerial haze proved desirable; its presence proved to produce the separation of perspective between the ridges wards the ground, at some angle substantially less than a right angle to the horizontal plane. Photographs made in this manner are often termed "air views". They satisfy the greatest part of the market demand available to the independent aerial photographer. Their viewpoint is readily understood by the layman, while that of the vertical photograph is often confusing to the uninitiated.

The best market for air views is to be found among owners of estates, farms, and homes. These properties usually constitute one of the most important interests in the lives of the owners. An aerial photograph showing in an attractive manner the carefully planned details of an estate is a very desirable and tempting thing to the owner. It represents a new means of explaining to others his methods and plans for developing the estate, and actually is the sole method by which the entire property can be visualized at once. The same considerations apply to the farmer, except that his interest has more of a business nature and his planning is more utilitarian than esthetic. Both classes share the feeling of pride of possession and accomplishment. For this reason they are particularly receptive to approach by the aerial photographer.

Contacts with home owners lead naturally to industrial aerial photographic opportunities. By carefully building up his clientele, the enterprising photographer will receive offers of contracts to photograph factories, colleges or institutions, resorts, real estate developments, and other subjects. Local newspaper editors should be shown sample photographs of scenes of interest in the neighborhood. If striking or unusual treatment is evident it is likely that a sale will be made. The editor should be advised that future work will be submitted for his inspection.

Starting Your Own Aerial Photo Business

When starting in business, the aerial photographer first should make a ground survey of likely subjects. Careful study must be given to each to determine the favorable photographic angles and the type of lighting that will be most helpful. As the position of the sun changes in the sky the lighting will change from side to side or from back to front, and the angle of lighting will vary. After noting all pertinent photographic facts the photographer should find out something about the owner, for future reference. Out of these first subjects, he should select a few in the same vicinity and take his Leica into the air and photograph them, at the time of day previously selected. Several trips should be made, if necessary, to get the proper lighting. The next step is to develop the films and carefully make enlargements of the good frames. These enlargements constitute the samples that are to be shown to prospects and no effort should be spared to make them perfect. If some of the negatives are blurred it is best to reject them and try again. A group should be made up for each owner and submitted to him for inspection. A fair price should be set on the prints and cheerfully maintained in the face of smaller offers. The owner realizes that the photographer has no other market for these samples and naturally attempts to secure them at a low figure. However, enough sales ordinarily will be made at the selected price to cover the initial costs incurred in setting up a book of samples.

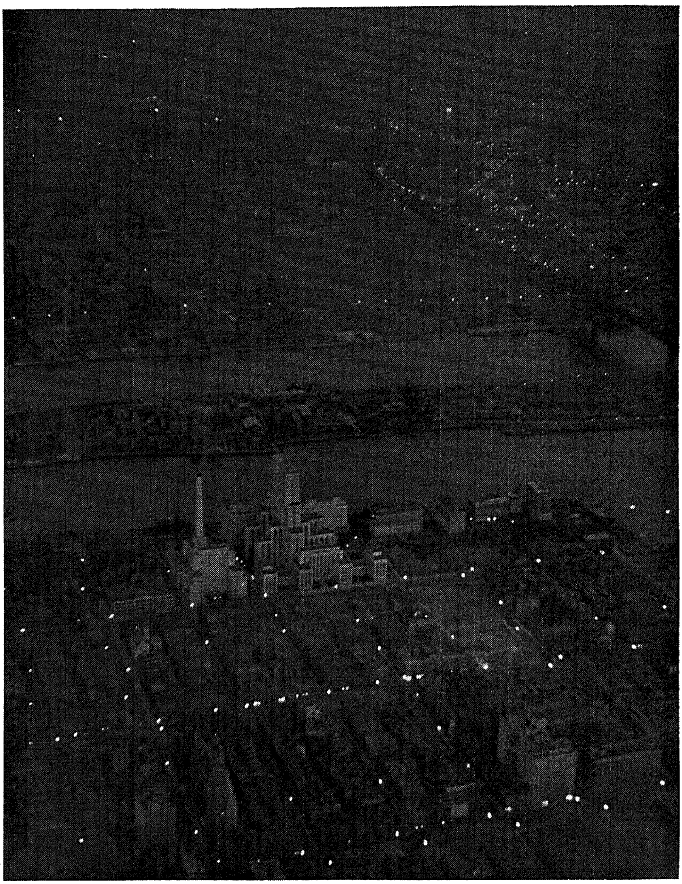


Fig. 413 Nightfall — John P. Gaty

Taken 40 minutes after sunset, midsummer. Altitude 2000 feet. Summar 50mm, 1/20. f:2.3. DuPont Superior Film.

Further sales should be made on a contingency basis. The owners of properties selected as subjects should be approached and shown the book of samples depicting the properties of their neighbors. Unique or interesting features of the property of the "prospect" should be discussed and commented upon with regard to their appearance from the air. The photographer should offer to make air views of the property for an agreed price, to be paid only if the owner is satisfied after inspection of the finished prints. If he is not fully pleased with the results it is fully understood that he owes the photographer nothing, incurs no future obligation, and obtains no pictures. The photographer rarely loses a sale made on this basis, as the owner is filled with anticipation for the air views and usually has made up his mind to pay for them at the agreed price. Each photographer must determine for himself what his costs are and how high he can profitably set his prices. A price schedule in the lower-middle range would be as follows:

Local photographs (one customer)

2 different air views	$20.00
4 " " "	$30.00
6 " " "	$35.00
Reprints of any air view	$ 2.50 each.

These prices are based on economical flying costs and short distances from the base to the objectives. The costs of long flights should be added to the usual prices set up to cover local customers. Once established, the price structure must be rigidly maintained to all customers in the same vicinity.

Customers should be followed up occasionally, as they may have shown their air views to friends who wish similar work done, or they may wish air views made of seasonal crops or vegetation. Sometimes they require new views with a change of season. A satisfied customer is always acting as a salesman for the photographer, and may often produce considerable business of an unexpected nature.

Many Leica owners may wish to make aerial photographs to present to their friends as gifts during the holiday season. Such air views are a source of pleasure to both the photographer and the recipient. General aerial scenes of a striking nature are prized by almost everyone, and views showing the homes of the photographer's friends are greatly appreciated by the owners. Enlargements intended for this purpose should be finished with the same degree of care accorded to those which are intended for sale. It is usually best to mount them attractively or to print them with wide borders.

Making the Preliminary Ground Survey

In order to obtain the finest aerial pictures of homes, estates, or buildings, a ground survey should be made prior to the day chosen for the photographic hop. The subject should be studied for the most promising photographic angles and their relation to the light direction at various times of the day. If the building has an industrial significance its function and usefulness should be studied, together with its placement with regard to related subjects. For instance, a resort hotel ordinarily would be near numerous places of recreation such as golf courses, beaches, mountains, or other places for guests to amuse themselves. A factory would be near transportation facilities, such as railroads, harbors, or rivers. The photographer should ask himself the question, "What is the purpose of this place and how can it be shown to best advantage in an aerial photograph?" The background objects should be observed carefully, as some may be objectionable and some desirable. The air view will disclose them, and camera angles may have to be selected that will include only the desirable features. The problem sometimes becomes complicated if favor-

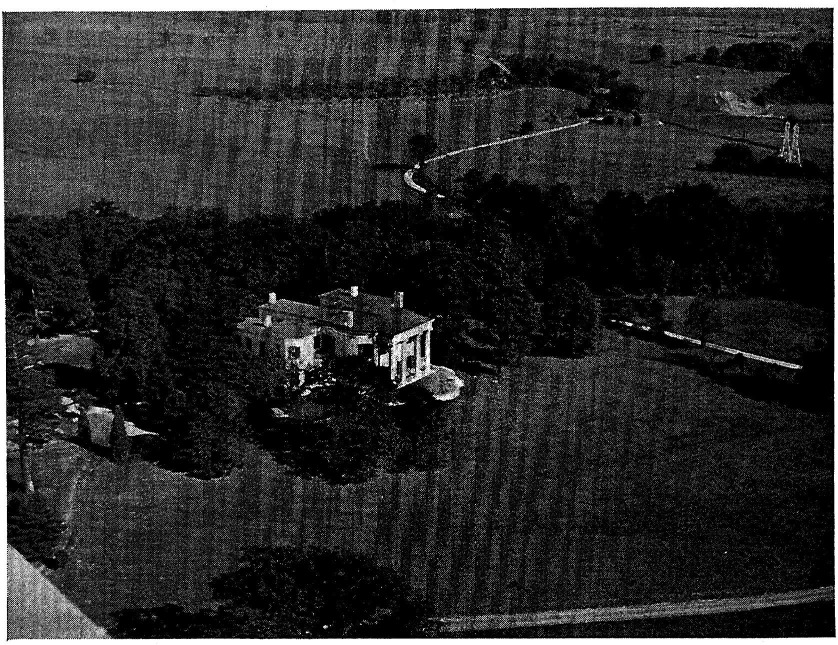


Fig. 414 A Country Estate — John P. Gaty

Altitude 500 feet. Elmar 90mm, 1/200, f:4, No. 2 Filter, DuPont Special Panchromatic Film able lighting, purpose, and background are in mutual conflict. A compromise must be made in such cases, and the intelligence and ingenuity of the photographer are given a thorough test.

Background objects are important in the photography of homes and estates, in the same manner. Transmission lines, railroads, cheap developments, and other industrial manifestations have a habit of cropping up in the distance when the aerial photographer is studying the camera angles of a sumptuous estate sequestered from the world by a private forest. Unfortunately, sometimes, the camera "sees" over the top of the sheltering trees and registers objects which the owner would dislike including in a picture of his home. Conversely, there may be a rugged mountain near, or a pretty lake, and these would be desirable objects to show in the photograph of the estate.

Controlling Perspective by Lens Selection

Fortunately for the photographer faced with these problems of what to show and what not to show, what to emphasize and what to subdue, the Leica is equipped with a full battery of lenses. Ranging from the 35mm lens with its wide field of 69 degrees to the 135mm lens with its narrow field of 18 degrees, they provide a flexible instrument in the hands of the capable photographer. By properly selecting an appropriate lens and the *proper position* with regard to the principal object of interest, great liberties may be taken with the apparent perspective in the finished enlargement. Background objects or foreground objects may be moved into apparently near or distant positions at the pleasure of the photographer. Such effects are not magical. They depend on simple laws of perspective. When a near viewpoint is adopted and a wide angle lens utilized, the resulting photograph will show a rapidly vanishing perspective and the background objects will be subordinated. If a distant viewpoint is selected and the same principal object of interest photographed with a long focus lens the photograph will show a slowly vanishing perspective and the background objects will be apparently much nearer to the principal object. Relative distances of various objects in a photograph can be judged only by their apparent relative sizes.

The real secret of the change in perspective lies in the position of the camera with respect to the various objects depicted, and not in the lenses. A choice of lenses is necessary in order to preserve the sharpness of the distant views. The long focus lenses produce larger images and fill the frame with the view desired. This may be enlarged to the desired size without running into the difficulties from negative graininess sure to be experienced when a small portion of the center of the frame is selected as the basis of a sizeable enlargement. Aerial photography demands clean cut definition of the highest order, and attempts by the photographer to secure this in large prints made from small portions of the negatives are doomed to failure. This high type of definition is essential because almost all details are exceedingly small and the eye of the observer seeks natural and well known shapes, such as the windows of houses in the distance. If these are not reasonably sharp the reaction is unfavorable and the enlargement is condemned as being blurred.

If a photographer attempted to make a 35mm Elmar lens do the work of a 135mm Elmar or Hektor lens he would have to take the same position and altitude for either lens and would find that the 35mm lens had imaged the selected view on but 1/16 part of the area of the normal frame. The remainder of the picture would be composed of sky and objects in which he had no interest. If he attempted to enlarge the small area showing the desired view he would start under a 4 to 1 handicap against sharpness as compared to that obtainable with the 135mm lens in a similar size print. On the other hand, it obviously would be impossible to use a long focus lens for a purpose requiring a short focus lens, for the angular coverage would be insufficient to include the desired objects, at the selected

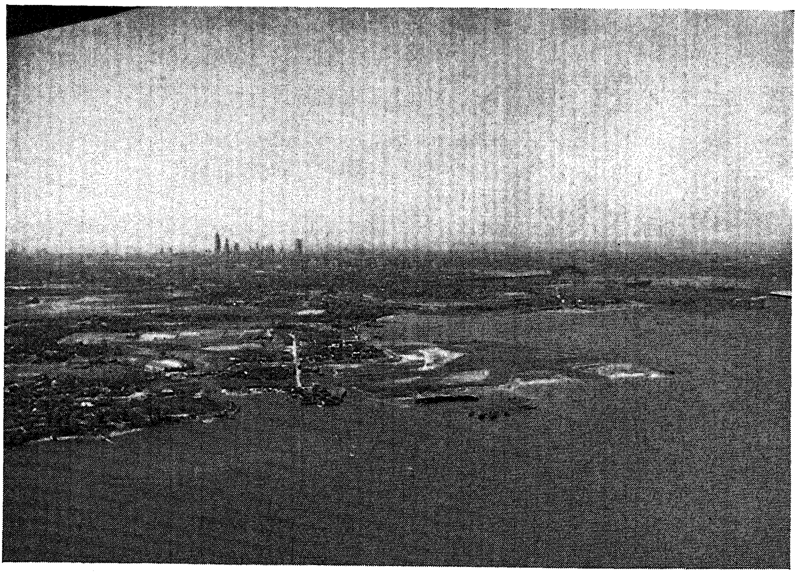


Fig. 415 North Beach Airport, New York City John P. Gaty
Wide Angle View, 1/3 mile to Airport; 6 2/3 miles to distant Manhattan buildings. Altitude 1000 feet, Elmar 35mm, 1/200, f:4, No. 3 Leitz Filter. DuPont Superior Film

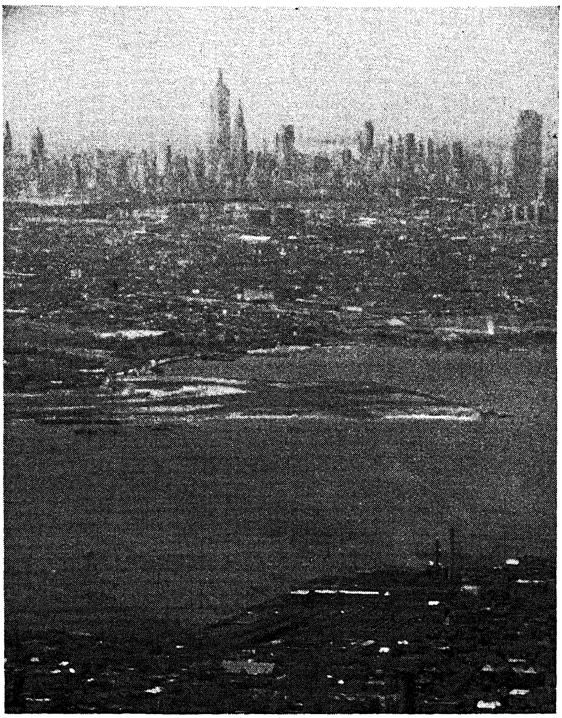


Fig. 416 North Beach Airport, New York City

John P. Gaty

Telephoto View. Camera —7 miles from Airport and 13 1/3 miles from Empire State Building. City smoke prevented better contrast and definition. Altitude 2000 feet. Special 200mm Experimental Lens 1/60 second at f:6.3. No. 3 Leitz Filter. DuPont Superior film.

distance from the principal object of interest. The presence of aerial haze in the atmosphere might absolutely prevent increasing the distance to a point where the long focus lens would cover the desired view, even if the convergence of the perspective were unimportant. Many times, when aerial haze is dense, close-up photographs can be made successfully under conditions that would prohibit making "long shots". *In all cases a proper lens hood should be used with each lens,* whether the air is clear or otherwise, and whether the view is far or near.

The two lenses that are most useful for aerial use with the Leica are the 50mm Elmar and the 90mm Elmar. With these two as a nucleus the beginner can work to earn money that will enable him to purchase further equipment. In order of their usefulness, other lenses would be the 35mm Elmar, the 135mm Elmar or Hektor, the 50mm Summar, and the 73mm Hektor. The first two are useful because of their widely differing angles of coverage and the correspondingly large degree of control that they permit the photographer to exercise over the apparent perspective shown in his prints. The latter two lenses are useful because of their large apertures,

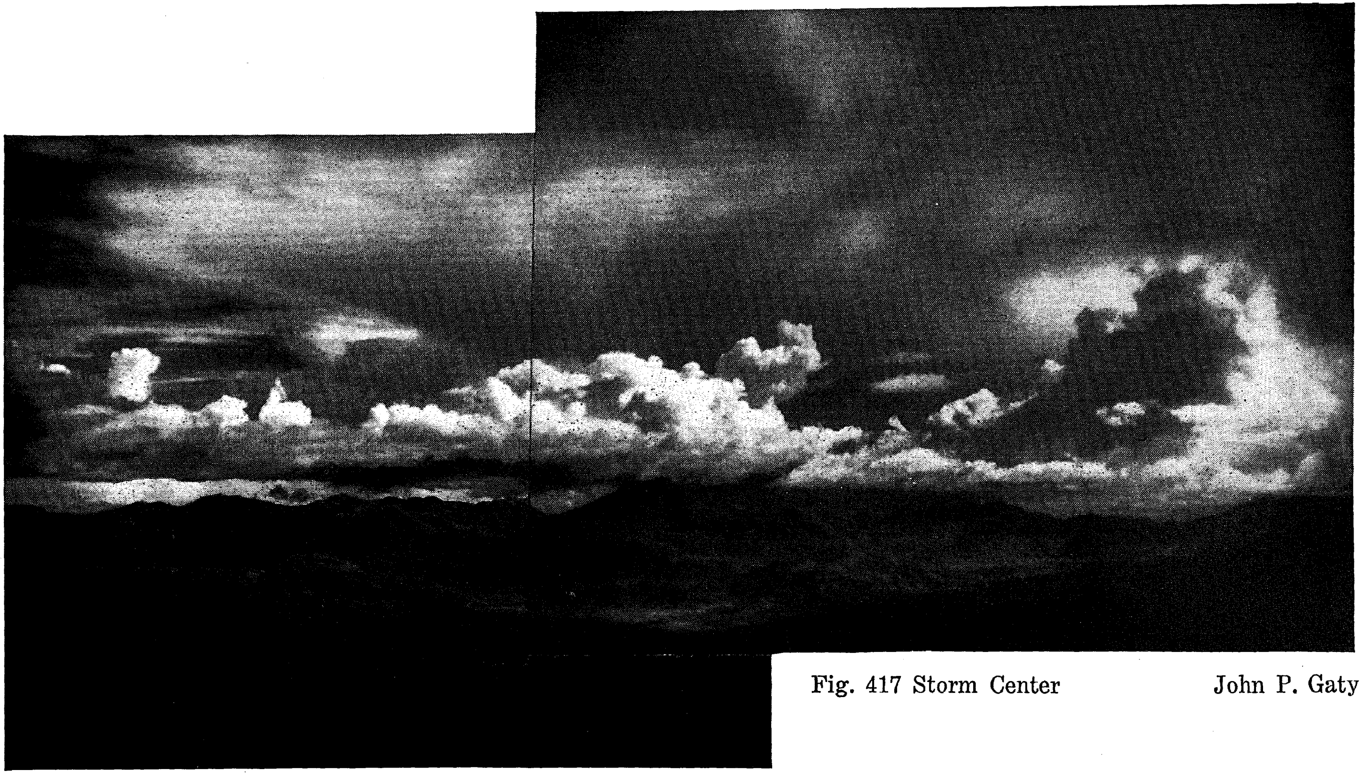


Fig. 417 Storm Center John P. Gaty

A composite View of a winter snowstorm over the California Coastal Range. Note the upper air flow proceeding forward and outward from the center. Altitude 2000 feet. Summar 50mm lens, 1/100 second at f:2.3, No. 25 Wratten Filter, DuPont Infra-D film, hypersensitized.

which permit aerial photographs to be taken under unfavorable light conditions. These maximum apertures must be used with discretion, since overexposures may be produced under ordinary lighting conditions. Their use is not recommended except for unusual lighting and for certain combinations of slow films and dense filters.

The use of the various lenses will depend on just what result is desired in the print. If subordination of background seems advisable the short focus lenses such as the 35mm and 50mm Elmars should be used, in connection with a relatively close position to the principal object at the moment of exposure. Similarly, these lenses will increase the apparent size of a given area of land, due to the rapidly converging perspective. Long focus lenses such as the 90mm Elmar or the 135mm Elmar or Hektor will produce the effect of bringing mutually distant objects to an apparent relative juxtaposition, if the position of the camera at the moment of exposure is correctly distant from the principal object of interest.

Filters for Aerial Photography

Light filters are almost universally used in aerial photography, because the distances commonly intervening between the majority of

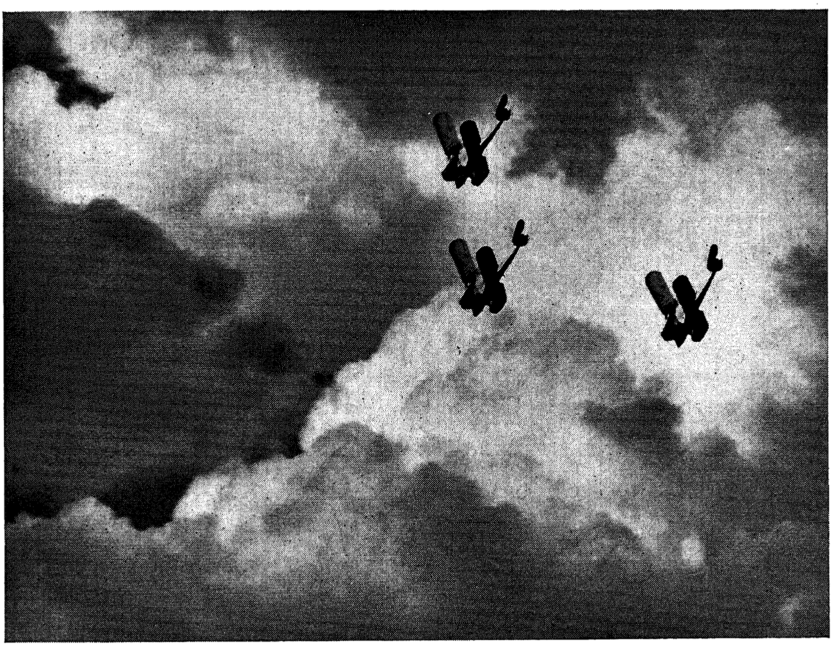


Fig. 418 Diving — John L. Davenport

Composite Photograph. One airplane photograph repeated three times upon a cloud photograph the objects in the view and the camera are great enough to cause dispersion of the shorter wave lengths of light by the aerial haze. This dispersion results in a general veiling of the details of distant objects and the production of "flat" negatives lacking brilliance and contrast. Yellow or red filters are used to eliminate the action of the shorter wave lengths of light on the film and thus remove the veiling effect of the aerial haze. Leica filters numbers 1, 2, and 3, remove varying percentages of the shorter wave lengths of light, the restriction increasing with an increase in the number. Sometimes a portion of the shorter wave lengths is desirable for the purpose of aiding the longer wave lengths in making a correct exposure under unfavorable light conditions. In certain cases aerial haze is advantageous in the extreme background. Such examples require the use of a number 1 filter. For the great majority of cases Leica filter number 2 will be the correct one to use, and this filter is recommended as the first choice. Leica filter number 3 allows slightly better penetration of aerial haze and sometimes will be found useful. A red filter similar to the Wratten 25 (light red) may solve some problems beyond the scope of the yellow filters, and is useful also for infra red photography.

Filters for Different Visibilities

In order to give a readily understandable general rule for the use of filters the following table shows the correct filter for use for different visibilities expressed in miles. The table is intended for use with supersensitive type panchromatic film only.

Visibility	*Filter for Close-ups (up to 2000 feet)*	*Filter for long shots (intermediate and long distance)*
Unlimited	no filter	No. 1 or No. 2
10 miles	No. 1	No. 2 or No. 3
5 miles	No. 2 or No. 3	No. 3 or Red (No. 4)
3 miles	No. 3 or Red (No. 4)	Red, (useful to 1 mi.)

The proper use of filters often becomes a compromise between unfavorable light conditions, permissible exposure time, and atmospheric haze. The table shows the least dense filters which may be used under the tabulated conditions. In any case a more dense filter may be used if the light conditions or air conditions permit the slower exposures necessary. Slower exposures are permissible in smooth air than are practical when the air conditions are turbulent. The use of longer exposures than 1/200 second in turbulent and bumpy air usually results in blurred pictures, especially when long focus lenses are used.

When conditions are favorable and the air is free from atmospheric haze, the minimum density filter should be used in order to increase the shutter speed. This is especially true in cases where a cloudless sky shows in the background. The use of a dense filter will render a clear horizon as a rather depressing shade of gray in the print. This may have to be dodged out in the enlargement. The proper use of filters, therefore, is influenced by the condition of the sky if any of it shows in the composition. A further factor is the direction of lighting. Haze is much more apparent when looking or photographing against the direction from which the light falls. In photographs taken against the light, add one to each number of the filters recommended in the table, and consider the red filter as number 4.

A Standard Leica Aerial Exposure

Exposure speeds will depend on a great number of factors. In order to avoid confusion, **the standard Leica exposure for aerial photography should be 1/200 second, with a diaphragm aperture of f:4, and a number 2 filter, when the camera is loaded with supersensitive type panchromatic film.** Ninety per cent of all aerial photographs can be made safely with these factors, because film latitude will compensate for the minor variations experienced in lighting.

Superpanchromatic type film is used exclusively in professional aerial photography. Long experience has shown it to be far superior to any other type of film. Its sensitivity to the longer wave lengths of light permits its use in conjunction with all types of filters that are helpful in aerial photography without the necessity of greatly increasing the length of the exposures. Modern superpanchromatic emulsions are fine grained and capable of rendering excellent definition. In order to realize their full potentialities, the photographer must take every precaution during the developing, fixing, washing, and drying of the negatives. Ample information on the processes of fine grain developing is available elsewhere in this volume. The rules laid down must be carefully observed at every step. Aerial photography with small negatives will never be successful if the photographer is slipshod and careless in his darkroom technique. The requirements of fine detail in the enlargements cannot be satisfied with grainy negatives.

Certain panchromatic films possess inherently finer grain than the superpanchromatic type, but their use involves the employment of slower shutter speeds. Such films are DuPont Micropan, and Eastman Panatomic. They are suitable mainly for aerial photography from cabin type airplanes, because the longer exposures required often produce blurred negatives if the camera is subjected to the eddies of the propeller slipstream. The factors for these films with various filters will be found in other parts of this volume. Such factors should be applied to the standard conditions outlined above in connection with supersensitive type panchromatic film. Diaphragm changes can be made to compensate for decreased film sensitivity, in cases where high aperture lenses are used. This practice is not recommended, since the "fast" lenses were not designed for this type of work and are subjected to an unfair test by the exceedingly high requirements for detail. The extreme apertures of the "fast" lenses should be reserved for emergency use in overcoming otherwise unconquerable light conditions.

Infra Red Photography

Infra red sensitive film, such as DuPont Infra D, provides an interesting experimental medium. Very unusual photographs of clouds and atmospheric effects can be secured with this material, and great penetration of atmospheric haze can be obtained by its

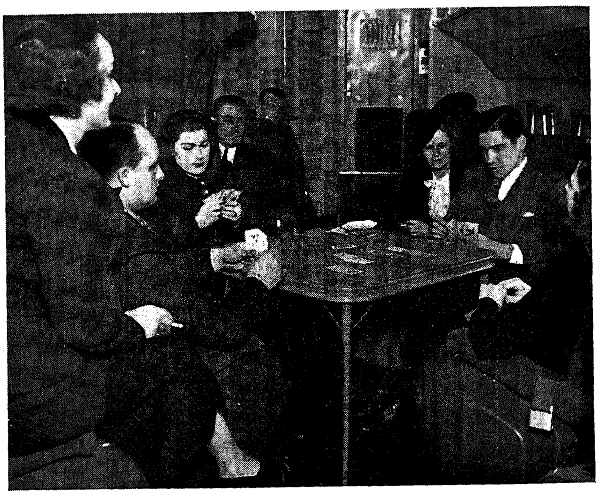


Fig. 419 A Card Game In The Air

Augustus Wolfman

Elmar 35-mm, Photoflash, f:6.3, DuPont Superior. While flying remember to take the close-up Intimate Photographs of People and other Subjects.

use. Certain difficulties must be overcome by the photographer in order to secure presentable aerial views from these infra red sensitive materials. The filter must transmit only red light, and the exposure must not be shorter than 1/20 second at a lens aperture of f:3.5. This long exposure usually is productive of vibratory blur in the negatives, and great care is necessary to prevent camera movement during exposure. When the air is rough and turbulent the photographer's task is almost hopeless. The infra red films are apparently readily subject to large grain formation in development, and every safeguard must be adopted in the darkroom to produce fine grained negatives. When using this material the Elmar series of lenses should be set to 100 feet on the focusing scale, the Hektor series to approximately 200 feet, while the Summar lens has a special focusing mark for infra red film. These adjustments are necessary to correct for the difference between the panchromatic and infra red focus of the lenses.

Infra red sensitive material offers a very interesting field for unusual photographic effects, but before its full potentialities can be realized the photographer must give considerable study to the effects produced in the prints. He is unable to visualize the response of the film to various light conditions, and the reflection coefficients of various natural objects and surfaces to infra red light in any other way. One especially interesting experiment is to use infra red film in connection with filters passing the higher ultra violet spectrum and the infra red spectrum together, but cutting out all of the visible spectrum to which the film is sensitive. Wratten gelatines can be used for this purpose, and the combination of Quinoline Yellow No. 17, and Rose Bengal No. 30 will do the trick. If less ultra violet is desired a No. 49 or No. 49a may be added to the first two, although these cut out the shorter infra red rays also. The use of No. 17 and No. 35 is also recommended. The exposure with the first and last combinations should be 1/20 to 1/30 at f:3.5, and that of the combinations with the No. 49 filters, 1/20 at f:2.0.

This deliberate selection of the extreme opposite ends of the spectrum implies that the photographer has great faith in the color corrections of his lens, and undoubtedly would cause a lens designer to have a severe headache if he could know about it. The 35mm Elmar will work satisfactorily under this unfair handicap, which is a great tribute to its design and construction. The print reproduced herewith (Fig. 420) was made with this lens and a No. 17 and No. 35 Wratten filter used together. It shows a very unusual

Fig. 420 Coastline John P. Gaty

This photograph was made by invisible light only: ultra-violet and infra-red. Note the absence of the usual infra-red effect of white foliage. Compare this with that shown in Fig. 421, which was taken with infra-red light only. The distance in this picture is limited to the foothills shown in Fig. 421.

Altitude 1000 feet, Elmar 35mm, 1/100, f:3.5, Wratten Filters No. 17 and No. 35 used together, DuPont Infra-D Film, hypersensitized

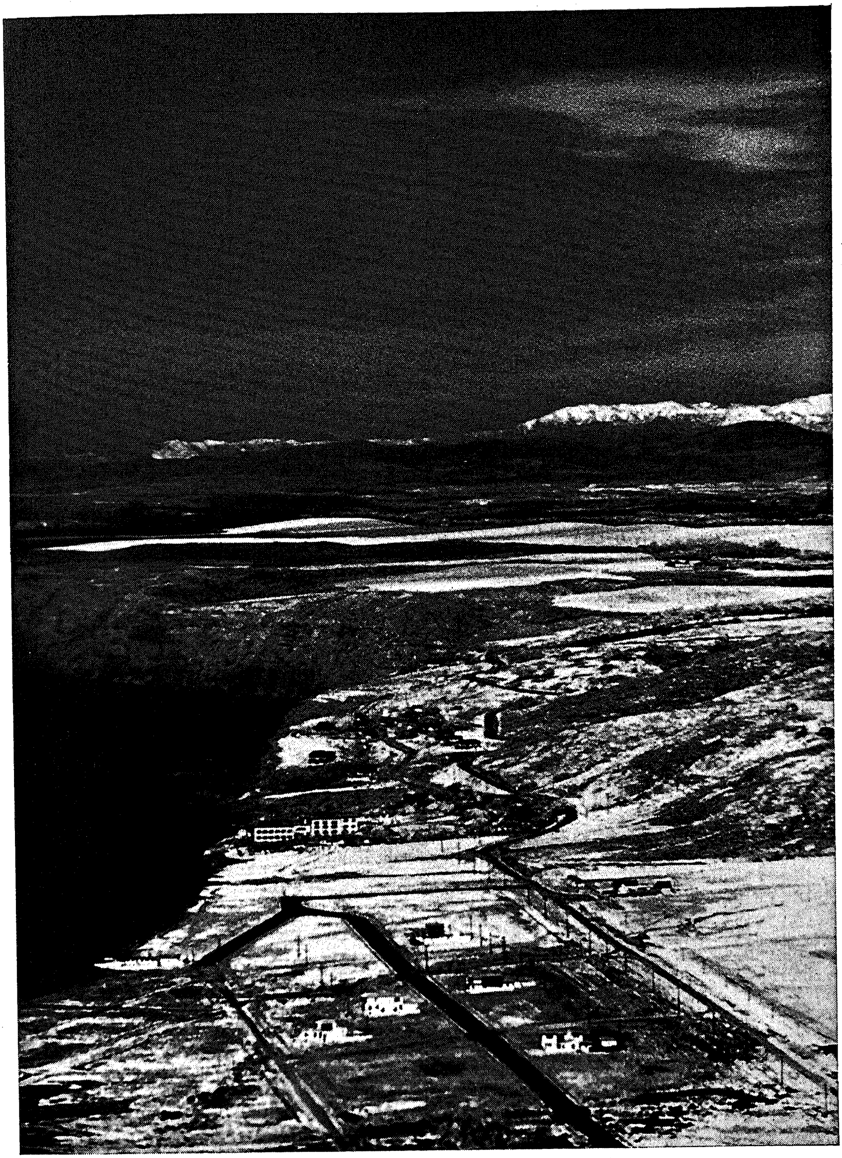


Fig. 421 Distance John P. Gaty

This photograph includes part of the view shown in Fig. 420. The long focus lens brought out the reasonable size of the snowcapped mountains. The large mountain is 70 miles away, while the smaller mountain is more than 100 miles distant.

Altitude 1000 feet, Elmar 135mm, 1/30, f:4.5, Wratten Filter No. 88A, DuPont Infra-D film, hypersensitized balance of atmospheric effects. Near the horizon the sky tone shades off to the palest possible gray, yet the clouds are rendered in bold relief near the zenith. A panchromatic film would show the horizon as a much darker gray if a sufficiently dense filter were used to correct the upper sky to a comparable tone. It is also evident that the usual brilliant and unnatural rendering of green foliage by infra red light is completely absent.

Use of Orthochromatic Film

Orthochromatic film of certain types, such as Perutz, possesses excellent inherently fine grain. This film should be used in aerial photography only for close-up shots on clear days. The use of any sort of yellow filter slows the speed down considerably and has a tendency to destroy the definition. This destruction of definition is not due to poor filter surfaces but to a peculiarity of the orthochromatic emulsion. The blue and red portions of the visible spectrum are capable of rendering excellent definition but the intermediate portion, including the green and yellow, shows only approximately half the resolving power. Orthochromatic films when used with yellow filters are forced to work with this unsatisfactory portion of the spectrum and therefore produce inferior definition. When this effect is added to the slow shutter speed conditions it is natural that orthochromatic film should produce disappointing results in aerial photography with the Leica.

Preventing Vibration During Exposure

The most important part of the technique of handling a Leica in the air is the avoidance of camera movement during exposure. Such movement may be derived from three sources: 1. Motor vibration is transmitted to all parts of the structure of the airplane, and if the camera is allowed to touch or rest upon any part of the fuselage vibratory blur will show in the negatives. 2. The slipstream from the propeller is filled with gusty vortices and these transmit intermittent energy to the camera when it is exposed to the blast. 3. The third source of movement is derived from the motion of the airplane itself. Smooth motion along its path rarely affects the sharpness of the negatives except at very low altitudes, and even under these conditions compensation may be obtained by swinging the camera with the principal object of interest as the airplane passes by it. This motion should be a slow gradual swing controlled by maintaining the object fixed in its chosen location in the field of the viewfinder. It should continue before and after the exposure. The great source of difficulty from motion results from turbulent and bumpy air. The airplane rocks and bucks and sometimes it is impossible to keep the object located in the viewfinder for more than a second. If the photographer can register a view between bumps, all is well. If not, he will find a series of blurred negatives as the result of a photographic hop. When the wind is high and the air bumpy, it is better to postpone aerial photography. Certain air conditions make an airplane no more suitable for photography than would be the rear seat of a roller coaster car in full career. In any case the greatest effort should be made at all times to protect the camera from all sorts of motion during exposure, by cushioning it with the hands, and protecting it from the slipstream of the propeller, as well as by attempting to anticipate whatever bumps may be encountered.

An Eveready carrying case or the use of a special neck strap for the Leica provides insurance against its accidental loss over the side of the airplane. Even when several different lenses are carried and a larger case is used the Eveready case will be found convenient. An ample supply of extra film spools should be carried with the different types of film intended for use during the flight. The ends of the leaders should be marked in pencil with the name of the film so that no mistake will be made when the camera is hurriedly reloaded. In this connection, of course, the new 250 exposure Leica will hardly require reloading during a flight. Sometimes when the film suddenly comes to an end, just as the airplane is circling over its objective, the large Leica is ardently desired.

Photographing From Transport Air Liners

Aerial photography from transport air liners offers some unique problems. The windows are made of shatterproof glass that is far from optically flat, and usually are incapable of being opened. The irregular surface of the glass has a tendency to ''soften'' the image on the film, and the interior surface reflects light from the windows on the opposite side of the cabin. In order to overcome these handicaps the photographer should select a short focus lens and hold the camera as close to the window as possible, without actually touching the glass with the lens mount. This practice will reduce the abberations due to the uneven glass and to some extent shield out the interior reflections. By placing the body close behind the camera or by holding up a coat, the remainder of the reflections may be eliminated. Usually the rear and front seats are the best locations for photography from air liners, since the view is least obstructed at these points.

Your Personal Airplane

In selecting a personal airplane for aerial photography the various open photographic angles should be considered carefully. High wing cabin monoplanes are usually the best for all around use. They have the greatest number of camera angles, the photographer and camera are fully sheltered from the slipstream of the propeller, and they are comfortable in cold weather. However, any airplane may be used if it possesses sufficient open spaces between the structural parts to permit an unobstructed field for the shortest focus lens to be employed. When such spaces are barely sufficient, more care must be used by the pilot in manoeuvering the airplane into the proper position to take a desired view, since in effect the airplane, and not the camera, must carefully be lined up with the object. Some airplanes have open spaces only at the two rear quarters between the lower wing and the tail surfaces. Such ''ships'' must be flown past the object before the exposure can be made. The photographer is in much the same case as the Woople Bird who always flew backwards because he wasn't interested in where he was going, but only in where he had been.

The photographer must possess a ready means of communication with the pilot at all times. In double cockpit open airplanes Gosport voice tubes and helmets may be used, or a system of hand signals arranged. Such signals must be worked out carefully before the flight so that there is no possibility of confusion. The photographer's wish for a change in altitude, direction, or position must be understood instantly by the pilot. Cabin type airplanes usually are so arranged that the photographer can converse readily with the pilot at all times. In cases where the pilot is also the photographer some ''ships'' will prove very unsatisfactory while others are fairly convenient. In any case it will be found that serious aerial photography is performed in a better manner when two individuals co-operate to do it.

Airplanes may be tested for their camera angles on the ground by the use of the universal finder. This should be used to check the open photograhpic angles from the seats or spaces available for the photographer. Horizontal angles alone must not be considered. The viewfinder axis should be depressed downward to 45 degrees or more, and raised upward slightly in order to check all possibilities. At the same time the change in altitude of the airplane after the tail is raised in flight should be considered.

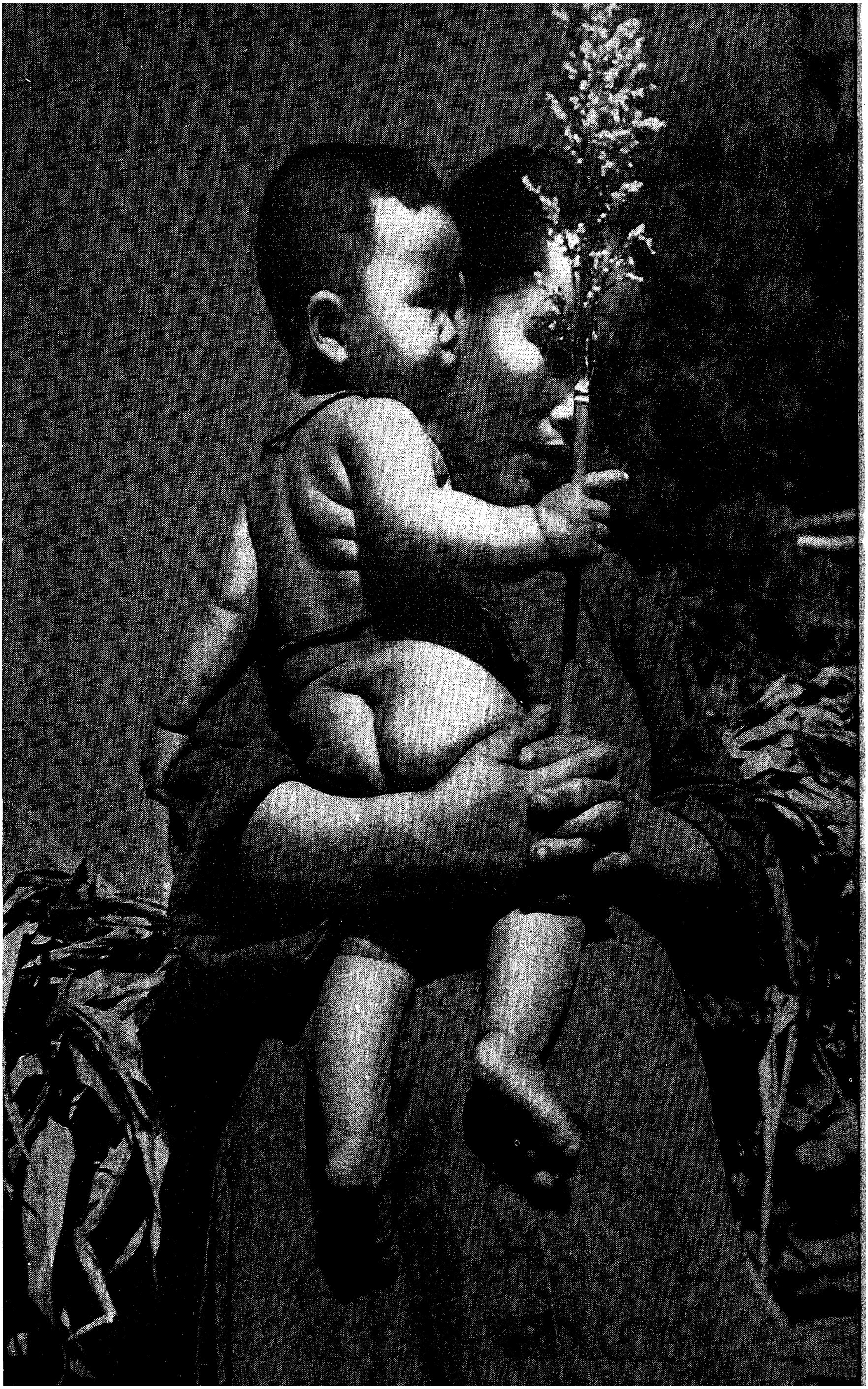
Aerial Photos At Low Altitudes

When using a personal airplane, the enthusiastic photographer often will be tempted to fly at extremely low altitudes to secure some detailed views of his objective. Unless these are isolated farm houses surrounded by fields suitable for forced landings, such practices must be considered hazardous. If the pilot attempts low altitude flying over populated areas, some aggrieved citizen is almost certain to report him to the Department of Commerce, with resulting trouble for the pilot. If the photographs are important and require low flying, a written application should be made to the local Department of Commerce Inspector, specifying the location, the date of the proposed trip, and other details. A waiver of the rules will be issued at the discretion of the Inspector, and subsequent trouble avoided.

Aerial photography is surprisingly easy to accomplish, but in order to obtain full satisfaction the photographer must be uncompromising in his attitude of watchfulness and care. For both novice and expert a rigid adherence to the following points will pay big photographic dividends.

1. The camera must be held properly.
2. The film and filter correct for the conditions and subject.
3. The developing handled in the most precise manner.
4. The enlarging done on paper adapted to the contrast values of the film.
5. The proper lens should be employed, at the correct distance, to fill the frame with the desired view.
6. Last, but by no means least important, showmanship should be used in preparing the prints. They should be mounted, or printed on paper large enough to provide a wide border around the exposed area. Careful spotting and retouching of blemishes must be done to eliminate signs of dust marks and scratches.

If such a course is faithfully followed the photographer will be rewarded with a collection of prints which will be a great satisfaction to himself and a source of pleasure to his friends, and perhaps the means to an interesting income. They will provide a permanent testimonial to his patience, skill, and artistic accomplishments. Best of all, they will serve as a reminder of many interesting and happy hours.



EXPLORING WITH THE LEICA

JULIEN BRYAN

CHAPTER 27

Leica fans and amateur motion picture photographers frequently ask me to 'reveal' what special technical tricks and devices I use in getting my intimate movies and unposed stills of native peoples in Daghestan, Manchukuo, Siberia, Turkey and other little-travelled parts of the the world.

When I reply frankly that I have no bag of tricks and that in the main I use fewer gadgets than most amateur photographers, they are often quite puzzled and seem to feel at times that I am holding something back.

If I have any specific theory about my work, it is something like this: that photography is to me a tool which I use for a very definite purpose, namely, to tell a story. For me, this is a simple and direct story of how people live in other countries.

If, in the future, there should appear some new device to help me tell this story better than I can do at present with my motion pictures and my still photographs, then I would give up photography and whole-heartedly adopt the newer, fuller medium. However, I sincerely believe that at the present time photography is the best tool for my purpose.

In the past eight years I have led a number of small expeditions abroad. Usually I have found that the amateurs who have come back with the most interesting collections of pictures were not necessarily those who were clever with the camera yet had no real objective except to photograph anything they came across. Rather, they were those persons, who, long before they went on my expedition, had sincerely devoted themselves to some definite field of interest, so much so that their basic reason for joining my group was to study their special interest while on an unusual trip. To give concrete

Fig. 422 A Manchukuoan Madonna Julien Bryan
Summar 50mm, 1/60, f:6.3, Light Red Filter, Super-X Film

examples, one was tremendously interested in the dance. Another was a professional social worker, eager to study the family and the care of children in places where no one had ever heard of surveys. A third was a student of ethnology who, in his studies, had become fascinated by the fact that there are 160 different ethnic and racial groups in the Soviet Union, and joined my expedition to see at first hand what was happening to these peoples under the new national policy in that country.

And all of these members of my group, concentrating on the fields of greatest importance to them, succeeded in obtaining well-rounded and connected photo-stories on the theme of their major interests. Naturally, from time to time, they took casual, disconnected snap-shots, as anyone else might do; but this was incidental.

These observations in the field have convinced me that the amateur could set himself no task more fruitful than to make a thorough photo-story—over a period of months, if necessary—on the subject which interests him most and which he knows best.

I think the trouble with many amateurs and some professional photographers is that they have in their own lives and work no powerful and underlying motive which their photography serves. They become "arty" and take pictures in the spirit of "art for art's sake." Possibly they obtain half a dozen very beautiful shots which are admired by friends or win a prize. From then on, they feel that they are "Artistic" photographers who have to live up to a certain reputation. If you ask them "What is the purpose of this photography?" they are confused and reply that they are "attempting to obtain more artistic pictures." But for what purpose? "Arty" pictures are too often a mere consolation for aimlessness.

The amateur should remember that he does not see the professional's average work, but only his best. In covering seven large countries of Europe and Asia in some eight years of travelling, I have exposed nearly half a million feet of motion picture film and about 30,000 Leica negatives. Only a small portion of these are beautiful and artistic photographs. A fair percentage of the 30,000 are good human interest photos, but a very large percentage are really poor and of little value to anyone. I have taken this great quantity of pictures in order to sift out the small percentage which will enable me to tell my story of human beings in those far-off countries and to tell it well. My main objective is to obtain pictures which serve my purpose, rather than to allow myself to shoot hundreds of artistic pictures which might be completely unrelated to my work.

Keeping a Clear Photographic Viewpoint

If I have any rules for my work, I should say first of all that I believe it is vitally important for every photographer like myself

Fig. 424 Julien Bryan shows a Harbin Chinese peasant the mysteries of a movie camera

to have some clear cut objective as to the use he intends to make of his pictures.

Mine, frankly, is that each year as I make these trips and return home, I hope that my photographs will help me in promoting better inter-racial understanding and in tracking down many of the prejudices and fears which people have toward other nationalities.

My theme, therefore, is people, how they live and work and play in distant lands. I like people. I like even strange people such as Mongolians and Tungus and Khevsurs. I have found in my visits to such tribes that they in turn will like you if you are friendly. A smile is worth vastly more than money, even though you may not speak two words of their native dialect. Before I visit such a tribe, I try very hard to learn something of their background and their customs, and above all what they consider good manners among their own people. Especially am I careful not to offend them by breaking their own code of etiquette. For good manners, no matter how unlike our own, mean unobtrusiveness, and this is an important secret of successful candid-camera pictures. This is true whether the pictures are of statesmen, children, or peasants.

Patience and Good Manners Essential

Patience is a very necessary virtue in photographing such tribes. Many times members of my expedition are thoroughly exasperated at the hours and days of seemingly needless delay in getting our work properly under way; yet the easiest possible way to break off diplomatic relations and to spoil entirely the work which you have planned is to display open impatience with the people whom you have come to photograph. It takes time to become acquainted with primitive peoples, for they are exceedingly dignified, and it is wise not to be too aggressive. I have had photographers with me who were anxious immediately upon arrival in some exotic spot to take out their cameras and begin shooting even before the members of our expedition had been properly introduced to the chief of the tribe and the elders.

I have never known primitive peoples to rush matters. When a stranger arrives, there are many small formulas that must be fulfilled according to custom. They are the hosts and you are their guests. In almost all such introductions there is a fairly long period of conversation which may prove nothing at all, but this is their custom, and in this way they get used to you. Their first suspicion that you have come with some subtle and not very honorable purpose is dissipated. As the ceremony surrounding the introduction goes on, I explain how I have long wanted to visit them and their country and how honored I am that they receive me and my expedition so cordially. I tell them without too much flattery that the people in my country are interested in their country and that we would like to tell the people back home about them. Frequently I show them a few pictures of tall buildings, such as the Empire State Building or possibly a children's picture book showing farm life here in America.

Then I go on to explain that we also need similar pictures to tell our people at home about them. I say that I will not only be grateful but very honored if they will help me to obtain photographs which show how their people really live. Even then I do not touch my cameras. Instead, I go around the village with them while they explain to me some of the principal features in their community life.

Whenever possible, I have with me on my expeditions an expert who speaks the dialects and who knows the cultural background of the people from scientific study. For example, on one of our expeditions into the High Caucasus we had an experienced ethnologist from the Ethnographic Museum in Tbilisi, capital of the Georgian Soviet Republic. Later, on an expedition to the Tungus tribe north of Lake Baikal, in Siberia, I was fortunate enough to have with me Professor Petri, recognized throughout the world as one of the greatest living authorities on the primitive Siberian ethnic groups.

In every case comparable to these, my pictures have been very much more to the point, have told a better story, and I myself have gained a deeper understanding and more accurate information about the lives of the people than if I had gone alone or relied exclusively upon the well-meant but often fanciful explanations given by native guides.

As the tribal elders are showing me around their village, I am building up in my own mind the unified story I will tell later with the cameras. To illustrate it, I do not want artistic and unrelated shots, but rather a simple, closely knit series of pictures that tell the life-story of the tribe. Once I have made friends with them and have explained the purpose of my visit, the work is much easier.

Now comes a very important phase in candid photography. When the introductions and preliminary conversations are over, many of the members of the tribe are apt to become restless and eager to return to their work. Most primitive peoples must work long hours daily if they are to survive. So I now ask the chief to make it clear to the others that I will be their guest for some days, and that on no account do I wish them to stop work or do anything out of the ordinary for me. On the contrary, I ask him to explain clearly to his people that it will help me most if they return to their work and pay no attention to me as I wander about their village in and out of their huts and wigwams. I strongly emphasize the fact that it will spoil my pictures if they look at the camera. I let them know that they can talk or laugh or eat or do anything which they normally do. Not until this point do I open my Leica—but when I do, I meet with excellent cooperation from the natives, who now feel that they are helping me in a very important project.

In motion pictures we use the term long shot, medium shot and close-up. I find the same terminology very helpful in still photography. At first a preliminary number of pictures are taken from a distance showing the village, the mountain or the valley in its relation to the country as a whole. Next we photograph a series of medium shots showing the characteristic dwellings. Last and most interesting of all come close-ups of individual people, animals and implements of their livelihood. But very rarely do I take these close-ups of either people or implements in the form of still-life or posed figures. Rather, with the advantage which the Candid Camera gives me, I make an entire series of action photographs showing some form of work from beginning to end. I watch a woman as she prepares the birch bark in the Siberian forest for her summer wigwam. I photograph her as she cuts the birch bark, as she treats it, as she softens the thread made from a reindeer tendon, and as she begins to sew the bark.

A Sense of Humor and Understanding Helps

On expeditions you must have a real sense of humor and the ability to laugh at yourself. On one occasion, near Lake Baikal in Siberia, I was visiting a tribe called the Tuturi Tungus, who have domesticated the reindeer, and live in wigwams in the summer. I had gotten down on one knee with my Leica in order to get a very striking and natural picture of a native woman as she was placing her baby into a curious L-shaped wooden cradle. She then fastened this cradle on the reindeer's back in preparation for a long trek through the Siberian swamps. But I had not noticed that there was standing behind me a large male reindeer who apparently suspected me of being a foreigner and an enemy of these people. Somehow or other he broke away from his tether and in three or four rapid strides he approached me from the rear and picked me up with amazing ease on his antlers. He was gentle though firm and simply tossed me nonchalantly some six or eight feet away into a patch of swamp.

I managed to get out with only a few scratches, but the local natives, the Tungus, were simply hysterical with laughter at my predicament. They didn't mean to be impolite, but some such incident had happened in the past to almost all of them and they were highly amused at seeing me in the same spot. And so was I.

That same evening, the local chief and tribal elders decided to give a special banquet for me. They told me that I was the first foreigner, (not counting a few stray Russians) who had ever visited their village. Now when we all went into the wigwam, for the grand event, I did not go immediately to the special place of honor which was set aside for me, but I took the worst position. This, as you can guess, was directly opposite the fire in the center, where the smoke got into my eyes. I sat down here and after much urging on the part of the chief himself, I finally moved to another seat, but still a long way from the coveted place of honor. It was only after some minutes more of persuasion on the chief's part that I moved again. All the time I argued that I was not worthy of the honor of this place that they intended for me. This was, as you may now guess, located so that the smoke did not get in my eyes.

The Tungus people, like many another primitive group, are a friendly, kindly race with a long story stretching back at least three or four thousand years. These people are amazingly kind to their children, and scarcely ever did I hear a nasty, coarse, or quarrelsome word, nor did I ever see a parent strike a child. One day I spoke to a Tungus woman about this. She smiled in surprise at the implication of my question and finally answered something like this: "Well, you see, among our people, we don't consider it good manners to strike a child."

I have found it true in almost all of these primitive groups, that they have come to look with a certain well-justified suspicion upon the foreigners who may come to visit them. In the past, the white man was known throughout the world for his robbery and exploitation of such tribes. We have a vivid example of this right here in America, with the white man's treatment of the American Indian. No condoning or apology now can justify this vicious expropriation.

Therefore, as I visit such people as the Tungus, I bend over backwards, first not to offend them; second, not to appear superior and condescending, and third, to pay my own way and not in any way impose upon them. I seldom, if ever, give them money for being photographed. If I am a guest in their home for a single meal, and I know they will be offended if I offer payment in money, then I always leave a gift. This may be some article in my knapsack which they admire and which I can spare, because I have brought extra articles of this sort. If we stay any length of time we of course pay for our food and lodging. For the important gifts that we give them, they will almost always, as is their custom, give us certain gifts in return. The presents which I have for them are always simple, useful articles, such as brightly colored dishes and cups of Bakelite, knives, forks and spoons, or attractively illustrated American children's books showing life in our country, or even little gilt safety pins from the five-and-ten cent store. Occasionally I give an inexpensive fountain pen and pencil. We become friends, and I am happy that they admire and like some small humble present of mine. When I accept gifts from them, I receive them only on the condition that it will work no great hardship to the givers. I explain that this will be very valuable for me in my work here in America because I can show my friends at home how my present hosts live and what fine work they do.

A very touching incident occurred on one occasion when I was leaving the Reindeer People. An old weather-beaten woman, a member of the tribe, about 75 years of age, was very much pleased with a small gift I had left with her. So, just as I was leaving for the long trek south to the Trans-Siberian Railway, she presented me with a birch bark vessel which she had made herself and which contained two quarts of fresh reindeer milk. This, she hoped, "would help supply me with nourishment until I returned to my own wigwam."

Preparing for the Expedition

Preparation for such a trip is always very important. I must travel light and yet at the same time have sufficient photographic equipment and film so that I will not run short in the middle of the expedition. I always carry two Leicas myself and usually my assistant also has a Leica. I carry 20 or more Leica magazines and one black silk changing bag. The latter is extremely valuable, for in case of a possible film jam, with either a Leica or motion picture camera, this can be quickly remedied even in bright daylight.

When I leave New York for a four or five months' expedition I take along all the film and photographic supplies I think I will need on the entire trip. I may occasionally leave some of these in a larger city as a base and go into the interior with only a small portion of my supplies with me. I do not leave New York City with the hopeful thought that I may be able to obtain adequate replacement in other countries. Frequently you cannot get any photographic supplies at all; or, if you can, they are apt to be fantastically expensive and none too fresh.

Fig. 425 General Shang Chen Julien Bryan
Summar 50mm, 1/30, f:4.5, Super-X Film

When ordering film for an expedition, I always specify "tropical packing." This means water-tight metal containers sealed with solder. In the field, every day, as soon as the film is exposed, we replace it in these sturdy cans, solder them up again, and in addition seal them with several layers of waterproof adhesive tape. Thus, when on Lake Baikal a few years ago, 5,000 feet of my movie films and all my still pictures for the summer spent 24 hours under water, they were not damaged in the least.

I always carry along a small Leica developing tank and about once a week, wherever we are, we make a few tests to see if our exposure has been correct and if the cameras seem to be in good working order. In most countries, however, we have found it better, where possible, to send the black and white negatives back to the U. S. for development, even if 30 to 60 days are necessary for this, rather than to develop the films abroad. Generally, we have found the chemicals, water and equipment not of the best for our purposes in these out-of-the-way regions. There is no question that here in the U. S. it is better to develop all of your films within 48 hours after exposure, but we have also learned that it is better to wait 60 days if necessary rather than to risk poor processing of important negatives.

Another rule which I have always rigidly maintained on these trips is that every night before retiring I prepare my film and cameras for the next day's work. The lenses of all the cameras are carefully cleaned and the film guide and aperture plate of the motion picture camera cleaned and polished also. Then all the cameras are ready for fresh film. If, for example, I have used up 29 exposures in one Leica and 22 in the second camera, these are invariably taken out and fresh film inserted.

On my first expedition I carried one Leica. In the past few years I have always had two. In 1936 I used one exclusively for Kodachrome color pictures and the other for black and white with a Summar f:2 50 mm lens. On the 1937 expedition, I took three Leicas, one equipped with a new Xenon f:1.5 lens.

I carry only two extra lenses, one of which is the f:3.5 35mm and the other an f:4.5 135mm telephoto. Both of these extra lenses are valuable to have in case of emergencies, but I have found in the main that I use the telephoto lens more frequently with motion pictures than with my Leicas. Even then not 2% of my motion pictures are taken with telephoto. In contrast to many explorers who use telephoto lenses for closeups of natives, I have found that the results are rather flat and not nearly so sharp or attractive as when the camera is placed about four or five feet from the subject and a lens of short focal length is used. This method, of course, makes it essential for you to be on friendly terms with the natives. Half-wild tribesmen must sincerely trust the stranger before they permit him to hold up close to their faces a weird machine that stares at them with unblinking eyes.

Eliminate All Unessential Equipment

I am always amused at the amateur protographers who tote a dozen different lenses and 50 other appliances, and spend their time not so much in taking pictures as in mothering a brood of gadgets. They forget that in dusty open country there is grave danger of dirt getting into the camera while they are changing lenses. Equally serious is the precious time wasted in this tinkering—almost invariably at critical moments. I reduce my gadgets to bare necessities to prevent technical pre-occupations from coming between me and the simple human stories I try to tell.

Selecting Film

There are many arguments about which is the best film. Some photographers are constantly changing to a new make of film. Others will take

Fig. 426 A Tungus woman in a Soviet clinic in Siberia

Summar 50mm, 1/30, f:3.2, Super-X

Fig. 427 Through Manchukuo — Julien Bryan
Summar 50mm, Super-X Film

four or five varieties of size and manufacture on a single expedition. In my opinion such procedure is foolish and hazardous. There are many excellent films available today. I think it is much wiser to find one which you like and to stick to it over a period of years. It happens in my experience that I have found Eastman Kodak very satisfactory, not only for speed and fineness of grain, but especially for its uniform quality and its ability to stand up six months after manufacture. For my motion pictures on the 35mm film, I use Super X entirely. For my Leica work I have Super X and Panatomic. Super X is invaluable for every variety of picture taken under questionable lighting conditions. Panatomic is excellent for normal outdoor exposure.

Obtaining Correct Exposure

Many people ask me what my procedure is in the matter of proper exposure. Accurate exposure is of course important in black and white Leica photography, but is absolutely essential in all work with Kodachrome and color photography. More than that, it is vital in motion picture work for the negative exposed in a single day may run into several hundreds of dollars in cost. A few years ago I took all of my photographs on the basis of long experience and guessing. Even then, however, I lost some very important shots. During the last four years, I have invariably carried two or more Weston exposure meters. I use them on all occasions. Frequently I make my own guess as to the correct exposure before taking the Weston meter reading; but I always check my own estimate with my photoelectric cell.

What Filters to Use

I feel the same way about filters as I do about lenses. Some of my friends use a dozen or more varieties. They seem to like their filters and get some very good results from them. I use two, one a medium yellow and the other medium red. Occasionally, if the picture is very important and I am uncertain as to which filter will give the best effect, I take three exposures. The first one is without a filter, the second with the yellow and the third with the red filter. I hope that one of these will be a satisfactory shot.

In spite of the really amazing accuracy of the focusing devices on the latest Leica cameras, I find that a large number of amateurs will take up to 75% of their pictures slightly out of focus. There is no reason today with modern equipment and with accurate focusers why 90% or more of the Leica negatives should not possess razor-edge sharpness.

A very large portion of my pictures are close-ups taken from 3½ to 6 feet. This is, of course, one of the remarkable advantages of the Leica camera, which is not possible with the larger outfits. In both my motion and Leica pictures I take far more close-ups and intimate pictures than most photographers do. I find in my lecture work all over America before audiences who have come to see my motion pictures that the intimate close-up shots of people draw the most enthusiastic response. The advice then, to all amateur photographers, would be to pack your films full of such intimate shots.

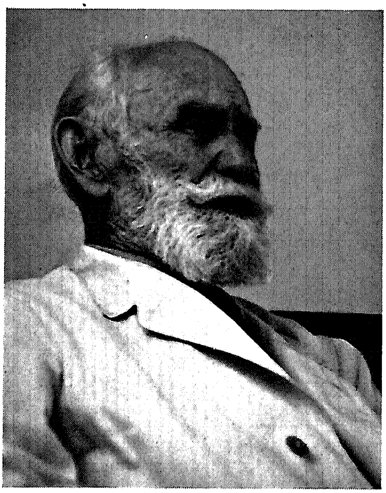


Fig. 428 The late Ivan Petrovich Pavlov, Soviet scientist, discoverer of the conditioned reflex.

Summar 50mm, 1/40, f:2, Super-X Film

On the other hand, special care is needed in the matter of focusing. In the case of photographs which must be made of a group of people six to twelve feet from the camera, my experience has proved that it is best to focus sharply on the person at six or seven feet and to allow those in the background to be somewhat fuzzy rather than to have the people in the foreground out of focus and those in the background sharp and clear.

Vary the Standard Photographic Viewpoint

Generally amateurs are much too fussy about keeping their clothes clean and seem quite content to take almost all their pictures from a prim standing position. Variety of camera position adds tremendous interest to all your pictures. Take shoulder high shots if you like, but also try to tilt the Leica upwards when you are down on the ground, even if it is a muddy rice field in Japan, and shoot a silhouette of the Japanese woman as she stands against the sky cutting her food supply for the winter months. On the other hand, I try to shoot from the second story of a building or stand on somebody's shoulders if necessary in order to get elevation. Don't take everything from a monotonous five-foot angle,—crouch, kneel, sit, lie flat; climb up on fences, roofs, ladders.

Fig. 429 Spinning Silk in Kyoto — Julien Bryan

Summar 50mm, 1/40, f:2, Super-X Film

Lighting equipment must be used if I am to obtain those intimate scenes inside homes, churches, schools, restaurants, nurseries, mines, factories, hospitals and court-rooms without which I would consider my photo stories of any country incomplete. My light kit, which fills only two small suitcases, consists of one dozen large photo-flood bulbs, several adjustable stands and reflectors, 300 feet of extension cable, a series outlet, and assorted types of electric plugs to meet the needs in different countries. In hooking up my lights, I have blown out scores of fuses in places ranging from Russian grocery-stores to the Presidential Palace of Turkey; but I carry a stock of replacements for such emergencies—and pity the photographer who doesn't!

Since much of my photography is done in regions lacking electric lights, I also carry a water-proof box of one minute magnesium flares, 100 or more flash bulbs for the Leicas and several home-made silverfoil and goldfoil sun reflectors.

I carry three tripods, the Bell and Howell Special, and two light and very quickly adjustable Thalhammer tripods. I use these almost entirely for my motion picture work but now and then find the Thalhammer effective with a Leica, especially as necessary for some interior shot which I want very much to obtain with the Leica. I have obtained some excellent close-up shots in dark churches with an exposure as long as two minutes by using a tripod for my Leica. I carry all my equipment in a dozen black fibre cases which are telescopic in form and generally made up for travelling salesmen. These cost me $4.50 each instead of the $50 to $100 each for the specially-built equipment cases considered indispensable by those who insist on being traditional explorers.

Photographic Restrictions and Censorship

More and more countries today have restrictions for the amateur and professional photographer which were not in effect ten or fifteen

Fig. 430 Temple Guard God in Jehol, Manchukuo

Summar 50mm, 1 sec., f:9, Super-X Film

Julien Bryan

years ago, and many are the unhappy amateurs who have not bothered to learn local regulations. They have been stopped for what seemed to them harmless photography by the police of some foreign country. As a matter of fact, almost all these regulations have been built up because of the fear that the foreign photographer is a spy, searching for military secrets. At the present time in many European and Asiatic countries there are regulations which prohibit photographs of anything of a military nature. Some of these may seem foolish to the foreigner, or to the outsider, for they may include railway stations in one country and so-called fortified zones in another, which to the foreigner do not seem fortified at all.

What steps therefore should the foreign photographer take in view of such restrictions? A certain group of pseudo-explorers has made glamorous the idea of obtaining illegal snapshots from the windows of speeding trains, and other thrilling angles. In these shabby adventures, considered "clever" by some, the American photographer, enjoying the hospitality of a foreign state, is "boldly snapping forbidden pictures" with the police "hot on his heels"—only to be "outwitted" by him, of course. All this sounds very exciting, but both the practice and the photographs are deplorable. In seven years of taking human interest pictures in many places ordinarily forbidden, in such thoroughly regulated countries as Japan, Germany, the Soviet Union and Turkey, I have had little of the unpleasantness which other travellers frequently report. I have found that every photographer like myself must depend a great deal upon the cooperation of the local government. Usually upon my arrival in the foreign capital, I go immediately to the government officials and tell them the object of my visit. Even though this may mean some delay, I have found that it is much wiser to go to the authorities first, rather than to have them come to you. This is a more polite and friendly way of approach, and in most cases has worked out very well for me. The officials are almost always surprised to see that you have taken the trouble to visit them. You now have an opportunity to describe the kind of photographs you hope to make. As a result of this fair and honest approach, you may even be given permission to make certain photographs which they do not permit their own nationals to take. More important is that after you have made this gesture you will not have to spend a discouraging interlude in a government jail because you were unaware of some obscure military regulation. To cut a long story short, increasing governmental restrictions in many countries have at times made diplomacy a major part of my job.

Careful consultation of maps, and months of study, are absolutely necessary before any expedition should be attempted; yet many photographers seem to feel that they can read a book about Turkey or Moscow or Daghestan the afternoon they arrive there, and thus become fully prepared. The time spent in planning, research and inquiry before an expedition starts is repaid many times over by the increased efficiency it gives you in the field.

If you are the leader of an expedition, you ought to be sure that every member, including yourself, is in sound health before you start, for if you are going into difficult country, you will have both sickness and accident on your hands at times. A thorough examination by your doctor and by your dentist is recommended. You will not take many pictures if you wake up with an infected tooth on some morning in Svanetia. It is always well to study in advance the diseases endemic to the territory through which your expedition will pass. Malaria and dysentery are two of the commonest. If there is no doctor along, the leader of the expedition must have sufficient medical knowledge to enforce strict precautionary measures against the local diseases, such as daily doses of quinine in malarial regions. The emphasis should be on prevention. Before travelling in the Near East and the Orient, it is absolutely essential to be innoculated against typhoid and to be vaccinated.

Fig. 431 Soy Beans, Harbin, Manchukuo Julien Bryan

Summar 50mm, 1/100, f:8, Super-X Film

I Should Like to Summarize in a Few Brief Sentences:

1. I think it of the utmost importance to have a definite objective which my photographic work will serve.

2. The objective in my case is to obtain pictures which tell a simple human interest story of the lives of ordinary people in far-off countries.

3. I have no special tricks or secret methods of which I am aware. I carry only two filters and but two extra Leica lenses.

4. Friendliness, honesty, and a liking for people are the principles of my approach.

5. Patience is an extremely necessary quality for a successful photographer-explorer. Display of temper at local conditions may relieve the photographer's feelings, but it will not help him to get good pictures.

6. A sense of humor and the ability to laugh at yourself are essentials.

7. Every effort should be made to learn what is considered good manners among the people to be visited.

8. It is important not to impose upon the people nor to be condescending in your attitude toward them.

9. Above all, no shots unrelated to the story should be taken; rather, after the people have been put at their ease, a whole series of shots should be made following the narratives implicit in their work-processes, their play-patterns, a day in the life of an individual or the group.

10. Not only should careful preparation be made for the trip, but in every case an expert should be taken along who knows vastly more than you do about the customs and lives of the people you plan to photograph.

11. The equipment should be simple, with no useless gadgets. The film should be limited to one make or brand.

12. In the field, the photographer should be so interested that he is able to work sixteen hours a day and take hundreds of pictures without feeling tired.

13. On returning from such an expedition, with three or four thousand Leica pictures, I select about 300 which tell the story. If they are good ones, this is enough.

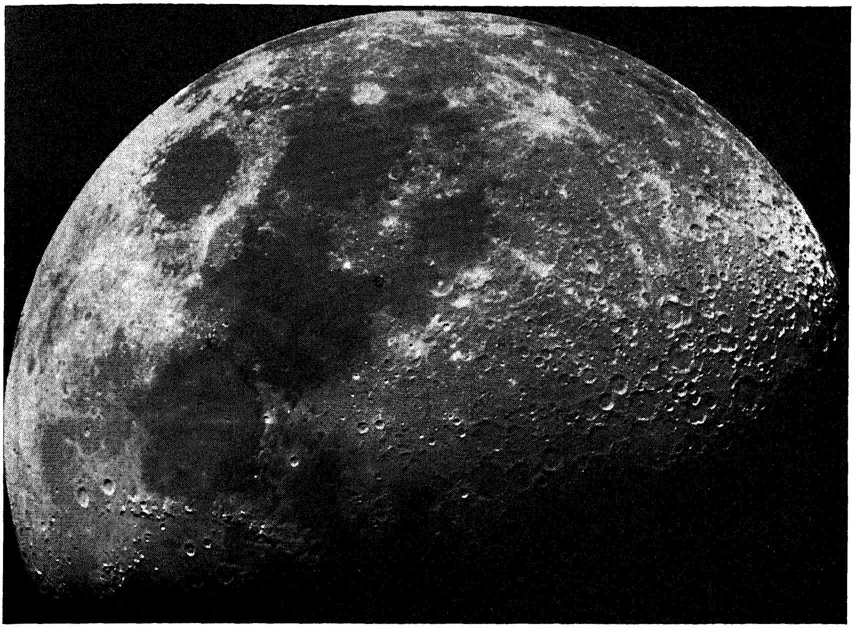


Fig. 432 Moon . . . Feb. 11, 1935 F. W. Schlesinger

Leica on Telescope, Focal length, 147 inches, Perutz Neo-Persenso, K2 filter, 10 seconds at f:15.

Mr. Schlesinger writes about this photograph as follows:

We have two telescopes here (The Franklin Institute of the State of Pennsylvania, Philadelphia) in the Astronomical Section of the Museum: a 10 inch Zeiss Refractor and a 24 inch Reflector by Fecher of Pittsburgh. We have been doing some astronomical photography with them, and I have tried some with the Leica, especially with the Refractor. The focal length of this instrument is 147 inches, and I have attached the camera so that the image is formed on the film without any eyepiece or camera lens intervening. Planetary images are too small, while the image of the moon is just barely too large for the frame of the camera. The reflector would be more satisfactory since it can be used at focal lengths of either 125 inches or 350 inches. I have been trying the Micro-Ibso attachment on the Refractor with fair results on the moon, and am sending you some prints of "lunar landscapes". Some of these prints are made with a 10x Eyepiece, Pan Film and a K2 Filter. The *f* value of the telescope is 14.7, exposures ran from 5 to 20 seconds.

As soon as the Reflector is available I expect to get some really fine pictures with this attachment, since this instrument has an *f* value of 4.5 and is, of course, perfectly achromatic, so that I can dispense with the filter. This will permit exposures from 1/10 of a second up. A shorter exposure is of great advantage in getting a sharp image, since it cuts down the motion of the image due to "bad seeing" or the unsteadiness of the atmosphere.

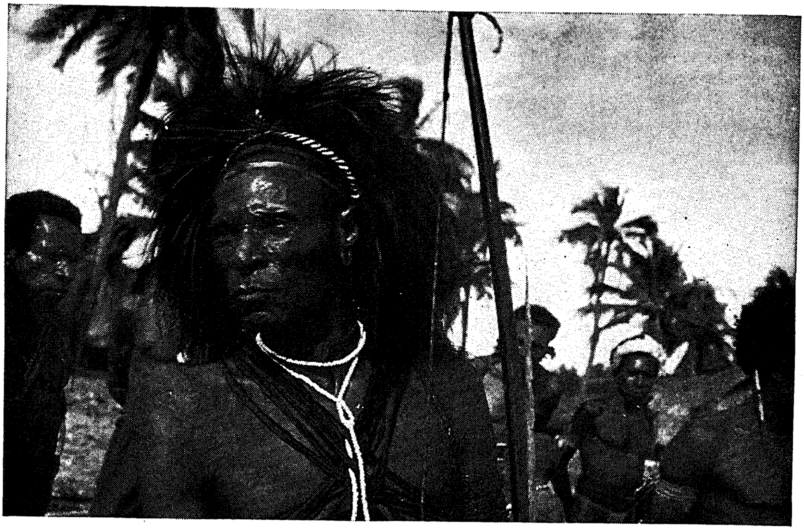


Fig. 433 A Fighting Man of the Delta Division, Papua, New Guinea, photo by John W. Vandercook

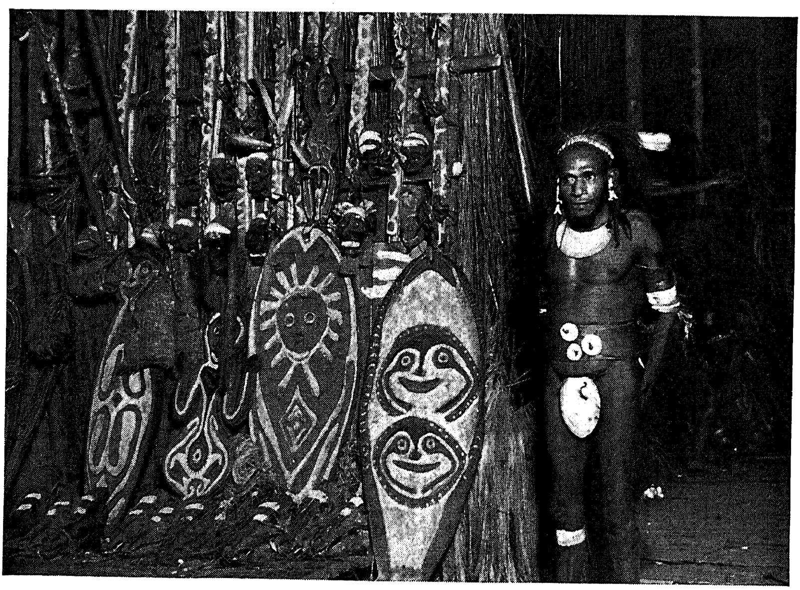


Fig. 434 Skull Collection and Native Carvings.—Interior of a Head Hunter's House, Swamp Country of New Guinea. Flashlight photo by John W. Vandercook

LEICA PHOTOGRAPHY IN THE TROPICS

Notes on Special Film Handling

JOHN W. VANDERCOOK CHAPTER 28

Several years of photographic work under difficult tropical conditions . . . a 600-mile trek across the Central African Highlands in the middle of the rainy reason . . . 400 miles by dugout canoe in the humid swamplands of southern New Guinea . . . and the highly variable conditions encountered in the uplands of Fiji and the Solomon Islands, have satisfied me of the singular advantages of the Leica camera, and the Leica method in general, for hot-country work.

One virtue which the Leica possesses is: It is the only camera I know of that when in use is sufficiently sealed to guard the film inside from moisture. Practically no humidity, I find, penetrates the closed camera. If the film has been cared for properly before and after use—satisfactory results are certain. Nothing can happen to it while it is *in* use.

My own methods of caring for film under tropical conditions—methods which have proven completely successful—are these.

I purchase all the film I need before leaving home. Even the less durable grades of super-speed pan will, I know from experience, last at least a year, if one takes care. And, so far as the tropics are concerned, I distrust the mails.

Some travelers order film to be sent out to them at various stages of their voyaging. The idea seems reasonable. Fresh film, straight from the factory, it should be fine. It is, unless it happens on the way to have had a long trip through tropical waters in the mail room of an average steamer. I have been in those mail rooms. They are usually amidships near the engines; near the equator their normal temperature is often well above 120°. And somewhere, in the midst of it, someone's film is simmering. For the same reason I allow no cases containing film to be taken to the baggage room. They stay with me in the cabin.

Film should be carried in a steel African uniform box. Boxes made in England for use in Africa and well worth the high price one pays for them—boxes guaranteed airtight and watertight. I have one which is large enough to hold, except for the cameras themselves, all of a rather extensive photographic equipment. It is roughly the size of an ordinary suitcase. And one should improve it in one particular which the makers overlooked. African uniform boxes are painted black when one gets them. Mine is now painted with a white enamel. When, as it often is, the box is being carried in the sunlight on the top of an African's head or a South Sea Islander's shoulders, the difference in the interior temperatures between a black box and a white one is decidedly perceptible. And very important.

All films, besides being kept in an airtight case, should be additionally protected in the usual way, by being packed in tins sealed with a twice-around wrapping of adhesive tape. There is no need to take any further means of preserving them until after they are exposed.

Then, in hot climates and under conditions of high humidity, it is inevitable that negative films, even in a very brief space of time, will absorb a certain amount of moisture.

Single quarter-plate film packs which I have used have absorbed, by actual measurement, more than a teaspoonful of water. This absorbed moisture, however, can be and must be removed by a very simple means.

A Simple Dehydrating Method

After a film is exposed return it to its tin, but seal in with it several dried squares of calcium-chloride saturated blotting paper. This chemical has the admirable characteristic of drawing extraordinary quantities of moisture out of anything with which it comes in contact.

The calcium-chloride blotters are prepared quite simply. Purchase a few ounces of pure *Calcium Chloride,* obtainable at any chemical supply house, and dissolve it in a small cooking pot full of water. Into this solution place forty or fifty 2 by 3 inch, or any other size which is convenient, bits of ordinary white blotting paper of a good grade, and simmer slowly over the fire until all the water had been boiled out of the pot. The blotting paper oblongs will be found to be sticky and still wet. Being careful not to scorch them, dry these in an oven. The moisture in them, it will be found, is driven off very slowly and the operation takes a surprisingly long time —but it is worth it. Thick asbestos paper could also be used for this purpose.

When the blotters are comparatively crisp and dry, seal them quickly into an absolutely airtight container. They will then keep indefinitely.

When an exposed film is returned to its sealed tin, put two or three of these pieces of blotter in with it, and after several days, take them out and replace them with fresh dry pieces. The old ones will be found to be almost incredibly saturated, but they may be dried out and used again an indefinite number of times. Repeat this process until, after an interval, it is found that the blotters are no longer absorbing any moisture. If another dry bit is put in for good luck the exposed film will in all probability remain in perfect condition in any tropical climate for from six months to a year and when at last it is taken out for development it will be found to be bone dry.

Developing the Film

Development is of course extremely difficult in the tropics. There is usually inadequate water, and that is warm. But, if Calcium Chloride is used, there is no reason to hurry. It is, I have proven to my own satisfaction, far less hazardous to wait for good developing conditions than to attempt bad ones.

Large negatives, of course, can be developed at high temperatures with the assistance of special hardeners and the results, if one is more than usually skilful in technique, will be perfectly satisfactory.

But Leica films, I am convinced, *must* be developed at low temperatures and only at low temperatures. No matter how efficient the hardener used, irreparable damage will have been done to the

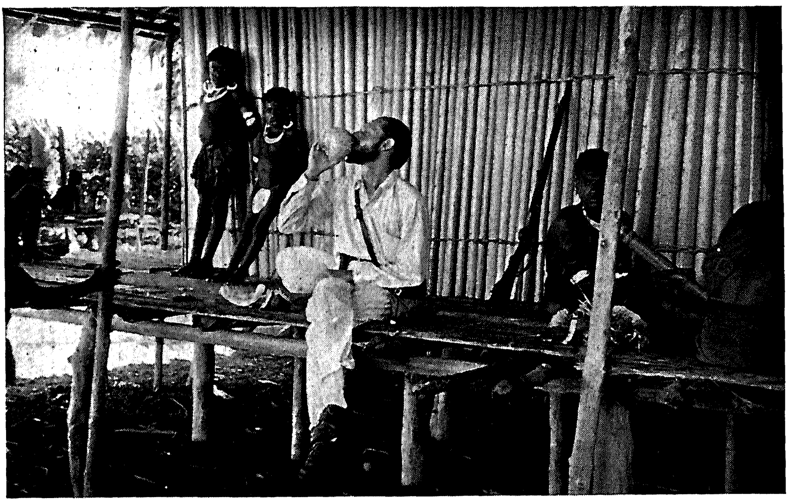


Fig. 435 John W. Vandercook Stops for Refreshments in New Guinea.

grain of the film in the first minute or two of development in a warm solution. *Wait for ice.* Wait, if necessary, for months. It will be worth it.

When at last ice is obtainable, keep all solutions *below* 65°. If still in a warm climate, start the development at 60° or even lower, and leave a thermometer in the solution during the whole period of development. By the time the development is finished the temperature of the solution, do what one will, will have risen perilously. To time the development accurately, one must therefore strike an average. For example, if development has started with the solution at 60° and has then risen to 70°, time as if for a temperature of 65°. Rinsing water and hypo had best err on the side of coldness rather than warmness. The same rule holds for the washing water. Also it is as well to remember that the actual dissolving of a dry developer raises the water temperature. Allow accordingly. It goes without saying that if one is using ice, water is scarce. Leica film has no more useful characteristic than the small quantity of water it requires for thorough washing. If a Reelo tank is used, fill it up, let it stand for a minute or two, then swish the water out of it with a vigorous rotary motion. If this is repeated six times the film will be quite clean. Eight changes are just so much safer—*if the tank is constantly handled, rotated and shaken, then completely emptied before the next bath is poured in.* With practice (touch the film to your tongue), taste is an excellent indicator as to whether or not a film is free from hypo. (Water containing hypo has a characteristic sweetish taste.)

Six quarts of water are sufficient for the development, fixing and washing of one Leica reel—an economy of great importance in most tropical countries.

Dry the film thoroughly with ultra-soft chamois or a very old and oft-washed bit of soft cotton material, and dry away from dust.

Incidentally, patent hypo-removers, in my experience, are fatal to Leica negatives. They have a curious explosive effect upon the texture of the negative which, though it would not be noticeable in the case of large pictures, produces extremely coarse grain.

Another point. The wise traveller avoids carrying liquids. Take along a dry developer. With equal reason, avoid developers that are put up in fragile glass tubes. Those tubes, if travelling is hard, will break with amazing ease.

And, most important point of all, a black cloth changing bag such as is made for motion picture use is the essence of pleasant

Leica travelling. A changing bag frees one from the need of a dark room and all necessary Leica operations can be performed in one. I buy my negative film in 100-foot spools and cut and wind them in a changing bag. Film may be introduced into the Reelo tank in a changing bag—and if one is using film faster than one has an opportunity to develop it, exposed films may be transferred from their cylinders to an empty 100 foot spool for storage and for Calcium Chloride dehydration—in a changing bag.

One final point. Some Leica users have difficulty in getting film ''started'' in the Reelo tank—the one which I personally prefer for tropical and changing bag use. Try this. Before attempting to get the film into the Reelo spool, first unwind it completely from the film magazines. For one thing, the ''far'' end is already shaped to a point suitable for insertion in the Reelo spool; for another, the weight of the cylinder, pulling at the film, tends to cause buckling. One works more smoothly with no impediment other than the film itself.

EDITOR'S NOTE: Elimination of atmospheric humidity (dehydration) from photographic materials and equipment presents quite a problem to photographic workers in the tropics. Primarily, but not exclusively for their benefit a new standard product known as "SILICA GEL" is recommended for this purpose. This is a manufactured material, hard and glassy, resembling in appearance the clear quartz granules. Silica Gel is highly porous and hygroscopic. Its pores are invisible but their capillarity is quite remarkable. The material will absorb up to 50% of its own weight of water from saturated air. Being chemically and photographically inert it is an ideal material for dehydration of photographic materials. It can be used over and over again: it is easily reactivated or regenerated by heating at a temperature of 300° F. (150° C.) for from three to four hours. This is easily accomplished by placing Silica Gel in an ordinary kitchen oven.

Silica Gel can be obtained from The Davison Chemical Corporation, Silica Gel Division, Rouse Building, Baltimore, Maryland.

Silica Gel should prove very popular among miniature camera workers for such odd tasks as dehumidification of films which stubbornly form Newton rings in the enlarger. A Leica worker in West Africa reports that he made an airtight camera case containing two trays filled with Silica Gel. This arrangement not only dries out the film while it is in the camera, but also prevents formation of mould in the camera mechanism and between the lens elements, something which frequently puts the camera out of commission in that part of the world.

Fig. 436 Photomural . . . New York Skyline

John T. Moss, Jr.

PHOTOMURALS WITH THE LEICA

JOHN T. MOSS, Jr.

CHAPTER 29

In Chicago in May, 1934, the world's largest photomurals were presented to the public in the Ford Exhibit at "A Century of Progress". These photomurals, which were photographic enlargements, formed a basic part of the wall itself and decorated a wall area twenty feet high by five hundred and eighty feet long. The individual pictures, of which there were thirty in number, were twenty feet high and ranged from eighteen to thirty feet in width. I had the interesting experience of being closely connected with the making and installation of this huge job of "pictorial wall papering". I have been asked many times to describe the procedure of making these enlargements, and knowing my interest in Leicas, quite often the broadside of questions concerning the photomurals would begin with, "Of course these enlargements were made from Leica negatives?" (Said with a gleam in the eye, which indicated a readiness to call me a liar if I answered in the affirmative.) The answer was obviously "no", but the idea of making photomurals from Leica negatives is by no means as absurd as it may sound. It can be done as accompanying illustrations show.

Relation of Photomurals to the Architecture

Photomurals are not just large photographs hung on the wall. The same principles apply to photomurals as do to painted murals. They should bear some relation to the wall space and surrounding architecture. There are, of course, many different types of rooms and if two extremes of the range of variation are selected, it may seem that the same principal could not possibly apply to both. After a close study of the two, however, it will be evident that the same foundation supports both types. Let us consider the treatment of a small room, two walls of which are paneled by moldings into three square panels each, each panel containing a four foot square photomural which is a complete scene within itself. Compare this to a long strip of wall space ten feet long and two feet high, above several doors on a flat wall. In the long narrow photomural a continuous scene may be used which is selected because it has certain accents in the pictorial composition which occur over the doors. Thus the picture itself relates directly to the architectural structure of the wall. In the paneled room, the type of decoration divides the wall into definitely formed spaces and the picture in each space can therefore be complete within itself. There is still no reason, however, why these three separate pictures cannot bear a relation to one another in mass, subject matter and general composition.

A good general rule to follow in making a picture for a wall decoration is to select the wall space to be decorated first, and then decide on the photograph to fit the space. Too many people would be inclined to make an enlargement of some arbitrary dimension and then stand in the middle of a room and wonder on which wall it would look best. This is hanging a picture, not making a mural to fit a wall space. Areas of wall at the sides of windows or between doors are often hard to decorate in the customary manner, and yet they often lend themselves very well to the use of photomurals. If such a space is chosen, care should be used to relate the area covered by the enlargement directly to the wall as a whole. Establish the limits or breaks in the wall itself and make the top or bottom of the picture line up with the top of a door or a molding, limiting its width by some other definite line on the wall. If this is not done the mural will not relate to the area of the wall, but will just be another picture "hung" at random on the wall. Elements or lines of the photograph itself can also be made to run parallel with, or line up with limiting masses or lines of the wall. When the mural is being planned these lines should be given careful consideration.

In most cases it will be found that only a part of the negative will be used. When the enlargement is made, study the projected image in proportions of the chosen wall area. Mark off the unwanted parts and see which part of the picture fits best into the space. **It is often wise, at first, to make small prints about five inches by seven inches and crop them to the proportions of the wall area which has been laid out at one-quarter full size (1 ft. to 3 in.).** After the composition has been studied and arranged to the best advantage, mount these small prints upon heavy cardboard cut to the proportions of the wall space to be filled. This will allow you to see how all of the pictures will relate to each other when they are mounted in final size on the wall.

With a little careful study a picture can usually be found that will tie in pretty well with the wall space selected or with the room itself, if more than one wall is to be used. The relation of the picture to the decoration of the room can even be carried as far as the furniture, if desired. If a high bookcase or cabinet is to be used in the center of the wall, the composition of the picture should relate to the point where the high mass of the piece of furniture breaks up into the picture. This is basically the same relation as mentioned before in the case of doors, and can be treated very effectively. If an unbroken wall space is to be used the photographs themselves can divide the room into panels and at the same time unify it as a whole. An example of this, on a large scale, is the photomural in the N. B. C. Studios in Radio City, New York. Here the photomural runs continuously around a circular room, but is divided into sections by the subject matter and tone of the prints of the photographs. A dark print is used next to a lighter one, but care had been taken not to get so much contrast that the wall as a whole would not tie together.

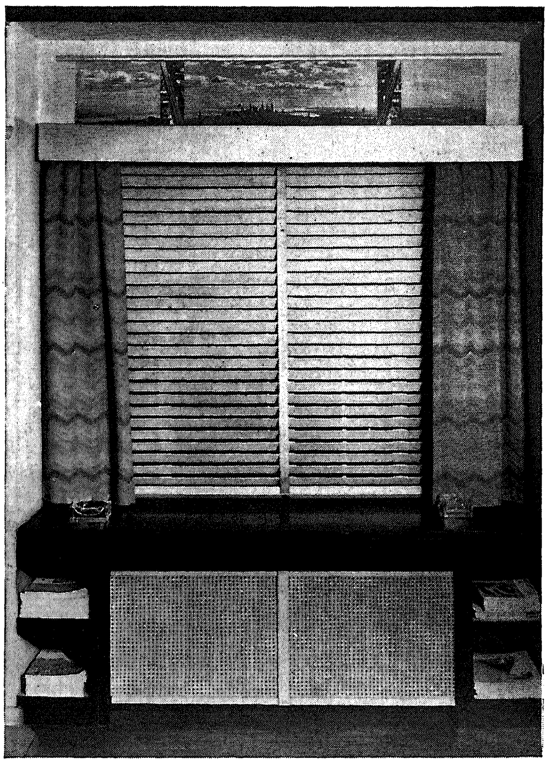


Fig. 437 Photomural by John T. Moss, Jr. Showing its Relation to Window and Wall.

The mural thus portrays the separate elements of broadcasting, but at the same time provides the room with a unified wall decoration.

Physical Limitations of Size

The Leica user cannot expect to produce photomurals twenty feet high by twenty-five feet wide. The manufacturing processes involved in the making of murals this size or even one half this size are beyond the physical capacity of most camera users. But what Leica user wants a photomural that size? It would be like having the Graf Zeppelin tied up in one's backyard. The Leica is a miniature camera, so scale down your photomurals accordingly. Even if you only make a mural three feet by four feet you will be making a greater enlargement in proportion to the Leica negative than the twenty-foot by twenty-five-foot enlargements, which were made from 8 x 10 negatives, resulting in a magnification of about twenty-four diameters. This scaling down does not mean using an 8 x 10 foot print stuck on the wall as a photomural. Two feet by three feet is a good size to begin with.

The large professionally made photomurals in most cases cannot be printed on one sheet of paper. The largest paper comes in rolls forty inches wide and several hundred feet long. This means that there must be one joint in the paper about every three feet. Very few photographers have the equipment to develop paper as large as three feet by ten feet thus making it necessary to use a horizontal as well as a vertical joint in most photographic murals. This does not harm the mural, however, if the matching of the tone values is carefully done. The average Leica user is probably limited to an eleven by fourteen inch sheet of paper, but this does not prevent him from making a mural to fit a larger space. If you are fortunate enough to have a tank that will take a piece of paper two by three feet or larger, by all means use it. It will eliminate much of the time required by matching. On the other hand, don't let your eleven by fourteen inch trays keep you from making a 4 x 5 foot mural, if you want one.

Subject Matter

Subject matter in photomurals is quite important. Just a large picture of little Junior sitting on the steps of the front porch will probably not make a good photomural. Junior has his place, and a very important place in most cases, but he doesn't do so well enlarged to half life size looking at you from the wall of the den with his best grin. The picture selected should be good from the standpoint of composition and not just the snapshot variety. That picture of Aunt Sophie on the steps of the Capitol at Washington probably is a swell likeness of Aunt Sophie, and anyone could be sure that the location is Washington but, enlarge it to two by three feet and put it on the wall and the answer is, "So what?"

Pictorial subjects for murals should have beauty or action or both. If the action is good, it will show a grace of line and mass which will be appropriate to the composition in most cases. Landscapes or general out-of-door scenes quite often lend themselves very well, if the object is just to fill a wall space with a pleasing picture without any particular purpose of telling a story. If, on the other hand, the subject matter of the mural is to directly relate to the type of room in which it is used, then indoor as well as outdoor shots are suitable.

It is taken for granted that most Leica users would make photomurals for their own homes, or at least for rooms in which the character of the picture would be governed by personal interests of the Leica owners or their friends. If by chance you have the opportunity to decorate the walls of an office, a store, or a club by all means go to it. **Industrial subjects are excellent for photomural work** and he who can get a commission to portray the workings of a factory for the office wall of the president, for instance, has a job which is one of the most interest.

Game rooms are among the best rooms in the home to decorate with Leica murals. On the walls can be shown shots of people using the ping pong table which is located in the room itself. Close-ups of trick pool or billiard shots could be arranged into a very decorative design along the wall.

The den, or library, is also an ideal place for photomurals. Golf, tennis, fishing, hunting or any of the outdoor hobbies of the Leica owner can be represented. The trips or tournaments of the summer months can be with you all the year round, and make an appropriate decoration for the walls.

Hallways and entrance vestibules are good places to decorate. Because they are only connecting links or entrances to other rooms, they can be treated in a more abstract manner as to subject matter. Here is a good place for your favorite landscape, whether it be a shot of Morro Castle in Havana, or a lucky exposure of the snow capped peaks of the Rockies at sunset. If the hall is a long and narrow passage a series of shots could be worked together to show in resumé fashion an automobile trip through Canada, or the West. Pick out the best shots and arrange them so they are in sequence, and bear a relation to each other in composition along the wall.

One thought for a bar or drinking room is a series of Leica close-ups showing the mixing and ingredients of the popular drinks of the present day. If such shots are carefully illuminated during the photographing, the prints will work into a very decorative pattern of highlights and shadows. Your guests will know exactly what they are getting when they order their favorite drink.

Another thought for the background of the bar itself is a shot of liquor bottles well arranged. With some of the good displays in the present day liquor store windows at one's disposal, a shot like this ought not to be hard to find.

If you are adept at facial expressions and wish to decorate the wall with a flavor of humor, get a long cable release and shoot yourself registering various states of emotional anticipation as you are about to indulge in your favorite mixture.

Children's playrooms or nurseries are good fields to experiment with. Here the murals may be treated in an educational manner or as a record of the junior members of the family. Here is the appropriate place for the children, but show them in action, if a record of children is the type of mural desired. Children on the beach or in camp offer many chances for good composition regardless of whether it is your own child or not. It is a good idea when arranging the pictures to forget that the children bear any relation to you, but keep only the composition of the space in mind. By doing so you will not be tempted to detract from the decorative quality of the wall by putting in a picture of your daughter, which may not fit in the scheme, simply because she wears your favorite expression in that shot.

From the educational angle, pictures of the zoo might be arranged around the wall of a child's playroom and serve the same purpose as juvenile picture books. Modern toys lend themselves very well to photography. With a little imagination, a very decorative and amusing band of shots might be made using the child's own dolls and toys.

Garden or floral shots can be very effectively used in decorating dining rooms walls. These might be used in the form of a continuous band, or if the dining room is divided into panels, such as are often found in Colonial houses, these panels can be filled with photomurals. In using floral shots, a more effective picture can be obtained by making close-up shots rather than general broad views of an entire garden. The close-up shows the beauty of the flower itself and is more interesting to the observer. When garden shots are taken for photomural purposes, get a group of flowers in the foreground of the picture to further enhance the beauty of the entire garden in the distance. As in any type of picture, this gives the photograph depth and prevents the picture from appearing flat and unreal. Beautiful landscapes are appropriate for the dining room. A panorama type of shot used as a continuous band or split up into panels would be very effective.

Composing the Photomural

Remember that in all previously mentioned examples the entire wall space does not have to be covered with photographs. In most cases it is much better not to cover too much of the wall. By only using a single space at one end or side of the room, the photograph takes on much more importance and you do not get the effect of the room just being papered with pictures. Photomurals are not just wallpaper in the all-over sense of the word. Wallpaper designs have been made from photographs, but a mural requires an entirely different treatment. The larger the area one attempts to cover with the enlargement the more difficult the composition of the wall becomes, so it is well to start out on a small scale until one makes a few successful experiments.

In figure 436 the space above the window is approximately six feet by one foot, and the subject matter was chosen both for its horizontal feeling and because of its local interest. Here the panel has been divided by a vertical picture strip on each side in order to separate the two scenes at each end. These two end scenes are located in the mural as they actually are in the New York skyline, but as they were taken about one-half minute apart, the clouds did not match with the clouds in the central panel. The shot of the elevated railroad tracks was therefore used in a purely abstract manner to separate the three views. The same shot was used on both sides, the negative being reversed on the right side in order to have the two diagonals of the pictures extending toward the center of the window. The horizontal feeling of the Venetian blinds of the window, broken by the two vertical tapes are thus repeated in the photograph by the horizontal clouds and skyline broken by the two vertical strips.

Because of the shape of the space horizontal joints in the paper were not necessary. There are two vertical joints in the center picture, but by careful matching these do not show at all. There is a joint on each side of the two vertical panels, but because these are frankly used as separating inserts in the composition, the joints are not a problem of matching. The Leica mural thus ties in well with the end of the room and makes a very interesting panel above the window, as well as presenting a view of the New York harbor which cannot be seen from many places in the City.

The above is just a simple example of what can be done in the living room. Innumerable variations of composition and subject matter are waiting for Leica users to make the most of. **There are few rooms in the house which could not be made more attractive by the use of Leica murals.** The bedroom, the bathroom, and even the kitchen, if the cook will allow it, all have their possibilities. A frieze of shots of truck gardens or cleverly arranged vegetables might make the kitchen a bit more unusual and decorative. As to the bathroom, if it has a tile wainscot six feet high, a narrow band of goldfish shots might be used just above it. Another possibility presents itself in a collection of shots of the surf taken while on a vacation at the shore.

In the case of the kitchen and bathroom shots, the photographic paper may be sprayed with a thin coat of colored or transparent lacquer in order to tone it in with the general color of the walls. Care should be taken in doing this, as too much color will obliterate the details of the photograph. But a thin coating will add rather than detract from the general effect. A cheap spray gun may be purchased for this purpose. Care should be taken to mask off the wall area directly adjoining the mural when spraying the lacquer.

Grain and Viewing Distance

One of the most important things in the making of satisfactory Leica murals is fine grain of your negatives. If your negatives contain as little obvious grain as possible the enlargements will be of the best. It might be the case, however, that a negative selected from your file which seems to fit perfectly in a certain wall space shows quite a bit of grain when enlarged to the required size. If the wall area is in a darkened hall or up high for instance, this grain will not be noticed, particularly if the viewing distance is great enough. A mural such as shown in figure 437 could contain more grain than one which was to be viewed close at hand. This mural is about nine feet above the floor and in order to see it at the proper angle a person has to stand about six or eight feet away from it. At such a distance an average enlargement of grain would not detract from the mural. This does not mean that grain should be disregarded, and paraphenylene diamine or some similar fine-grain development is recommended as it will give the best results when enlarged. It simply illustrates that you can use a negative with grain in certain instances. If negatives are made purposely for the mural, decide what effect you wish on the wall and keep that in mind during the taking of the picture, the development of the negative, and the printing of the enlargement.

The actual making of Leica murals requires no more skill than it takes to make any eleven by fourteen inch enlargements, but it does require more patience.

If the design on the wall is to have the effect of a pattern of blacks and whites, get contrast in the negative and make prints which bring out this quality. If the wall is to have a general tone carried out by the mural, make the negatives less contrasty and print all of the pictures with the same general tone of gray. Negatives which are made especially for photomurals should be developed for a slightly shorter time than the average negative. It will be found that negatives which might be considered thin for a 5 x 7 inch print will produce a very satisfactory 20 x 30 inch enlargement. This is particularly true if a paraphenylene diamine developer is used.

Technical Photomural Procedure

There are two ways of projecting when an enlargement of more than the average size is desired. The Valoy enlarger can be turned horizontally, and the image projected upon a wall or it can be used vertically in more or less than usual manner.

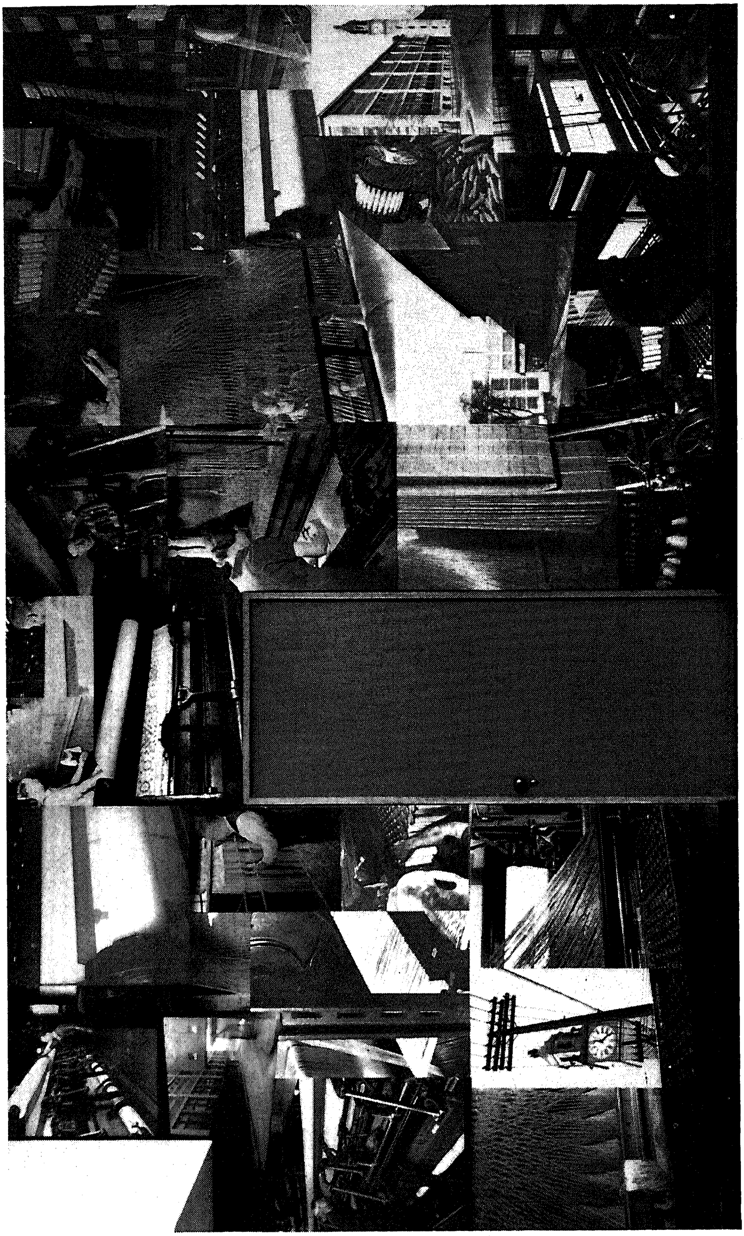
If the horizontal method is used, the swivel extension arm is a very handy accessory. This allows the lamp housing to be swung at right angles to its normal vertical position, and fastened with a set screw. If, however, one does not own a swivel arm, the enlarging stand may be used horizontally, but some method must be devised to support the free end of the tubular upright. Books or a box of the right height can be used, or a cradle of wood can be made with little effort. Thus the baseboard of the enlarger serves as one support and the books or box the other, the whole set-up taking the shape of an inverted letter "U". The enlarger housing must be moved around on its supporting arm until it is directly above the tubular support. In this position it can be moved forward and backward until the projected image on the wall or vertical screen is the desired size. Care must be taken to hold the enlarger housing with one hand when the other hand is used to move it along the tubular support, or it will swing down on one side or the other, upsetting the whole enlarger easel and possibly damaging the enlarger itself. Be sure that the tubular support is perfectly level, namely that the improvised support is the same height as the depth of the easel board which is fastened to the other end of the tube. If the tube is not level the projected image will be distorted. After the enlarger is set up in this position, some sort of surface should be selected to receive the projected image, such as compo-board or sheet cork, to which the photographic paper can be fastened with thumbtacks. A large drawing board may also be used. This board or projection surface is also useful in focusing, as a sheet of white paper can be tacked to the surface and the enlarger focused sharply. The white paper should then be removed and replaced with the photographic paper when the print is made. This horizontal method is perfectly satisfactory and will give enlargements of great size, but because the enlarger is in an unusual position some Leica users might find it awkward to manage.

The second method is one in which the enlarger remains in a vertical position. It can be placed upon a table of normal height (thirty inches), and raised to full height of the standard upright and it will enlarge the Leica negative to approximately two by three feet when turned around 180° from its normal position above the easel and projected upon the floor. The easel board should be weighted or clamped to the table to keep the enlarger from tipping over. This is the method that was used to enlarge the sections of the mural in figure 436.

A piece of white paper was placed on the floor for the purpose of focusing, and also to determine where the various dividing lines of the sections of paper would occur on the image. The white paper had been marked off in rectangles the exact size of the various sections of the mural; and where the lines of these rectangles divided the projected image were to be the divisions at which the sheets of printing paper had to be joined. The enlarger remained in one position so this method of plotting the position of each section of the mural in relation to the whole image was quite important in making sure the image matched perfectly at the edges of the sections. Only the skyline part of the negative was used as there was more sky than necessary in the frame of the picture, for this composition.

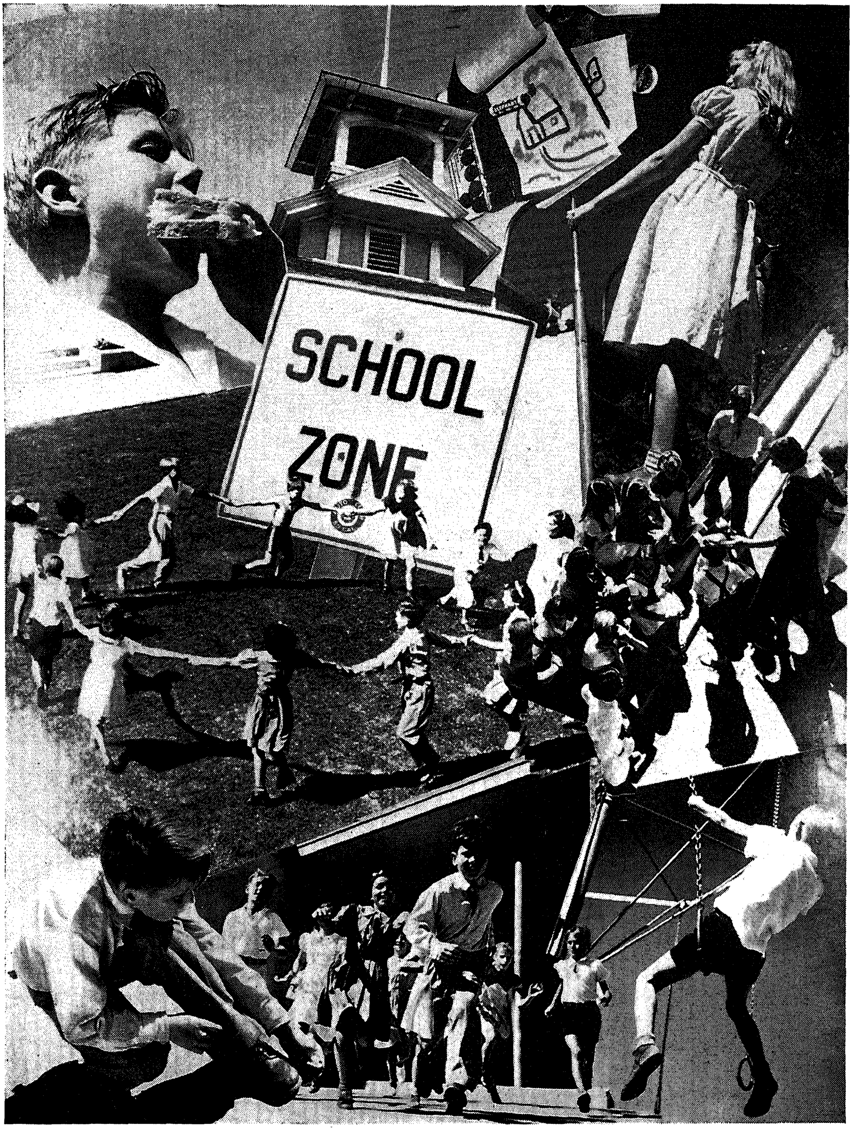
After test strips had been made to determine the tone value desired, the projection was then made on three eleven by fourteen inch sheets for the center picture starting at the left side. The image was overlapped about three-quarters of an inch on each piece of paper, so there would be a safety margin when the sections were mounted. Thus by having a slight bit of the same part of the image along each of the edges of two sections which are to be joined, it is easier to match the parts of the picture and there is no danger of leaving out a section of the picture in attempting to project just what is to finally appear on each section. The foreground was masked in each of the exposures in order to darken the sky and give the whole picture a general dark tone. The exposure was one and three-quarter minutes on the whole picture and then the sky was exposed for another one and one-quarter minutes, masking the foreground. A shorter exposure could have been made by using a photoflood bulb in the enlarger. The negatives of the end panels were then exposed in the same manner, the test strips having shown that the exposure was the same as the center panel. The two inserts were then exposed for a period of time that would give them a slightly darker tone than the center and end panels. This value was determined by a test strip and used to further emphasize the vertical breaks in the composition. The prints were made on Eastman Vitava Projection Paper (C2), but single weight paper is preferable as it will not curl at the edges as easily and pull away from the wall after it is mounted.

The timing of the exposure and of the development is important, as even small variations will give a different tone of gray and thus show a line where the two pieces of paper are joined together.



Photomural at the Scranton Lace Company office, Textile Building, New York...by Barbara Morgan, Willard D. Morgan...John Weber, Architect

This photomural, measuring 10 by 20 feet, covers one wall and is composed of forty individual pictures, representing various steps in the manufacturing of lace curtains



Photomural

Victor Haveman

Care should be taken in the focusing of the image. This can be done at f:3.5 and then the lens should be stopped down to between f:4.5 and f:6.3 as the spread of light is more uniform at this opening. Certain negatives may be found difficult to focus sharply when they are enlarged to 30 or 40 diameters. One method of setting the focus is to remove the negative from the enlarger and place a small feather between the condenser and the frame which carries the negative. The lens should then be focused sharply on the finest part of the feather. The fine lines of the feather will be finer than any line on the negative, enlarged to this size, so if the feather outline is sharp one can be sure that the negative will be, with that adjustment. Remove the feather and leave the enlarger set at that focus during the projection of the negatives.

After the sections of paper were carefully developed and fixed they were allowed to dry in the usual manner. The edges of the dry prints were then skived or pared; that is, they were turned face down and the edges were thinned by tearing off a thickness of the paper about one-half inch along the edge. This bevels the edges of the paper and prevents the edges from peeling off along the joints after they are pasted to the wall. It also prevents a double thickness of paper at the joint, which would show. If the paper is beveled down as thin as possible without tearing the edge, the overlapping edges of the two sections will amount to the same thickness as a single sheet of paper. The edges can also be beveled by rubbing the back with sandpaper until the edge of the paper is almost as thin as tissue paper. Thin muslin was then applied to the wall (or mount) with vegetable glue thinned to a brushing consistency. The sections of photographic paper were then wetted and glued to the muslin surface (after it was thoroughly dried). The matched joints should overlap about one-half to three-quarters of an inch. If the edges have been thinned as described above there will be no double thickness of paper at these points. The various sections of paper should be carefully applied so that horizon lines or other parts of the image match perfectly.

If you do not wish to apply the mural directly to the wall, it may be applied to masonite, or wall board. One-eighth inch thick masonite will carry quite a large mural without any extra bracing on the back of the panel itself. If the murals are mounted in this manner they may be changed from time to time without damaging the wall surface. The prints should be spotted very carefully as defects will show up on a mural and detract from the decorative effect of the wall. This spotting can be done with a brush and India ink, or on large enlargements a paper stump and charcoal pencil will often be effective. The charcoal pencil will work particularly well where even tones are desired to cover a large defect in the print. The pencil should be rubbed over the spot lightly leaving a series of lines. These lines should then be blended into an even tone by rubbing them with the paper stump, or a piece of cotton.

The above mentioned examples are undoubtedly not all of the uses for Leica murals but they should serve as a start toward another service for this many-purpose camera. Whatever the location of the Leica mural, relate it directly to the wall, don't just "hang it."

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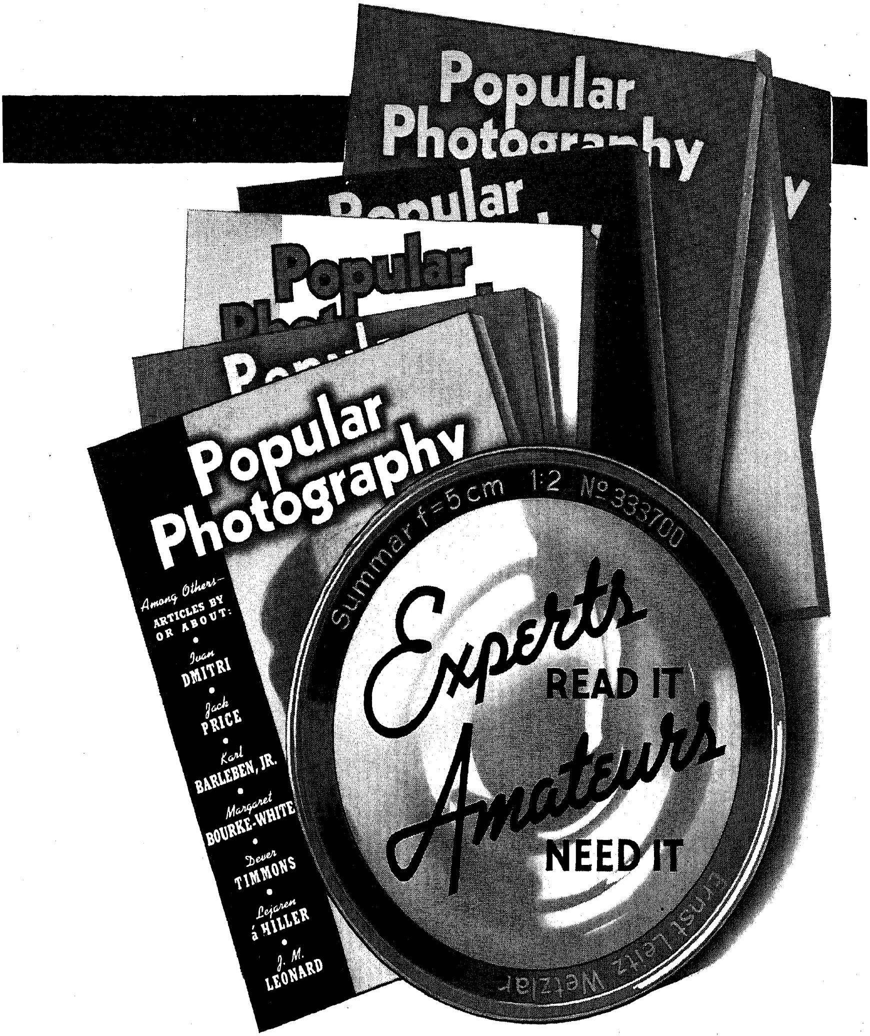
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Jack PRICE
Karl BARLEBEN, JR.
Margaret BOURKE-WHITE
Dever TIMMONS
Lejaren á HILLER
J. M. LEONARD
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BATON ROUGE, LA.	**Stroube Drug Co.**	
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	Andrew J. Lloyd Co.	300 Washington St.
	Pinkham & Smith Co.	15 Bromfield St.
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	E. B. Meyrowitz, Inc.	255 Livingston St.
	Geo. J. McFadden, Inc.	202 Flatbush Ave.
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	Buffalo Photo Material Co.	37 Niagara St.
CAMBRIDGE, MASS.	**Belluche Photo Service**	180 Franklin St.
CHARLESTON, W. VA.	**Camera Shop & Photo Supply**	110-a McFarland St.
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CHICAGO, ILL.	**Bass Camera Co.**	179 W. Madison St.
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	Central Camera Co.	230 S. Wabash Ave.
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	Norman-Willets Co.	318 W. Washington St.
	Von Lengerke & Antoine	33 S. Wabash Ave.
	Wolk Camera Co.	335 S. Dearborn St.
CINCINNATI, OHIO	**Huber Art Co.**	124 W. 7th St.
CLEVELAND, OHIO	**The Dodd Co.**	1025 Huron Rd.
COLORADO SPGS., COLO.	**Photo-Craft Shop**	218½ E. Pikes Peak Ave.
COLUMBUS, OHIO	**Don McAlister Camera Co.**	73 E. State St.
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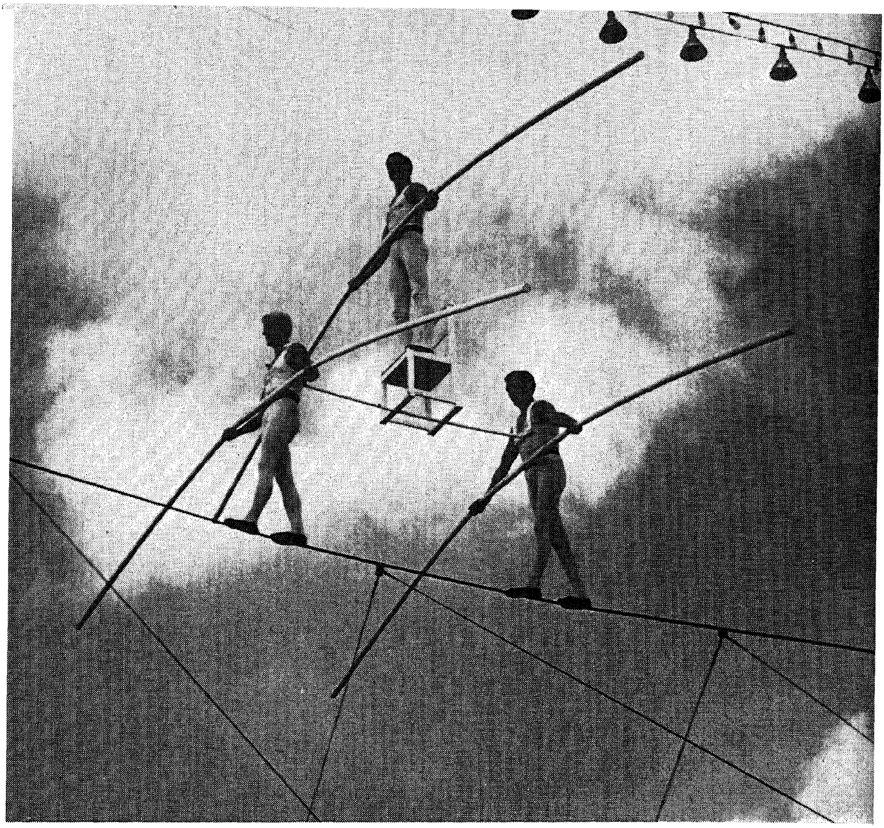

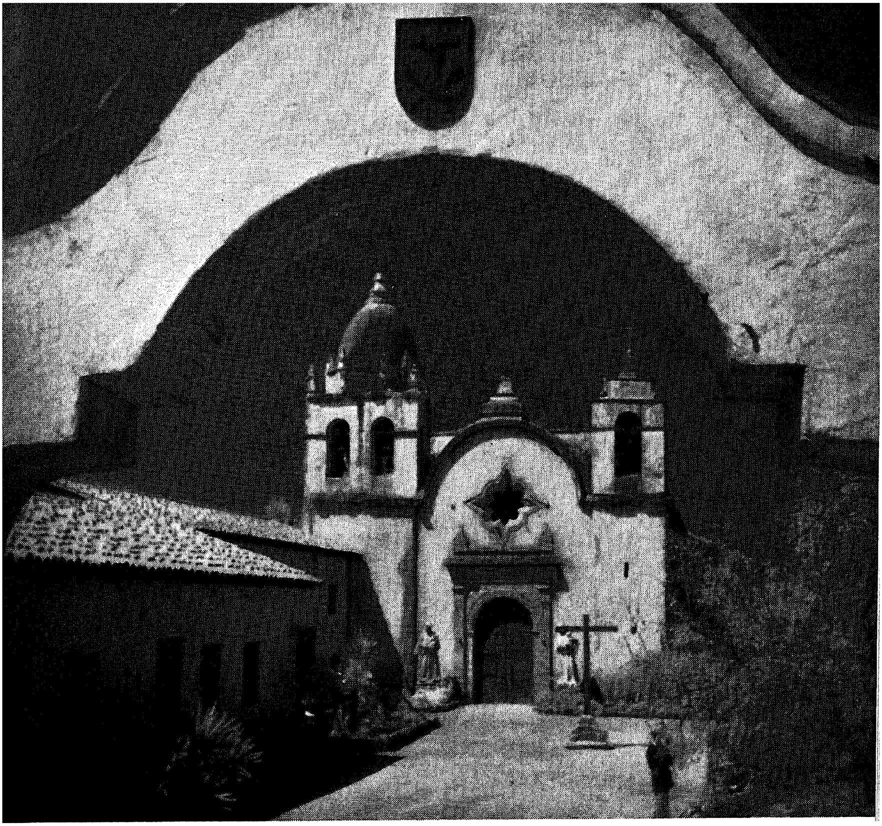

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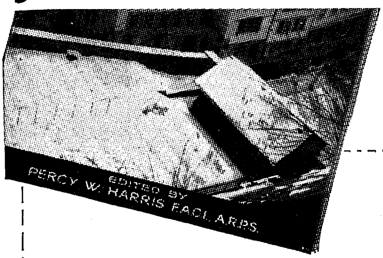

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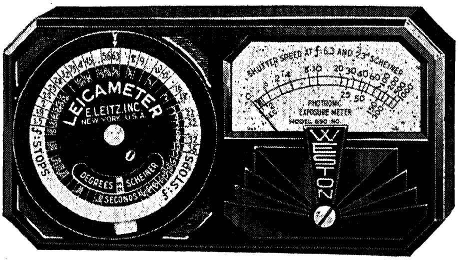

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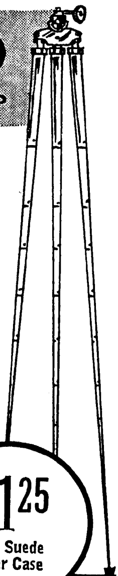

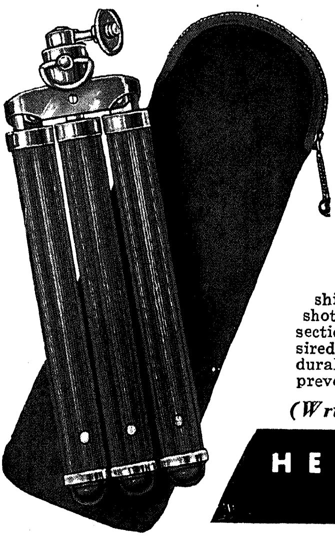

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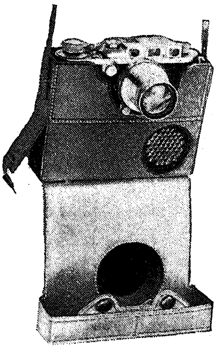

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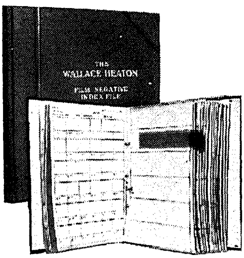

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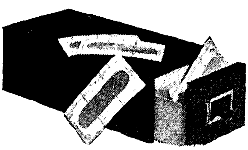

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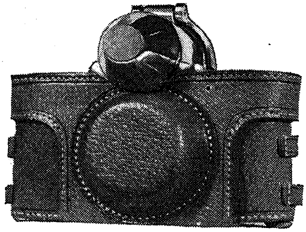

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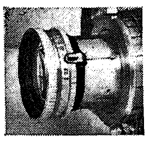

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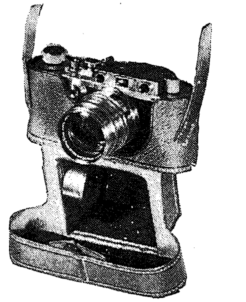

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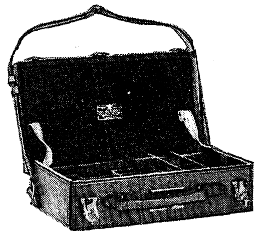

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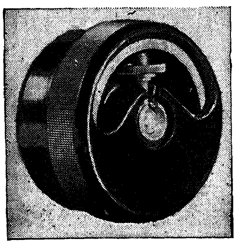

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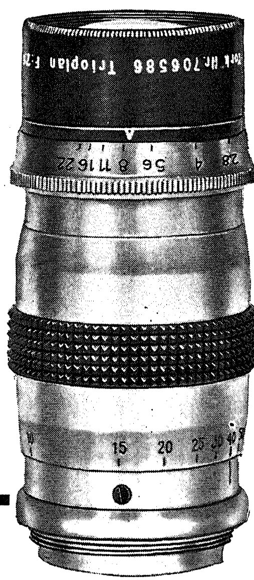

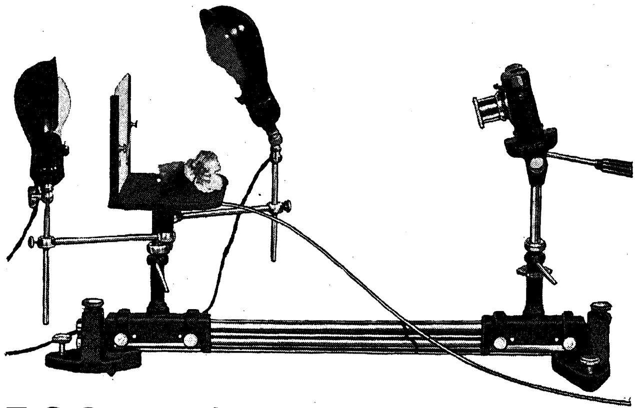

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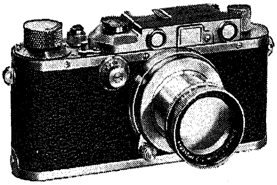

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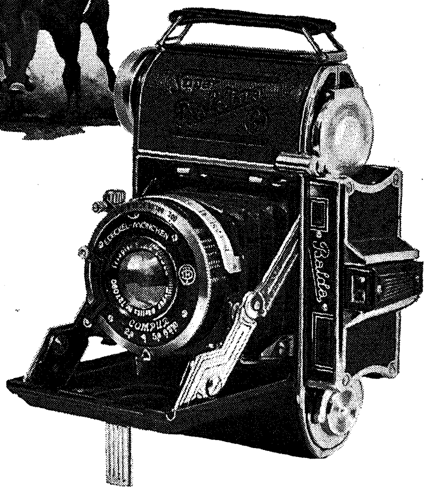

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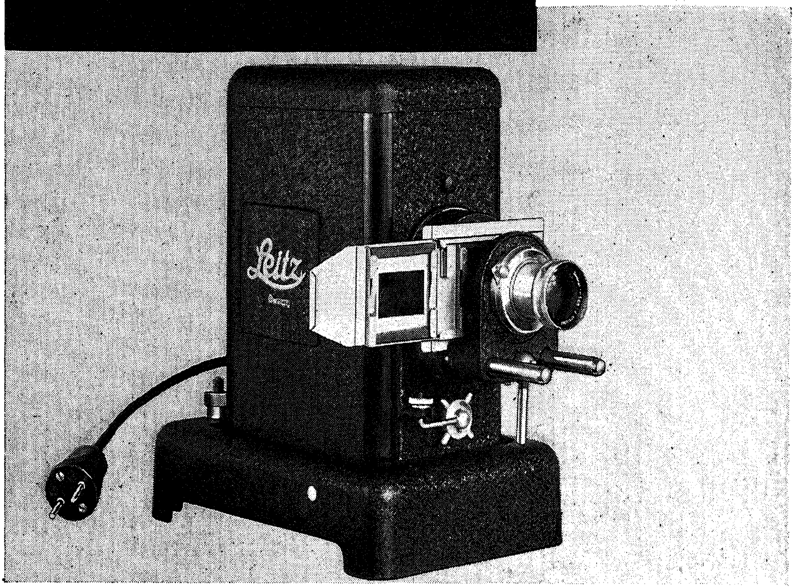

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