The NEW LEICA MANUAL

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AND 24 CONTRIBUTORS

A Manual for the Amateur and Professional covering the field of Leica Camera Photography

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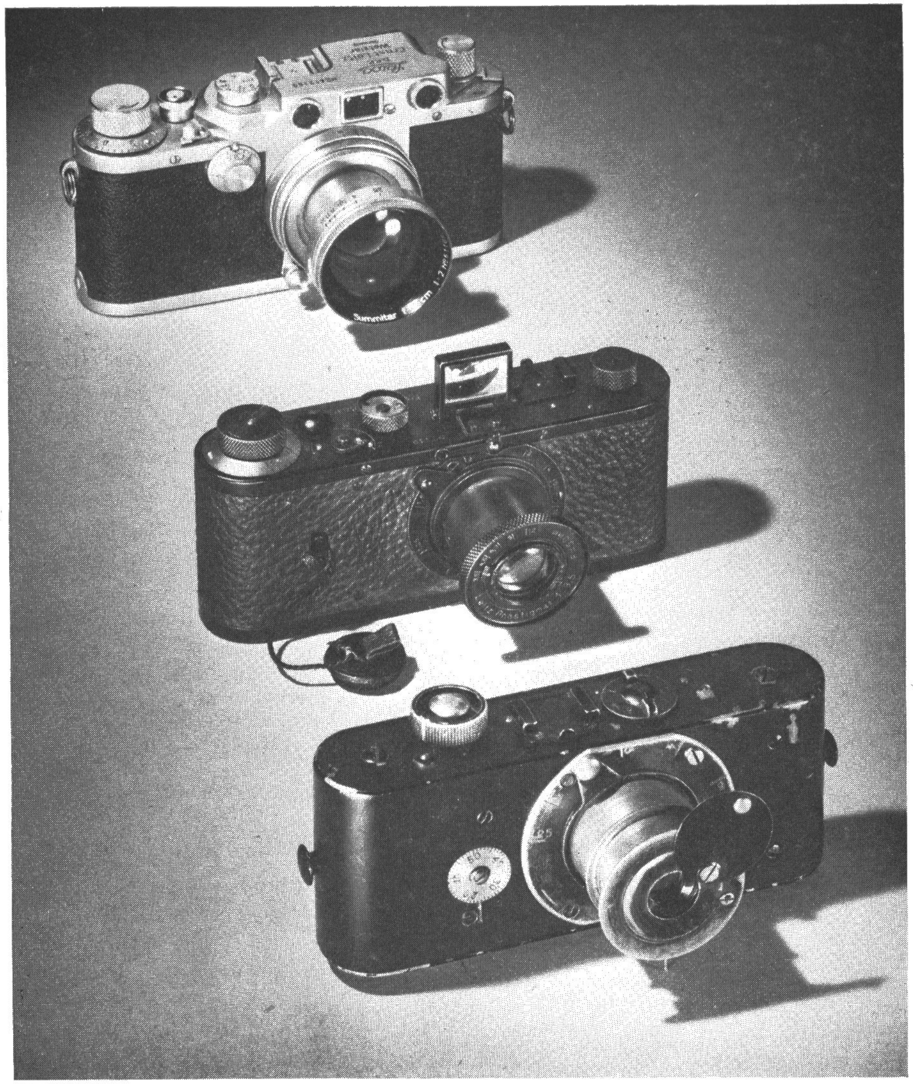


EVOLUTION OF THE LEICA. The three important models are shown. *(Bottom)* The first 1914 camera. *(Middle)* The 1924 Leica. *(Top)* The 1949 model. The latest 1951 Leica IIIf is illustrated on page 11. Basically, the 1914 Leica was the same then as it is today, even to the film and shutter coupling to prevent double exposures.

INTRODUCTION

A quarter of a century ago, in the spring of 1925, a small new camera was shown to the world at the Leipzig Fair. The Leica was introduced with restraint in a terse statement describing all its features in a hundred well-chosen words. The newcomer to photography was received warmly, with comments ranging from "new and excellent," through "original, practical, meriting widespread attention," all the way to the farsighted appraisal: "the masterpiece of the miniature."

The extensive history of the miniature camera preceding the Leica is rich in fascinating, amusing, and often pathetic inventions of men who, from the earliest days of photography, strove with remarkable persistence to simplify its processes and to reduce the size and weight of picture-making equipment. Most of these efforts brought out small cameras that were ingenious, attractive, or both, but all had this in common: They were scaled-down versions of larger cameras with many of their shortcomings magnified. They were doomed by their bondage to films and plates not suited to their needs.

The originality of the Leica went beyond its appearance: It was new because it tapped a great supply of fine and inexpensive negative material—35mm motion-picture film, universally available in a great variety of emulsions. Because it introduced a negative size twice as large as the conventional motion-picture frame that, combined with lenses and emulsions capable of resolving fine detail, produced "enlargeable" pictures. Because it functionally stored away an exposed picture as it placed a fresh negative in the film gate while it "cocked" the shutter for the next exposure. And because, small as it was, it held the then unbelievable number of 36 pictures! All of which in a single camera was not only new and different; it was good and very desirable.

Oskar Barnack, its farsighted and thoughtful designer, did not plan as brilliant a career for the Leica as it enjoys today, twenty-five years after its first public showing. Almost a half a century ago, about 1905, Mr. Barnack, then a young man of twenty-six, used to carry a 5x7 camera on his Sunday outings into the hills of the Thuringian Forest. The camera, with its tripod, plate holders, and other gear was contained in a leather case the size of a sample trunk. He felt then that there must be an easier way to enjoy photography and decided to explore this idea. The prototype of the Leica camera was ready, essentially not much different in size and general appearance from its current version, just before the start of World War I, when work on it was interrupted. After the end of that war, the work was resumed, and a pilot production quantity was built and distributed in 1924. These first cameras were so well received that the firm of Ernst Leitz decided to launch the camera on a larger scale.

What was originally conceived as a pocket camera, convenient for tourists, sportsmen, and week-end photographers because of their logical preference for "small negatives for large pictures" — Oskar Barnack's own motto — grew in just a few years to a most impressive stature in the world of photography. So great and broad is its appeal that the Leica today is as firmly accepted by an amateur as it is by top-notch professional photographers. And as the number and quality of its users grew and expanded, its unmistakable influence upon photography and photographers asserted itself in a remarkable development of special Leica literature, books, periodicals, in Leica clubs, schools, salons, and in other similarly cultural pursuits throughout the world.

Obviously, such a broad and largely spontaneous acceptance of a small camera is not brought about by the mere recognition of its unquestionably brilliant conception, good design, fine appearance and workmanship. These attributes are often recognized in automobiles, typewriters, fountain pens, or watches. The fine makings of the Leica, however, have combined to endow it with an availability for creative work the mechanics of which could be mastered with ease by anyone with a desire to portray or to interpret things, people, or events as one sees them. Thus, to many, this fine small camera represents a means of self-expression, a way to assert their attitude toward the world they live in. To others, the Leica is an important method of communication, or a way to make a living or to improve it. And to many thousands it is a wonderful pastime made especially attractive because it can so easily be shared with others.

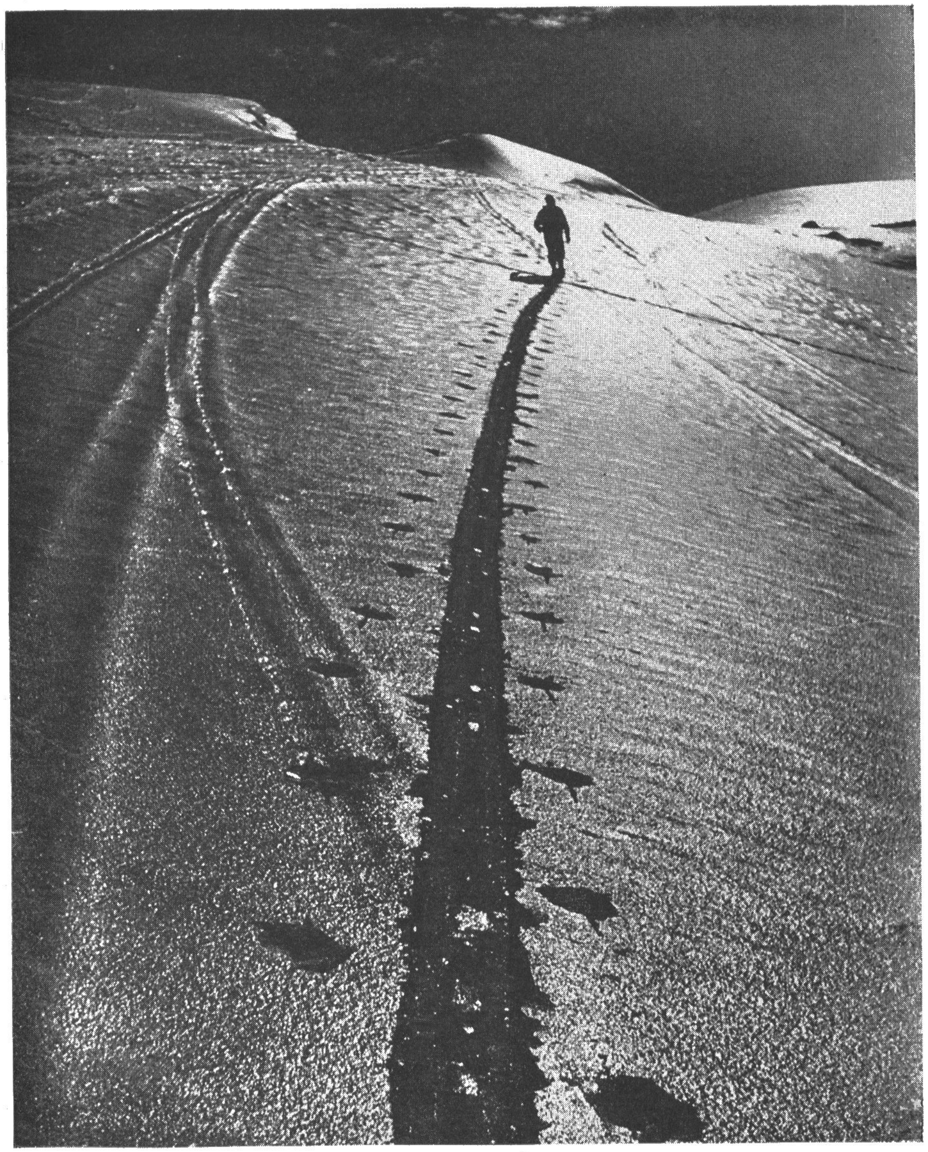
The Leica reached such great popularity because the broad range of its actual and potential applications appeals to the imagination of people in general, and because it struck a spark of enthusiasm in some particularly gifted people. Some of these, with their Leicas in hand, grew into personalities through their ability to see the world, its events, its people and their actions and emotions, through the remembering eye of their Leicas, thus portraying them for others to see. The brilliant work these people have done with their cameras has focused the attention of the world upon them and upon their Leicas as well.

These masters of the camera have brought fame to the Leica, as the camera has brought it to them. From its earliest days, they have pioneered in photographic accomplishments considered heretofore impossible. Great names of photographers came up from obscurity and became bywords not only to other photographers, but to the public at large, which learned to recognize their pictures, their style, and their particular domain. Dr. Paul Wolff, the German photographer whose brilliant Leica photographs created a new school of photographic approach. Dr. Erich Salomon, whose photojournalistic feats have made photographic history. Henri Cartier-Bresson, the Frenchman whose photographs uniquely document much of the turbulence of our times. Alfred Eisenstaedt, whose photographs of people . . . all sorts of people, kings and carpenters, judges and those judged . . . have appeared in *Life* magazine since its first issue. Tom MacAvoy, whose Leica photographs of the political scene unfolding itself in Washington have earned him so many scoops. It is impossible to list these men here adequately. Whatever their names, whatever their accomplishments, in whatever field of endeavor, these men are great photographers to us — heroes to others. They inspire us and others, because they lead us and show us the way to the meaning of pictures. There are thousands of men and women throughout the world who make fine, sometimes great, Leica pictures daily. These may be just family pictures, or formal portraits, or photomicrographs, or records of travel, or shots made at the circus. Few people get to see these. But they are great accomplishments nevertheless. Accomplishments of a great many people, each of whom feels that his Leica is a very personal thing, one capable of making its owner fully articulate, very much admired, or even prominent. And this is probably Leica's greatest value.

This 12th edition of the Leica Manual is being offered to new and old users of the Leica camera fifteen years after the first edition made its appearance, and twenty-five years after the Leica first came to be with us. Its contents ar entirely new, it features many new and prominent contributors, and many of its concepts of Leica technique and approach have changed in keeping with the changes and advances photography has made in the last few years. Its slightly larger format and its color illustrations will make the information it offers more attractive. This volume cannot hope to cover all the knowledge of all applications of the Leica camera. It offers some basic and fundamental facts, some typical applications, and a host of adaptations of the Leica to problems that may prove to be similar to those encountered by people who practice 35mm photography for pleasure, for profit, or as a pastime. We offer this volume to all those who wish to improve their work, in the hope that its contents will help them to develop a deeper appreciation of miniature-camera photography.

The Editors

New York, January, 1951



CLARIDEN GLACIER — Frans Stoppelman

Photographing almost directly into the sunlight gave this dramatic backlighted skiing scene. 50mm Elmar, f/18, 1/60, Leitz U. V. filter, medium pan film.

THE LEICA CAMERA AND EQUIPMENT

WILLARD D. MORGAN

After a quarter-century of fascinating developments, miniature-camera photography with the 35mm camera has become an accepted practice. Since the first Model A Leica camera was introduced in 1924 the Leica photographer has had the advantages of many new fine-grain and high-speed films, color films, flashlamps and the electronic speedflash, fine-grain developers, new printing papers, and various improved models of the Leica camera, including a wide range of accessories. Still another important factor in this rich background of miniature-camera photography has been the work of thousands of Leica photographers whose pictures have appeared in exhibitions, newspapers, and magazines all over the world.

In the hands of inquisitive photographers the Leica camera has been used to photograph people and scenes under difficult lighting, and in rapid succession. High-angle and low-angle shots give another variation seldom seen before the days of the Leica. By 1930 enterprising Leica users were getting news scoops in their local towns and at international conferences. The phrase "candid camera" came out of this experimental period. Public officials and celebrities were finding that they couldn't sneeze or enjoy a quick nap on the speakers' stand without having such candid moments recorded with the Leica camera for some publication. Out of this historical period came the modern picture magazines and the greater use of photographs in all publications. The publication photographers of today are using their Leica cameras to cover many important features and picture stories. (See the chapter on The Leica in Photo-Journalism for detailed information.)

All the models of the Leica camera are similar in appearance to the original Model A. All have the focal-plane shutter (except Model B), and provision for using standard 35mm motion-picture films. New improvements, such as interchangeable lenses, built-in range finder, new shutter speeds and lenses, and internal changes, have made the Leica camera the finest precision instrument of its type available. Now let's learn about the various models and how to use them, and get information about some of the accessories. (Other specialized Leica accessories are explained in their related chapters. See the index for complete information covering all subjects and items in this manual.)

Early Leica Camera Models.

Model A Leica camera · This original model of the Leica is no longer manufactured. The lens mount cannot be unscrewed for the use of interchangeable lenses. There is one top shutter-speed dial with speeds from 1/20 to 1/500 second for the focal-plane shutter. At the base of the focusing mount there is a spring stop that automatically locks the lens at infinity. Most of the Model A cameras were equipped with the 50mm Elmar f/3.5 lens; a few came with the 50mm Hektor f/2.5 lens.

Model B Leica camera · This discontinued model was equipped with a between-the-lens shutter instead of the focal-plane shutter used in all other Leica cameras. The 50mm Elmar f/3.5 lens on the Model B camera was not interchangeable.

Model I Leica camera (also known as Model C) · In 1930 the Model I revolutionized camera designing by the provision for interchanging lenses. A separate detachable range finder was available. The interchangeable lenses on the earlier cameras in this series had to be checked at the factory for use with each camera. Later the letter O was placed on the lens flange (visible when the lens is removed from the camera). This mark indicates that the distance between the face of the flange and the emulsion surface is standardized, and any interchangeable lens can be used.

Leica camera 250 (also known as Model FF) · The 250 is the same as the Model III (below), but with extra-large magazines holding sufficient film (33 feet) for 250 exposures.

Standard Model Leica camera (also known as Model E) · The Standard Model has interchangeable lenses, separate detachable range finder, and one top shutter-speed dial providing speeds from 1/20 to 1/500 second and Z (Bulb). The rewind knob can be lifted up for greater convenience in rewinding films.

Model II Leica camera (also known as Model D) · The Model II has one shutter-speed dial on top of the camera with speeds from 1/20 to 1/500 second and Z (Bulb). With this model the popular satin-chrome finish was introduced as optional and a built-in lens-coupled range finder was used for the first time.

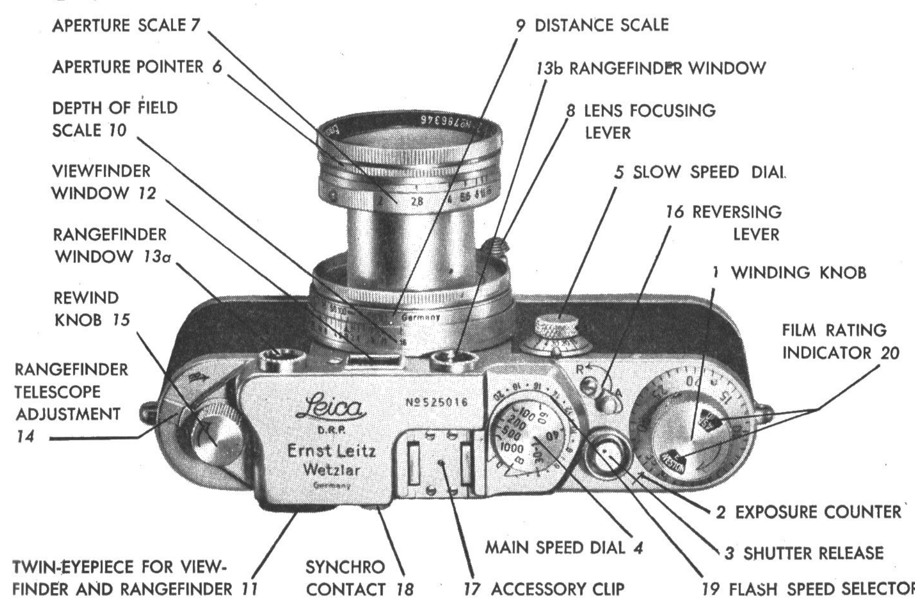
Model III Leica camera (also known as Model F) · Model III has shutter speeds on the top dial from 1/500 to 1/20 second and Z (Bulb). The new front slow shutter-speed dial, from 1/20 to 1 second, was added for the first time, made with black or satin-chrome finish.

Model IIIa Leica camera (also known as Model G) · In Model IIIa shutter speeds are from 1/1000 to 1/20 second and Z (Bulb); slow speed dial from 1/20 to 1 second. Range-finder focusing lever on the eyepiece instead of below the rewind knob, as in later models. The range-finder and view-finder eyepieces are not close together, as in later models, but separated about ¾ inch. The top speed of 1/1000 second was introduced for the first time with this model.

Model IIIb Leica camera (also known as Model G, 1938) · In Model IIIb a new feature placed the range-finder and view-finder eyepieces close together, as in later models. Two shutter-speed dials ranging from 1/1000 to 1 second. Range-finder focusing lever at base of rewind knob.

Current Leica Models.

Model IIIf Leica camera. · The latest mid-century addition to a distinguished line of Leica cameras. In addition to the features and dimensions found in the IIIc model the new IIIf has built-in synchronization with a built-in automatic synchronizing dial, adjustable for various flashlamps, including strobe high-speed flash. Positive synchronization at all shutter speeds up to 1/1000 second. There is also a film-speed indicator on the winding knob. A compact pocket-size flash unit, with fan-folding reflector and spring-clip flashlamp ejector, is available for special use with the Leica IIIf.

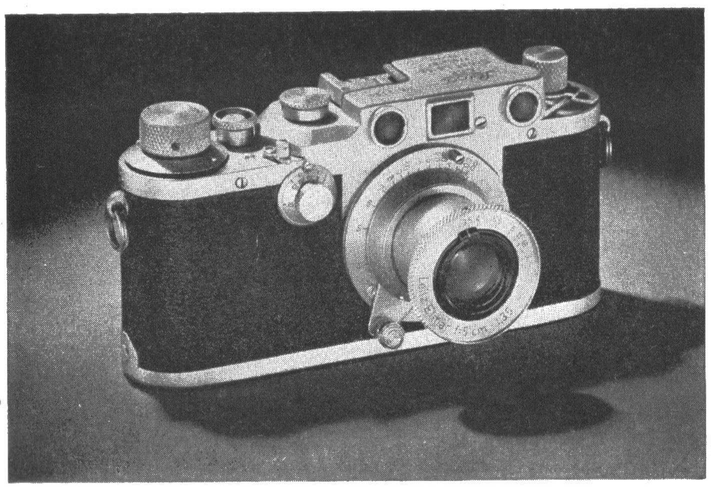


1. Model IIIf Leica camera. Note the Flash Speed Selector numbers. Synchro Contact, and the Film Rating Indicator which are some of the important features on this latest model. The Film Rating Indicator can be installed on previous Leica models.

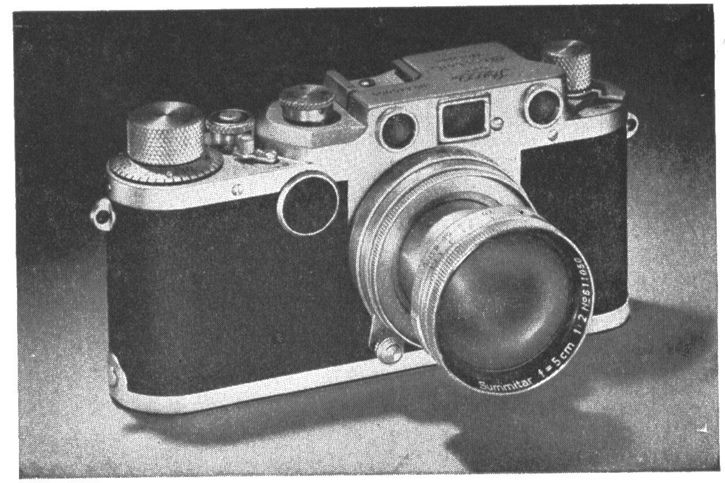
The synchro-contact point for the unit (Fig. 1, No. 18) is built into the range finder housing and the flash unit slides directly into the accessory clip on top. The synchronizer contact plug at the end of the connecting cord locks into position over the synchro-contact point. The built-in flash speed selector (at the base of the shutter-speed dial) is set after the flash factors have been determined by referring to the table supplied with each outfit. When the desired shutter speed, lens aperture and distance have been determined, turn the flash speed selector dial to the number indicated in red on the table. Strobe units can be adapted to this Leica IIIf without modification or additional accessories. No factory installations are necessary. The flash unit weighs only 9½ ounces and will hold four pencil-type dry cells giving a 6-volt charge. The fan-type reflector folds into a compact space when not in use.

Another important feature of the IIIf is the handy film-speed indicator in the winding knob which is set after loading the camera with film. For setting, lift the knurled knob and turn to the right for black and white or to the left for color films. Both ASA and Weston ratings will appear.

Model IIIc Leica camera · This postwar camera, with new internal construction, known as the C series, is 1/8 inch longer than the former Leica models. Consequently the accessories that attach to the baseplate of the C models cannot be used with the other cameras. Another slight difference in this series is that the calibration of the top shutter-speed dial ranges from 1/1000 to 1/30 second and Z (Bulb) and the slow speed dial from 1/30 to 1 second and time. Other features include a built-in range finder with magnifying telescope system, range-finder and view-finder eyepieces close together, eyelets on each end of the camera for attaching the shoulder strap, chromium-plated housing.



2. Model IIIc Leica camera with 50mm Elmar lens.

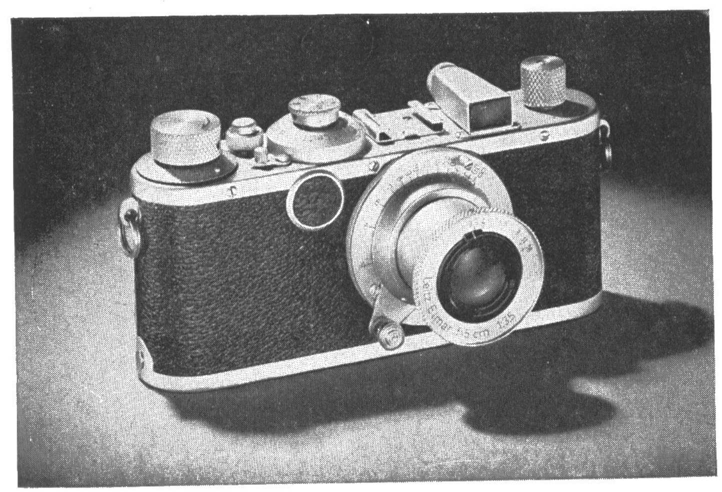


3. Model IIc Leica camera with 50mm Summitar lens.

Model IIc Leica camera · Model IIc is similar to the IIIc, but without the slow speeds under 1/30 second. Top shutter-dial speeds range from 1/500 to 1/30 second.

Model Ic Leica camera · In Model Ic shutter speeds on the top dial range from 1/500 to 1/30 second. No built-in range finder. Attachable range finder available. Special view finder attaches into an accessory clip on top of the camera. Chrome trim.

NOTE: The Model IIc Leica can be converted into a IIIc model by sending the camera to the Leitz service department.



4. Model Ic Leica camera with 50mm Elmar lens.

Your New Leica Camera • One of the great moments in the life of a photographer is when he acquires his new Leica camera. There is nothing quite comparable to the moment when the new camera is unpacked and the Leica owner starts to inspect his equipment. Even the fresh smell of the leather case provides a pleasant sensation. Here is the camera of his choice. Now let's see how it works.

Before loading the Leica camera, examine the various parts and check with the direction booklet. Wind and release the shutter . . . set the top or front speed dials at various shutter speeds . . . adjust the counter dial . . . pull the lens barrel out and lock it by a slight turn to the right . . . learn the proper way to hold the camera . . . turn the focusing mount of the lens and watch the images move out of focus or into focus through the range finder that is coupled with the lens . . . focus the magnifying telescope system . . . open and close the iris diaphragm of the lens . . . study the depth-of-field scale at the base of the lens mount . . . note the image area covered in the view finder . . . move the counter dial to zero after winding the shutter . . . move the small lever between the winding knob and the shutter-setting dial to R (Reverse) . . . pull up and turn the rewind knob, then push it back into position and change the reverse lever back to A (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 real objects and imagine that you are making real pictures.

Once you have gone through this routine a few times the actual operation of the Leica will seem quite simple. You will become familiar with a new type of camera, one that has been built to eliminate the usual amateur photographic troubles, such as double exposures, out-of-focus pictures, underexposures because of slow lenses, and failure to stop rapid motion because of slow shutter speeds. You are entering into a vast fraternity of miniature-camera users numbering into the millions.

Taking Your First Leica Picture • If you have familiarized yourself with the working parts of the Leica camera and read through the direction booklet, you are now ready to take your first Leica pictures. Follow these routine steps when preparing the camera for the first exposure:

1. *Remove the Leica from the carrying case.* Remove baseplate and take-up spool. *Insert film according to directions given on pages 21 and 22.*

2. *Check the reversing lever,* located between the winding knob and the speed dial, to make certain that it is at A (Advance). This lever is moved over to R (Reverse) after all the exposures have been made and the film is to be rewound into the original film cartridge.

5. Correct way for holding and focusing the Leica camera. When ready for making the exposure change to the correct holding position shown on page 18.

3. *Turn the winding knob as far as it will go* (one complete turn). This action simultaneously winds the shutter and advances the film for a new exposure, thus making double exposures impossible. Release the shutter by pressing on the shutter-release button. Set the shutter a second time, and before releasing, set the film counter dial to zero at the base of the winding knob. Release the shutter after this second winding. The camera is now ready for making the first picture.

4. *Determine the correct exposure* by using a standard exposure meter.

5. *Set the shutter speed.* To do this, turn the shutter winding knob until it stops, then lift the top speed dial and turn it to the desired position. The slow-speed dial of Leica Models III, IIIa, and IIIb is set at any desired stop between 1 second and 1/20 second after the top speed dial has been set at

20-1, which represents 1/20 to 1 full second on the slow-speed dial. When 1/20 second is to be used on these models, place both dials at the figure 20.

On the IIIc, IIc, and Ic Leica models the top speed dials show exposure figures from 30 to 1000 that represent fractions of a second (40 = 1/40, 60 = 1/60, 100 = 1/100). Intermediate speeds cannot be set. When the top dial is set to B (Z), the shutter remains open while the release button is pressed down. The slow-speed dial with figures from 1 to 30 can be set into action only after the top dial has been set at the 30-1 figure. Always remember that the top shutter-speed dial can be reset only after the shutter has been set. Rewinding the shutter brings the speed dial back to its original position.

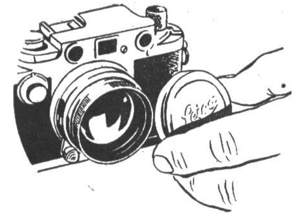
The slow-speed dial is marked for exposure times of 1/30, 1/20, 1/15, 1/10, 1/4, 1/2, and 1 second. Intermediate speeds can also be set, such as 3/4 second, halfway between 1/2 and 1 second. When set to T, the shutter opens when released and stays open. After the time exposure is complete, close the shutter by simply turning the slow-speed dial back a little and the shutter will be released. Do not press the top release button to close shutter for this time exposure. Set the front slow-speed dial to 30 when the faster speeds on the top dial are used. A safety spring holds the front dial at the 30 position. The spring must be pushed down with the thumbnail when changing to other speeds.

6. *Pull out the lens barrel* and lock it into position by a slight turn to the right if one of the 50mm lenses is in use (except the Summarit or Xenon f/1.5).

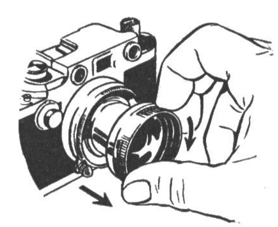
7. *Set the iris diaphragm* of the lens to the proper opening, which has already been determined by the exposure meter.

8. *Adjust the telescope magnifier* (1.5x) fitted on the viewing aperture of the range finder. The range-finder eyepiece is adjusted by turning the small lever fitted under the rewinding knob on the IIIc model or at the base of the eyepiece on some of the other models. This adjustment compensates for slight deficiencies of the eye when focusing on near or distant objects to obtain sharpness.

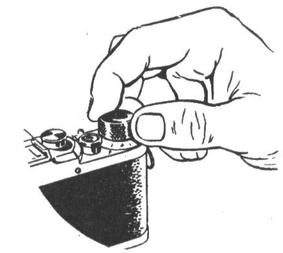
9. *Focus the lens* by looking through the range-finder eyepiece and at the same time rotating the lens barrel back and forth until the 2 images coincide. The 50mm lenses have a locking catch at the infinity position. Press the knob on the end of the focusing lever to release the catch for focusing. A separate attachable range finder is available for Leica models without the built-in range finder. Shift the eye to the right (when holding the camera horizontally) and compose the picture through the view finder. When you are ready to make the picture, squeeze the release button gradually until the shutter trips. *You have now taken your first Leica picture!*



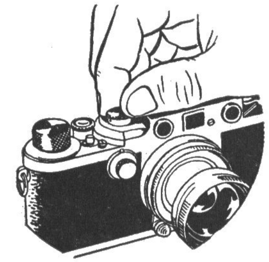
1. Remove the Lens Cap from the Lens . . . a simple step which is often overlooked.



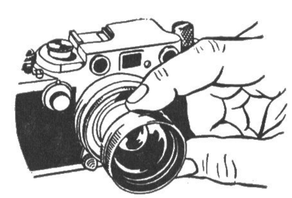
2. Pull out the Lens and lock it in position. Make sure it is firmly locked.



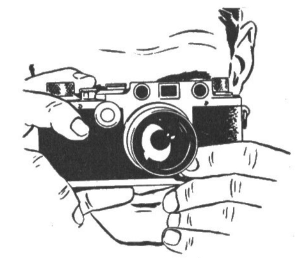
3. Turn the Winding Knob (in the direction of the arrow) as far as it will go.



4. Set the Shutter Speed Dial according to exposure meter readings or exposure table recommendations.

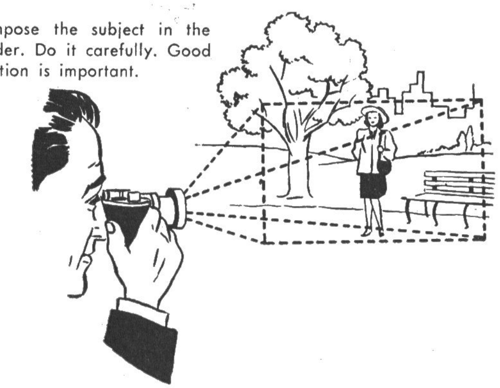


5. Set the Lens Diaphragm to the aperture indicated by the exposure meter or table.

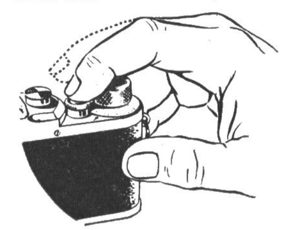


6. Focus the Lens with the Rangefinder. Both images should overlap so that a single image is seen.

7. Compose the subject in the Viewfinder. Do it carefully. Good composition is important.



8. Press the Shutter Release Button to expose the film. Move only the finger on the Button, not the entire arm.



6. Working routine for preparing camera and actually taking the picture. By keeping these simple steps in mind the operation of the Leica camera will be mastered very quickly.

You can read the distance between the subject and the camera on the distance scale at the base of the lens after using the range finder. There is a second line marked R that is used for determing focus when infrared film is used with various lenses, with the exception of the 28mm and 35mm wide-angle lenses, which have a sufficient depth of field to cover any slight variations of focus. When using infrared film, focus the lens in the usual way.

Then move the lens mount until the index mark R coincides with that position on the distance scale first indicated by the regular focusing index.

9. *Turn the winding knob* to bring the next film into position. When there is film in the camera, each time the shutter-winding knob is turned, the rewinding knob turns in the reverse direction (counterclockwise), thus passing the film on properly for the next exposure.

9. *(Left)* Wrong position. Never release camera when taking horizontal pictures. Note that camera is pressed firmly against the head to give steadiness. The forefinger of the right hand is over the release button.

8. *(Top right)* A good steady position for making vertical pictures. Note use of right thumb for releasing the shutter.

9. *(Left)* Wrong position. Never release camera by pressing release button in this way because the camera will be jarred during exposure.

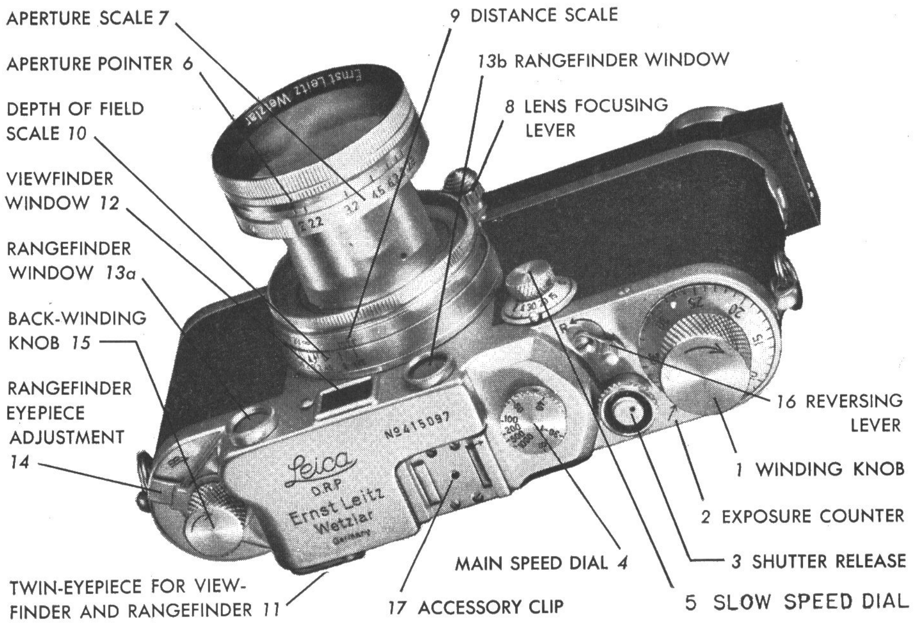
10. *Keep on taking pictures* until you have used up the entire roll of 36 exposures. Try various shutter speeds, outdoor and indoor views. Keep written records of your first exposures to compare with the developed negative. Remember the essential picture taking steps.

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

11. *Caution.* When pressing the release button with the forefinger, avoid jerking the camera by pushing the release abruptly. Instead, hold the finger on the release and squeeze the button down gradually, as you would make the gradual trigger squeeze that is so essential for accurate shooting with a rifle. Place the thumb of your right hand under the baseplate to counteract the downward action of the forefinger. Wherever possible, it is best to use shutter speeds of 1/40 or 1/60 second or faster when the camera is held in the hands, in order to avoid any possible motion during exposure. After considerable experience it is often possible to hold the camera quite steady even at 1/20 or 1/8 seconds.

12. *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, put the lens cap on, release the shutter, and just move the reversing lever to R and rewind all the film back into the film magazine. 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. (In the Model IIIc, the release button itself turns). Remove the film magazine from the camera after the winding has been completed and move the reversing lever back to A (Advance).

Depth-of-field Scale · All Leica lenses have a depth-of-field scale, which is convenient for checking the limits of sharp focus in the scene. It will be noted that one flange is calibrated in feet and the other scale has the engraved f-numbers. When the lens has been focused by using the range finder, the center line on the depth-of-field scale will indicate the distance figure. The distance between the identical f-numbers on the scale shows the depth of field or sharpness to be obtained at a fixed distance. If the lens is set at f/11, then read the near and far distance points opposite each figure 11 on the scale to obtain the depth-of-field distance in feet or meters, depending upon the calibration of the camera.



10. Model IIIc Leica camera and complete description of the outside parts. Note removable baseplate with contacts for flash synchronizer.

Outside Parts of the Model IIIc Leica Camera.

1. *Winding knob.* One complete turn winds the shutter, advances the film to the next picture, and registers one count on dial 2 at the base of the knob.
2. *Exposure counter* automatically records each photograph taken. On this counter dial there are two small lugs used for turning the dial counterclockwise, against the direction of the arrow on the winding knob, to the zero mark.
3. *Shutter-release button.* A Wire Cable Release can be screwed onto the thread at the base of the release. Some of the earlier cameras have a protective bushing that must be unscrewed before attaching the Wire Cable Release.
4. *Top shutter speed dial* for setting high speeds of 1/30 to 1/1000 second. The winding knob must be given one complete turn before setting the speed dial. Once this dial is set it need not be changed for successive exposures unless the shutter speed is to be changed.
5. *Slow shutter speed dial* turns to change shutter speeds between 1/30 and 1 second and T (Time). Speeds between 1 second and 1/8 second are continuous for making any exposure settings between the marked numbers on the slow-speed dial.
6. *Aperture pointer* sets the lens diaphragm.
7. *Aperture scale* is calibrated with f-numbers for setting the lens diaphragm.
8. *Lens focusing lever* is pressed to release the lens mount from the infinity setting, and is 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 seen.
9. *Distance scale* is calibrated in feet or meters to show the distance between camera and object when correct focus has been obtained by use of the range finder.

10. *Depth-of-field scale* is calibrated in f-numbers on both sides of the distance-scale index.
11. *Twin eyepiece* for view finder and range finder.
12. *Window* of the built-in view finder.

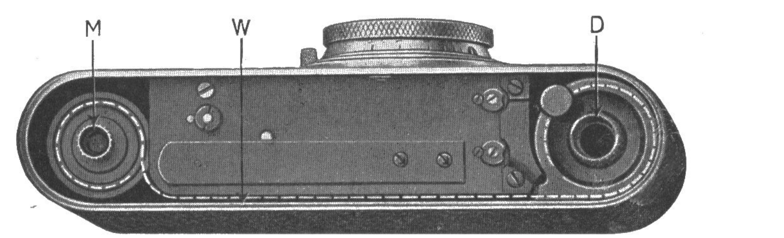
13a, b. *Front windows* of the built-in range finder, which has an interior mechanism connecting with the lens mount for obtaining correct distance and focus automatically.

14. *Range-finder* eyepiece adjustment lever.
15. *Rewinding knob* is pulled up and turned to rewind the exposed film back into the film magazine after all exposures have been made.
16. *Reversing lever* disengages the automatic coupling of film advance and shutter mechanism when the exposed film is to be wound back into the film magazine. When this lever is set at R, it operates somewhat like a clutch on an automobile, disconnecting the camera mechanism. Keep the lever at A (Advance) when making exposures.
17. *Accessory clip* holds the Universal View Finder and other accessories.

Loading the Leica Camera • It is always advisable to load and unload the Leica in the shade and not in direct sunlight, to be safe from fogging films. Keep film cartridges in their containers until ready for use and then return them to the containers after exposure. Before opening the camera make sure that all the film has been wound back into the film magazine; if some is left on the Take-up Spool, the film will be ruined by daylight.

To remove the baseplate, turn the locking flange from the CLOSED to the OPEN position and lift the plate away from the camera. Some baseplates are marked AUF (open) and ZU (closed). Place the opened camera in front of you with the lens facing away from you. The camera is now ready for loading.

1. Make sure that the reversing lever is at A (Advance).
2. Remove the Take-up Spool.
3. Hold the Take-up Spool in the left hand and the film magazine in the right, with the tops pointing down or toward your body. Insert the trimmed film projecting from the magazine into the clip of the Take-up Spool as far as it will go. In doing this let the forefinger touch the film



11. Dotted line shows correct position of film in the camera. The film (W) unwinds from magazine (D) and passes along back of camera to the takeup spool (M).

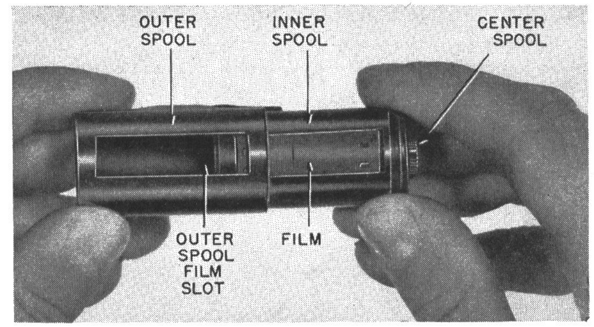
tip and also overlap on the spring clip. Then press the film into a secure position. The perforations should be next to the top flange of the Take-up Spool. Do not wind the film around the core of the spool.

4. Turn magazine and Take-up Spool around ready for inserting into the open camera. Pull out the film until magazine and spool are spaced far enough apart to fit into the camera—and no more.
5. While holding the film magazine in the right hand and the Take-up Spool in the left, with the trimmed side down, lower the film into the narrow slot along the camera back. Do not force anything. If the magazine does not drop down all the way, give a slight turn to the rewind knob.
6. Replace the baseplate, with the lock still set at OPEN, and then turn the lock to CLOSED. The film is now properly placed in the lighttight camera body, ready for use.
7. Give the film-winding knob one full turn. Pull up the rewinding knob and turn it clockwise until there is a slight resistance, enough to tighten the film, but not with so much pressure that it will pull the film off the Take-up Spool. Release the shutter and turn the film-winding knob again and at the same time watch the rewind knob to see if it also turns in the opposite direction to the arrow.
8. Set the exposure counter dial to 0 by turning it counterclockwise and release the shutter. The camera is now ready for taking the first picture.

Unloading the Camera • After the full roll of film has been exposed the film-winding knob cannot be turned. Do not try to force another turn, but rewind the film and remove from the camera. Place the cap over the lens before rewinding. This protects the lens from finger marks. Here are the steps to take for unloading:

1. *Turn the reversing lever* from A (Advance) to R (Reverse), which disengages the automatic coupling of the film advance and the shutter mechanism.
2. *Pull up the rewinding knob* and turn in the direction of the arrow until the film is removed from the Take-up Spool. Just as the film comes to the end you will feel a slight resistance. Continue with 2 or 3 additional turns until the film pulls away from the clip on the Take-up Spool and enters the film magazine.
3. *Remove the baseplate* and take out the film magazine containing the exposed roll of film. This film is then ready for development in a darkroom under the proper conditions.

Occasionally you may wish to remove the film roll from the camera after half a dozen or more exposures have been made. This may be necessary when you require a different film or when you wish to develop part of the exposed section



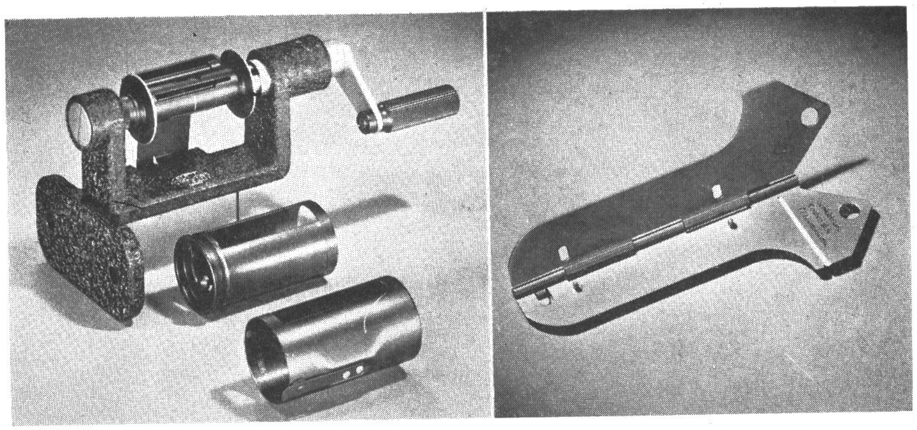
12. Leica film magazine being assembled after loading the 35mm film from a larger bulk or stock roll. This all-metal film magazine is for re-use.

of the film. 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. Now *stop turning* in order to prevent the film leader from going back into the film chamber. Open the camera and remove the film magazine with the 2 or 3 inches of the film leader still outside the magazine. Then take the film magazine to the darkroom and cut the exposed portion of the film from the roll. Give a generous estimate for the length to be cut. Remember that there are 8 Leica pictures per foot of film. Cut a new leader on the remaining film and put the magazine back into the camera.

Loading the Leica Film Magazine • The all-metal Leica film magazine, has been constructed to hold about 5¼ feet of 35mm film, which is sufficient to make up to 36 double-frame exposures 24x36mm in size. This cylindrical magazine contains 3 parts: the outer shell B^1, the inner shell B^2, and the center spool B^3. The guide groove on the inner shell and the pin inside the outer shell opposite the safety spring assist 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 you load it 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 (counterclockwise) until the safety spring clicks into the locked position. Before the chamber is closed pull the film out several inches. The film magazine can be opened only after the safety spring has been slightly lifted and the inner shell turned to the right (clockwise). Then withdraw the inner shell and remove the film in the darkroom.

Bulk 35mm film can be purchased in various lengths at a few cents per foot. Motion-picture cameramen often have short lengths of 35mm film that is either discarded or sold for a small amount. When you have your own



13. *(Left)* Mechanical Film Winder for use when loading the magazine reel. *(Right)* Film Trimming Guide which is used for cutting the leader and trailer of the film before loading into the magazine.

metal film magazine, it is also possible to load it with 35mm film that is not available in the standard daylight-loading film cartridges. Cut film lengths up to 5¼ feet for loading into the magazine. Carry out all loading operations in total darkness, unless you use the proper safelights. Practice loading the film magazine in daylight with a short piece of film in order to become familiar with the operations before working in the darkroom. The Leitz Film-Tank holds a bulk roll up to 325 feet of 35mm film and permits Leica camera magazines to be loaded in daylight.

Each length of film must be correctly tapered for inserting into the magazine spool. The leader end, which fits into the Take-up Spool of the camera, must be partly cut away. When you use the Film-Trimming Guide to cut the spool end of the film, open the guide and insert the film with the emulsion side down. Let the end of the film project slightly beyond the end of the guide, close the guide, and then cut the film around the edge. Always make certain that no fingerprints are left on the emulsion side.

Now place the other end of the 5¼-foot length of film into the trimming guide and make a longer cut in order to make it easier to load the film into the camera later. Note that no cut is made through a perforation on the film edge. The Film-Trimming Guide has two pins that engage in the perforations and hold the film in the proper cutting position. Put the film into the guide with the emulsion side facing the two pins. After a little practice, you can cut with scissors without the Film-Trimming Guide.

Winding the Film · In order to make it easier to wind the film spool with fresh unexposed film, you may use a stationary Mechanical Film Winder. You can study the operation of this winder from the accompanying illustration. Attach the Mechanical Film Winder to a table or a heavy block of wood. A slit core receives the film spool ready for the film-winding process.

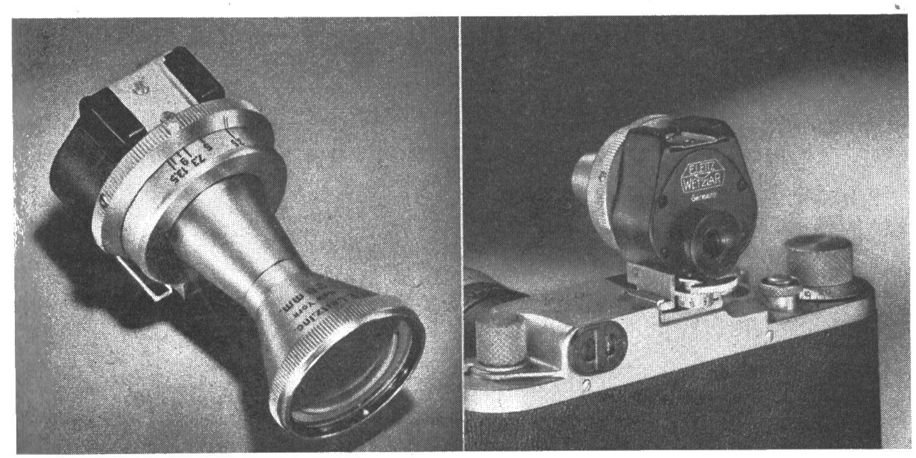
After the film end has been fixed to the center spool, wind the film tightly during the turning of the handle. Do not attempt to pull the film and thus tighten the film already rolled on the spool—this would produce scratches.

Leica Accessories.

The Leica camera is unique in having the wide variety of accessories that permit the user to adapt his camera for use with interchangeable lenses or for the most exacting copy work. Many of these accessories are described in the various chapters to which they relate. Some of the important accessories not illustrated elsewhere in this book are described and illustrated in this chapter.

Imarect Finder · One of the important accessories for the Leica camera is the Imarect Finder, which is quickly attached to the clip on top of the camera. While the regular direct optical view finder in the Leica is used only for the 50mm lenses, the Imarect Finder can be used for all Leica lenses from 35mm to 135mm focal lengths, and also for the 28mm lens when a special adapter is attached. This finder contains an adjustable diaphragm that is easily moved by turning a calibrated ring to various engraved stops which indicate the various focal lengths. The view-finder diaphragm is rectangular and the sides retain the standard 2:3 proportion of the Leica negative size when changed for any field of view. Images viewed through the Imarect Finder remain consistently sharp and erect when the camera is used in either the horizontal or the vertical position. Thus the field of view covered by the Imarect Finder coincides with the actual image focused upon the negative area within the camera.

Setting the finder for lenses of different focal length · The scale on top of the finder is engraved with 6 index lines and 5 numbers, 3.5, 5, 8.5, 9, and



14. *(Left)* Imarect Finder with special front adapter for use with the 28mm lens. *(Right)* Rear view of the Imarect Finder as seen in position on the Leica camera.

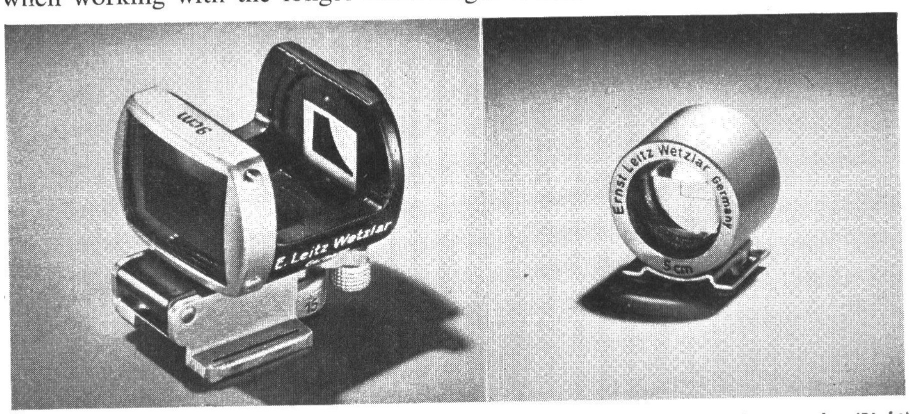
13.5, corresponding to the Leica lenses of from 35mm to 135mm focal length. The knurled ring is engraved with two index marks, long and short. Use the long mark when the subject is over 6 feet from the camera and the shorter line when subject distances range from 3½ to 6 feet. The shorter line reduces the finder image slightly in order to provide a more accurate view of the subject at close range. Set the finder to coincide with the focal length of the lens used by turning the milled ring until the proper index marks match.

When you are using the 28mm wide-angle lens, attach the special 28mm adapter to the front of the Imarect Finder. Turn the knurled ring on the Imarect Finder so that the index line is opposite the 3.5 mark. The index line for the 127mm lens is not numbered on the scale, but it can be set between the 9 and the 13.5 marks. Click stops assure positive setting at any selected focal-length marking on the long line for all but the 127mm lens.

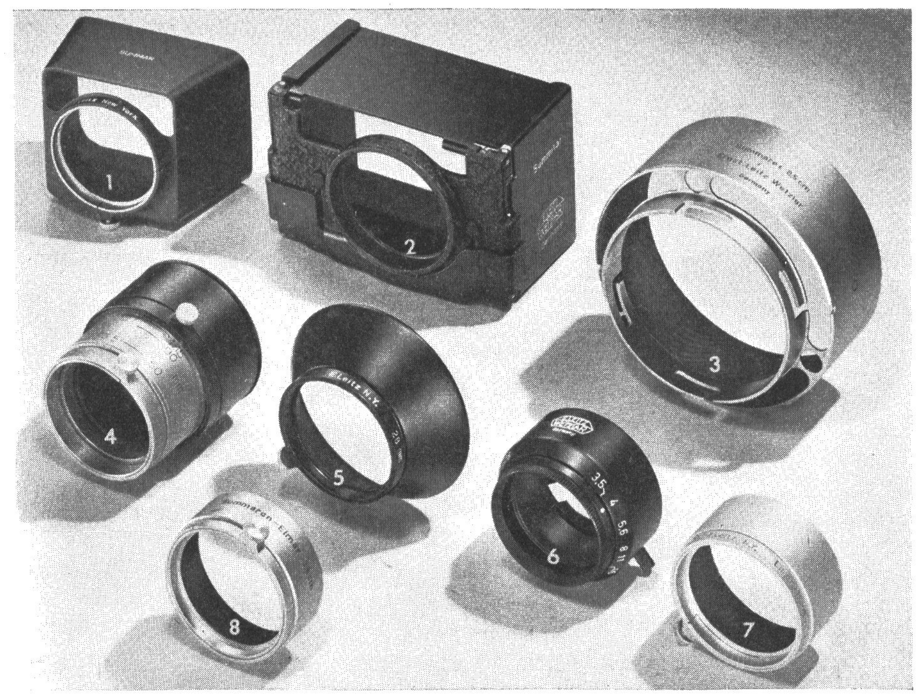
Parallax adjustments · When subjects are photographed at close range, the standard accessory view finder sees one image and the camera lens another. This difference in parallax, as it is called, is easily corrected in the Imarect Finder for distances between 3½ and 15 feet. A quadrant lever at the base of the finder connects with a parallax scale calibrated in feet for making the adjustments.

The parallax scale (in feet) at the base of the Imarect Finder is calibrated for distances of 3.5, 5, 7, and 15 feet, and for ∞ (infinity). When you are photographing subjects beyond 15 feet, leave the Imarect Finder set at the infinity mark.

Another important use of the Imarect Finder is to determine the field of view of a scene without the camera. By sighting through the finder you can easily determine whether there is a picture worth taking without having to remove the camera from the case. Such a convenience is of special value when working with the longer focal-length lenses.



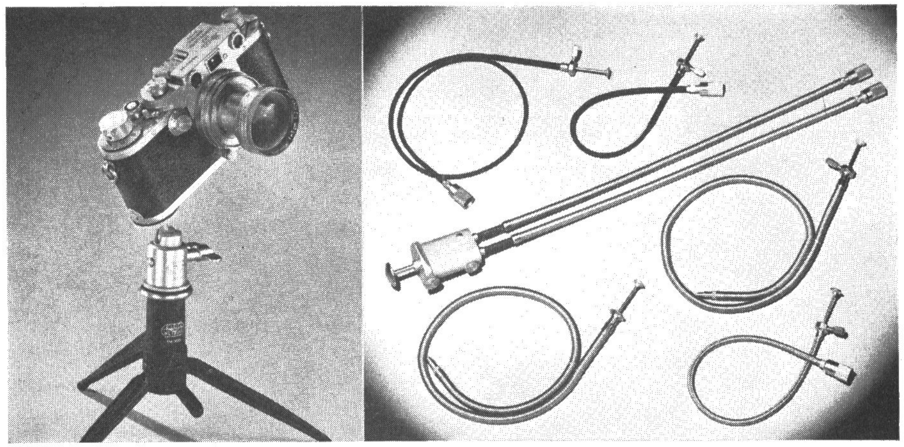
15. *(Left)* Leica Sport Finder which gives a large field of view when taking action photographs. *(Right)* Leica Brilliant Finder gives a larger direct image, and fits into the accessory clip on top of the Leica.



16. Sunshades are important lens accessories. Use them as often as possible. 1. Sunshade for the 50mm Summar. 2. Summitar and Summarit lenses. 3. 85mm Summarex. 4. Adjustable sunshade for 50mm and 90mm Elmar lenses and also the 135mm lenses. 5. 28mm wide angle. 6. Combination Slip-on Ring and Sunshade. 7. 50mm Elmar. 8. 35mm Elmar and Summaron lenses.

The Vidom Universal View Finder preceded the present Imarect View Finder, and was somewhat similar. In the Vidom Finder the image is reversed from left to right, while in the Imarect Finder the image is seen just as the eye sees it. Also, when using the Vidom Finder it is necessary to turn the eyepiece when changing from a horizontal to a vertical picture or vice versa. The Imarect Finder does not require this eyepiece adjustment, because the image is always erect in either position.

Sport Finder · The Leica Sport Finder is an optical type of finder designed for sport and action photography. It consists of a front element that has a translucent silver band which outlines the field of view recorded by the lens, and a rear sight around the edges of which is a white mask. The latter is imaged in the silver band of the front element. When you look through this finder, you see a relatively large area, and the field to be included in the picture is outlined by a translucent white band. This finder also has provision for compensating for parallax. Separate models, which look alike, are used for lenses of 90mm and 135mm focal length.



17. *(Left)* Leica camera mounted on a Ball-Jointed Tripod Head which locks the camera into any position desired. Note the special table tripod which is very useful for holding the camera. *(Right)* Wire cable releases are important accessories for taking pictures when the camera is mounted on a tripod or other fixed support. The double release shown diagonally across the center is for use with Telyt lens and Mirror Reflex Housing.

Leica Brilliant View Finder · This finder is available for use with the Ic Leica and also for other models using 50mm lenses. Some photographers who wear glasses or prefer the larger direct-vision type of finder will find this accessory helpful. The Brilliant View Finder fits into the accessory clip on top of the Leica.

Sunshades and their use · Use a sunshade on the Leica lenses whenever possible. Such protection eliminates stray light from entering the lens and causing a slight halation on the film. The larger the aperture of the lens, 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. An Adjustable Sunshade and Combination Filter Holder (for all lenses with a front diameter of 36mm) can be used for the 50mm lenses and also the longer focal lengths with the exception of the Summarex, Thambar, 105mm, 200mm, and 400mm 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. It accommodates unmounted filters 34mm in diameter. The front and back sections screw apart for the insertion of glass filters. There are also special lens shades supplied for the 28mm, 35mm, Summar, Summitar, Xenon, and Summarit 50mm lenses.

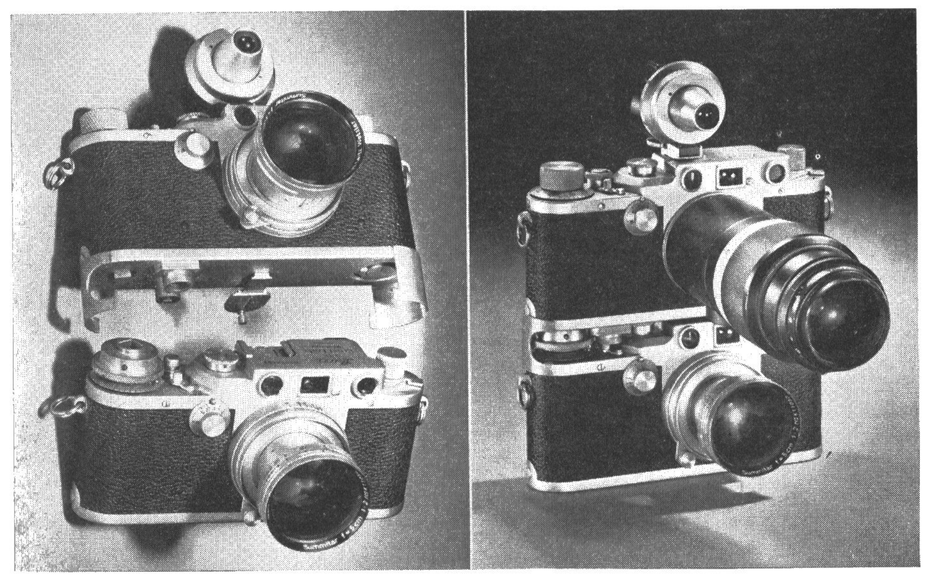
When to use the Wire Cable Release · When you are making time or instantaneous exposures, the 10- or 20-inch Wire Cable Release is of special value. This release is indispensable for making exposures in photomicrog-

raphy, all types of close-up copy work, and wherever exposures are to be made without jarring the camera.

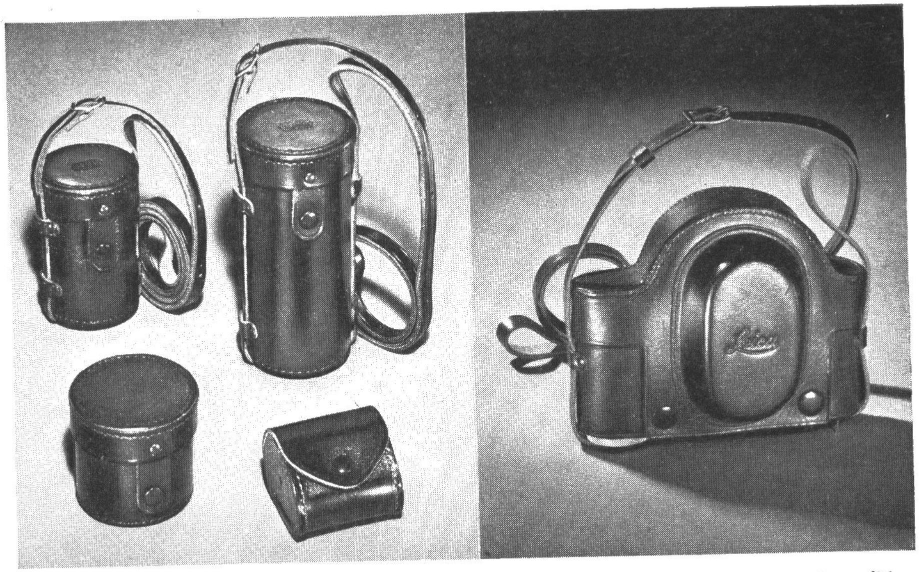
The Leica Tandem · A special coupling has been devised for locking two Leica cameras together, one on top of the other, for simultaneous operation. This arrangement provides the possibility of taking color pictures in one camera and black-and-white photographs in the other. The two coupled cameras can then be used for stereoscopic photography in the vertical position or with any special combination of lenses. Numerous other applications of the tandem system of photography will come to mind.

Correction Lenses · Photographers 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. This difficulty can be overcome by the use of special Leitz correction lenses on the eye lenses of the range finder and view finder. These lenses have the same correction as that contained in the eyeglasses worn by the Leica user. With these correction lenses in position it is not necessary to wear eyeglasses and the eye can be placed close to the camera. Nearsightedness, farsightedness, and astigmatism can thus be corrected. A prescription is required from your optician for matching the lenses. These correction lenses are only available for the IIIc, IIIb, and IIc Leica cameras.

Protective Cases for Leica Equipment · All Leica equipment should be kept in protective cases when not in use. Such protection will prevent the



18. The Leica Tandem provides for the use of two Leica cameras operating simultaneously. Various combinations of lenses, films, and shutter speeds can be used. Stereoscopic pictures can also be taken.



19. Leather protective cases are essential for keeping Leica cameras and lenses in good condition. Many of the accessories have special cases for added protection when not in use.

camera and the lenses from receiving scratches or hard knocks. Sand and dust will be kept out. There is an Eveready case for the camera and individual cases for the lenses and some accessories. Combination cases are used for camera, additional lenses, filter, finders, extra magazines, and other accessories. Too much emphasis cannot be laid upon the importance of keeping all Leica equipment neatly fitted in the proper protective cases.

Summary · As there are over 200 Leica accessories, they cannot all be described in this chapter. But most of the other important accessories are fully described in some one of the following chapters. (Consult the index.) Directions are supplied with most accessories when purchased. Special booklets and circulars giving additional information are also available from photographic dealers. The reader should study all the following chapters very carefully, even though he should only be interested in one or two special subjects at first. By reading about the many applications of the Leica you may find suggestions that can be applied to your own particular field of photography.

LEICA LENSES AND OPTICS

JOHN S. CARROLL

The heart (one might as well say the eye) of the Leica camera is its lens. Indeed, the success of the Leica, as of miniature photography in general, is due as much to the Leica lenses as to any other factor.

The beginner in Leica photography will in all probability limit himself to but a single objective—generally, the 50mm lens supplied as standard equipment on the camera. The advanced worker, on the other hand, can take advantage of a wide variety of Leica lenses, each having its particular use and its special advantages. Both the beginner and the advanced photographer, however, should know at least a few basic facts concerning lenses and their use. Some of these concern only the lens designer; others are of major importance to the user of a given lens.

To the designer, the major considerations that must be taken into account concern the principal faults to be found in lenses and the means that must be taken for their elimination. These faults are known as *aberrations.* In *chromatic aberration,* rays of light of different colors are not brought to a focus in the same plane. *Spherical aberration* is a lens aberration in which vertical and horizontal lines are not focused in the same plane at the edges of the field. *Distortion* is the incorrect rendering of the shape of an object.

Except for the very simple lenses, such as those used on box cameras, such faults cannot be permitted in a lens intended for making negatives for considerable enlargement. For miniature cameras, therefore, the highest degree of correction is essential; the success of the Leica lenses is a measure of how well this correction has been carried out.

The user, however, is not concerned with this aspect of lens optics; he must assume that the designer of the lens has carried out the necessary corrections for these major aberrations, as well as for such other faults as *flare, coma,* and so on. The photographer must know a number of attributes of lenses in general if he is to obtain the optimum performance of any lens. Some of these attributes are as follows:

1. *Focal length.* This measure controls, basically, the size of the image

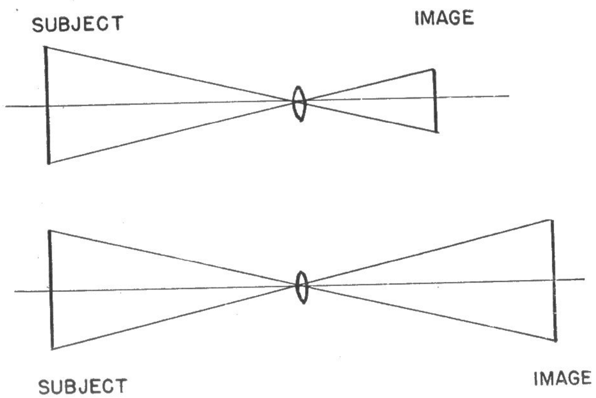
produced by the lens at a given distance. Since, in turn, the distance from which a given subject must be photographed determines the perspective of the picture, the focal length of the lens can be said to be a determining factor in the control of perspective.

2. *Speed.* This term is a misnomer; "speed" is actually a measure of the light-gathering power of the lens, and is usually expressed in the form of an f-number.
3. *Resolving power.* Simply defined for the moment, this is the measure of the ability of the lens to image extremely fine detail.
4. *Depth of field* (sometimes wrongly called depth of focus). This is the distance between the points nearest to and farthest from the camera that are acceptably sharp in the final print. Depth of field is a function of the speed and the focal length of a given lens.

Focal Length • If we examine the lenses of different cameras, we find that for a correct focus of any given object there is a certain distance between the lens and the film. In large cameras, this distance is relatively great; in smaller cameras, the lens-to-film distance for an object at the same distance from the camera is correspondingly less. Obviously, this is a characteristic of any given lens, and there must be a method by which this characteristic can be measured and specified.

We can, of course, classify lenses by the distance between lens and film for subjects at a given distance; this is, in fact, the method used. It is necessary, however, to specify just what subject distance is used for this measurement.

The *focal length* of a lens is therefore defined as the distance from lens to film when the lens is focused on an object *at an infinite distance.* Such an object is not easily found, except perhaps in astronomy. However, for practical purposes, when the lenses in question are of fairly short focal length, any object more than 100 feet away may be considered as approximately such an object at infinity. Note that this distance, except for single lenses



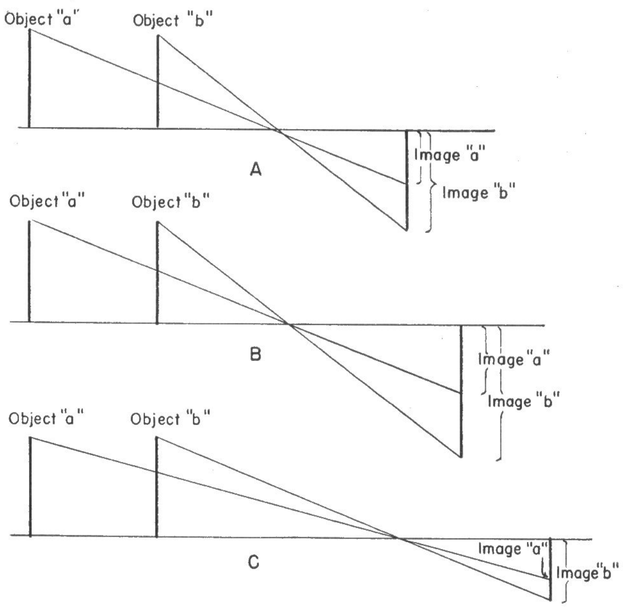
1. For objects at any distance, the sizes of the images produced by various lenses are proportional to the focal lengths of the respective lenses.

used in box cameras, is not measured from the *rear* surface of the lens, but from a point within the combination known as the *principal plane.* Normally, this does not concern the user of the lens.

More important to the practical photographer is the effect of the focal length of a lens on the size of the image it produces. Take for example Figure 1 showing an object of a given size as imaged by two lenses. It can readily be seen from this diagram that the lens of longer focal length produces the larger image, furthermore, that the size of the image is directly proportional to the focal length of the lens. Thus if one lens has twice the focal length of another, the image it produces will be twice as large as the other.

Naturally there is, or should be, a focal length most suited for *normal* use with any given camera. A simple rule of thumb calls for a focal length equal to the diagonal of the picture area. Thus for the Leica the picture area is 1 x 1½; the diagonal of this picture is a little more than 1¾ inches, and the lens generally used is a 50mm, which is slightly less than 2 inches. This gives a horizontal angle of view of 40°, which is approximately that of the eye. Pictures taken with such a lens will encompass about the same picture area that would be seen by the eye placed at the same distance from the subject; for this reason, the perspective of pictures made with the 50mm lens will appear most nearly normal.

2. Phylis Brooks. Summitar 50mm lens, f/2, 1/20 second under prevailing light. Photo by *Life* photographer Peter Stackpole (c) *Time* Inc.



3. (A) When object "a" is twice as far from the lens as object "b", its image will be ½ the size of image "b." (B) Using a longer focus lens from the same viewpoint, both images will be larger, but image "a" is still ½ as big as image "b." (C) When the same two objects are photographed at greater distances, such that object "b" is 2/3 as far from the lens as object "a," the image of "a" will be 2/3 the size of image "b."

However, note that perspective is not *determined* by the focal length of the lens. Perspective is a function of the viewpoint from which a picture is made; the focal length determines only the size of the image, and therefore the amount included in the picture area.

See, for example, Figure 3. In view A, two objects alike in size are photographed from such a distance that the image of one is twice as large as the image of the second. In view B, the same two objects are photographed *from the same distance* with a lens of longer focal length. It is evident that while the images of both objects are larger in the latter picture, the *relationship* between them—that is, the perspective—has not changed. The image of the first is still twice as big as that of the second. In view C, the same two objects are photographed from a greater distance. Now the relationship is changed; one image is now two-thirds the size of the other. It is obvious that at this new distance, the relationship 2:3 will hold regardless of the lens in use.

It is now evident that the distance from the subject controls the relationship between various objects in the picture. The focal length of the lens, on the other hand, controls the size of the whole picture; its influence on perspective is limited to the choice of subject distance in order to secure a given image size, or conversely, the size of image secured when the viewpoint is chosen for the desired perspective.

Thus, for example, if the desired perspective demands a close viewpoint, from which the normal lens will see too little of the desired subject, a shorter-

focus (sometimes called a wide-angle) lens is needed. For the Leica, there are two such lenses available. One of these, the 35mm Summaron, includes about 50 per cent more at a given distance than does the normal lens; the other the 28mm Hektor, includes nearly twice as much as the 50mm lens.

On the other hand, when the standard 50mm lens includes too wide an angle, and you cannot or do not wish to approach the subject more closely, you must use a longer-focus lens. For this purpose there is available a wide range of long-focus and telephoto lenses, ranging from 85mm to 800mm (3½ inches to 32 inches) in focal length.

Figure 4 shows a portrait as made with the standard 50mm lens and another with a long-focus lens. In this case, the camera-to-subject distance was changed so that both pictures would have identical-sized images. It will immediately be evident that the picture taken from the greater distance has the more natural perspective. The improved perspective here is the result of the choice of viewpoint; the focal length of the lens used had no effect on the picture except to determine the size of the image.

4. Perspective control through choice of viewpoint. *(Left)* Subject close to camera; short focus lens exaggerates perspective. *(Right)* Subject farther from the camera flattens perspective; long focus lens maintains image size.

Figure 5 shows a familiar scene taken with various lenses, wide-angle, normal, and long-focus. All these pictures were taken from the same point, changing only the lens. It is obvious that the perspective of all these pictures—that is, the relationship between the sizes of various objects at different distances—is the same.

Lens Speed • As has already been pointed out, the speed of a lens is actually a measure of its light-gathering power. This is controlled by two factors. The first of these, obviously, is the diameter of the lens itself; naturally, a big lens will collect more light than a small one. However, since we are not concerned primarily with the light collected by the lens, but rather with the light that the lens transmits to the film, a second factor enters. The intensity of light diminishes with the distance from the source; thus the focal length of a lens has an influence on the amount of light reaching the film.

These two basic factors controlling lens speed are obviously related to each other. It is best to examine them separately. First, as to the diameter of the lens, the actual light transmitted through a circular aperture is proportional to the *area* of the aperture, and geometrically the areas of any two circles are proportional to the squares of the diameters. Thus, for example, a lens 2 inches in diameter will not transmit only twice as much light as a lens 1 inch in diameter—it will transmit four times as much.

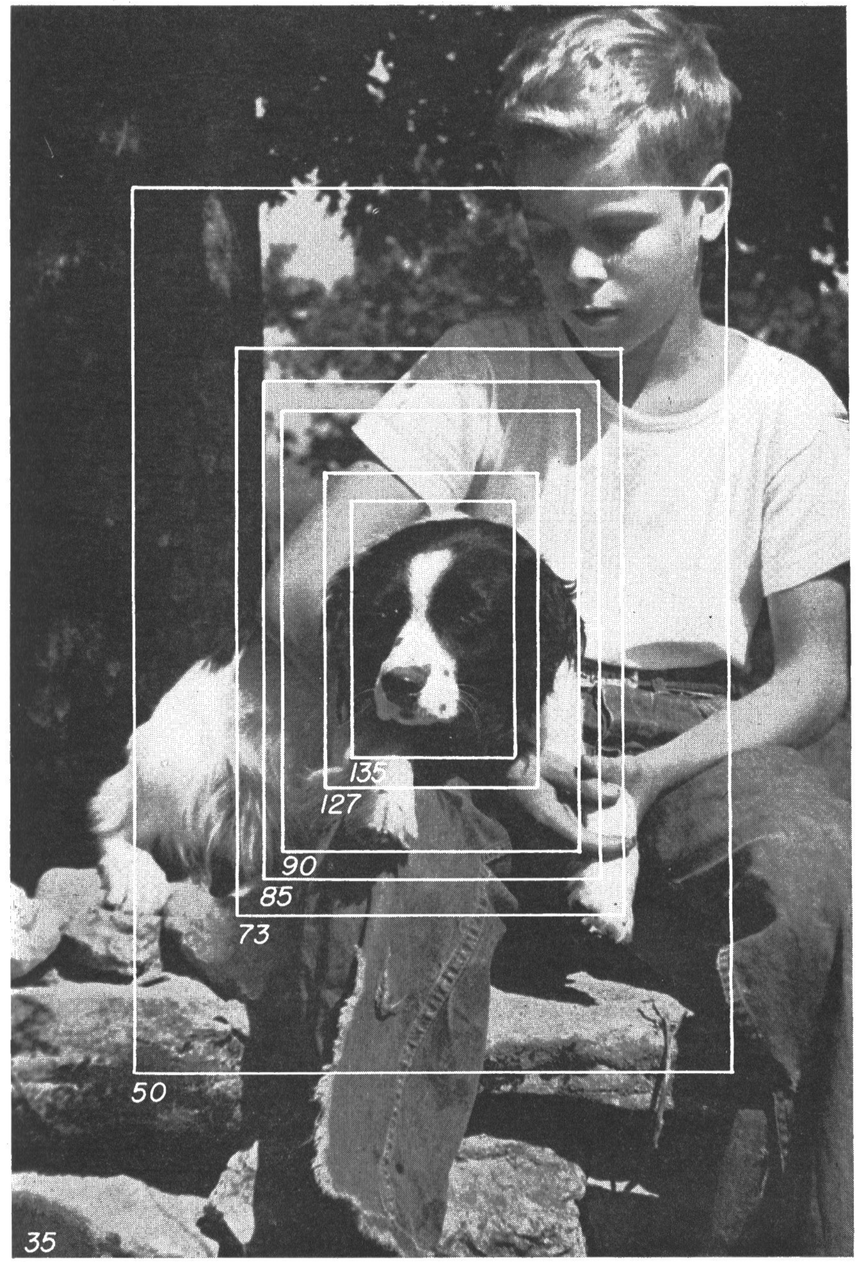
Second, if the lens aperture is considered the source of the light reaching the film, it is obvious that the amount of light reaching the film will be smaller the greater the distance is from lens to film. It can be shown geometrically that the intensity of light at any point is inversely proportional to the *square* of the distance from the source. Thus a lens having a focal length of 4 inches and a diameter of 1 inch will transmit to the film exactly the same amount of light as another lens having a focal length of 8 inches and a diameter of 2 inches. The *ratio* of the lens diameter to its focal length is the same in both cases.

This ratio can, then, be used to define the light-gathering power of the lens, since all lenses having the same ratio of focal length and diameter would transmit the same amount of light to the film. This ratio is called an *f-number;* it is defined as follows:

$$\text{f-number} = \frac{\text{focal length}}{\text{diameter}}$$

For each of the two lenses just mentioned, the number would be 4. Hence these lenses are described as f/4 lenses; any other lens whose diameter was 1/4 of its focal length is also an f/4 lens.

Resolving Power • In order to be able to make enlargements of considerable size from a small negative without significant loss of detail, there must be present in the negative many details too small for the eye to see.



5. Comparative fields of view covered by the various Leica lenses from 35mm to 135mm focal lengths. Photo by Ralph Morrissey.

The first consideration in any discussion of resolving power, then, is: How small a detail can the eye perceive?

Some standard definition of detail is necessary, of course; otherwise a lens (or the eye) would have different resolving powers when measured on different types of objects, and this indeed is the case in practice. For the sake of measurement, however, some type of standard, easily reproducible object is needed, so that figures secured by different observers will be comparable.

A solid gray object has no detail at all—the eye sees nothing but a uniform expanse of gray. A single black line on a white background is a detail of sorts; however, it is difficult to measure the degree of resolution on the image of just one line. Even a very poor lens, or a good one out of focus, will show some sort of line, though perhaps quite vaguely.

The simplest sort of detail consists of black lines of a definite width separated by white spaces that are equally wide. If you draw such lines closer and closer together, you finally find a spacing such that the eye no longer sees individual lines, but simply a uniform gray field. At the closest distance for the average eye, 10 inches, such lines would be about 1/100 inch apart. At 20 inches, of course, they could be farther apart and still not be distinguished — 2/100 inch, to be exact. At 40 inches, they would have to be 4/100 inch apart.

Thus, for example, the individual bricks in a wall, being approximately 2 inches high, can just barely be seen at a distance of 2000 inches (167 feet); beyond this, the wall appears to be simply a solid red tone. Or, to take another example, the illustrations in this book, printed by the halftone process, are made up of dots spaced about 1/120 inch apart. At normal viewing distance (10 inches) these dots are too close together to be separated by the eye. Hence you see these illustrations as smooth gradations of black, gray, and white. Apparently, too, you are able to perceive many fine details in these illustrations, yet it is obvious that no detail in any such picture can be smaller than 1/120 inch—a single dot.

Now if you were to enlarge one of these illustrations to twice its size, the dots would be 1/60 inch in diameter and would be plainly visible to the eye. You could get no additional detail by enlarging a picture whose maximum detail is 1/120 inch.

Therefore if you are to enlarge a small picture to any degree, the detail present in the negative must be as many times smaller than 1/100 inch as the number of times the image is to be enlarged linearly. For example, a negative to be enlarged to 5 times its size must have detail as small as 1/500 inch in order to have the final print considered "sharp." Actually, most good lenses have a resolving power better than the film that will be used to receive

their images: resolution, therefore, is limited mainly by film and processing, to be discussed in other chapters.

No lens, of course, can have absolutely perfect resolution. Even if it were possible to eliminate all aberrations and make a perfect lens, its resolving power would be limited by the fact that light is made up of waves; no object that is smaller than the wavelength of the light used can be imaged. More important, this wave motion causes light rays passing through an aperture to be broken up or *diffracted,* hence the resolving power of a lens depends also on the size of the lens aperture.

Contrary to the general impression, the resolving power of a lens actually gets worse as the lens is stopped down. (The apparent improvement in sharpness on stopping down is due to the elimination of traces of spherical aberration.) Actually, the resolution of a lens is given by the formula:

$$R = \lambda \frac{\text{focal length}}{\text{diameter}}$$

Where

R = the spacing between two points just resolved,

λ = the wavelength of light used for the measurement.

But, as we have seen, focal length divided by the diameter is equal to the f-number of the lens in question, so the formula simplifies itself to:

$$R = \lambda \text{ (f-number)}$$

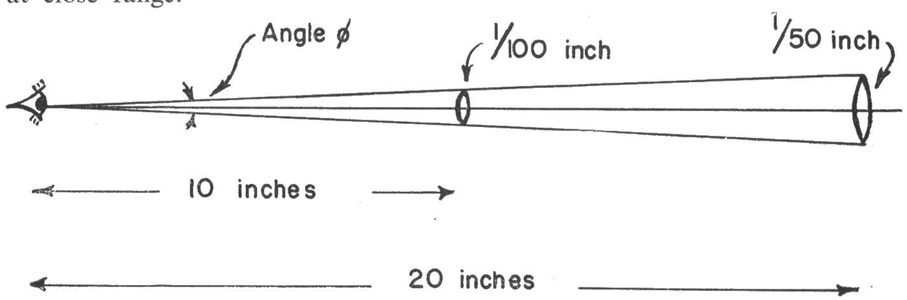
From which we see that the greater the f-number (the smaller the aperture!), the greater will have to be the separation of 2 objects to be resolved. That is, the more the lens is stopped down, the *poorer* its resolving power gets.

Except for apertures far smaller than the miniature-camera photographer normally uses, the effect is unimportant, however. This is due to the fact, already mentioned, that the resolving power of most lenses is better than that of the films in use. For example, if the measurement is made with blue-green light of wavelength .0005mm, the theoretical resolving power of a lens at f/16 is .008mm, or 125 lines per millimeter, which is equal to the resolving power of all but the finest-grained films. At larger apertures, the resolving power will of course be even better.

High-speed pan films usually resolve about 45 lines per millimeter; this is equivalent to about 1125 lines per inch. As has been pointed out already, the eye resolves about 100 lines per inch in a print held 10 inches away, so for normal viewing distances the negatives on high-speed pan films can be enlarged at least 11 times their original size without perceptible loss of detail. There are fine-grain films used for copying that have a resolving power of 150 lines per millimeter; such films have been used for enlargements of from 30 to 50 times their original size.

Actually the most important factor in any consideration of resolving power in photography is the distance at which the ultimate print will be viewed. As already noted, the eye can separate details 1/100 inch apart in a print held 10 inches away; at greater distances details must be proportionately larger.

The viewing distance for photographs depends to a great extent on their size. Prints smaller than 8 x 10 are usually held in the hand for viewing. Enlargements 11 x 14 and bigger are generally hung on the wall; except when they are being deliberately examined for defects, they are seldom viewed at close range.



6. The eye resolves 1/100 inch at 10 inches; this corresponds to an angle of view (ø) of 0°2′, and the corresponding resolution at 20 inches will be 1/50 inch.

Now if you examine the diagram in Figure 6 you will see that with a constant ratio between resolving power and distance, there is a constant angle of view (ø) encompassed by the smallest visible detail. So, since the eye resolves 1/100 inch at 10 inches, the angle ø is equal to 0° 2′, or about 1/30 of a degree.

But if as a given negative is enlarged to larger and larger sizes, the resulting prints are viewed at greater and greater distances, the amount of detail visible remains constant. What this statement appears to mean is that if a negative contains sufficient detail for an 8 x 10 print, there is no limit to the degree of enlargement possible.

This is perfectly true, if the entire negative is used in all cases. If only a part of the negative is used for the enlargement, the over-all print size will be smaller, and the tendency will be to view it from a shorter distance. Or in other words, if only part of a negative is enlarged, the detail will be less in proportion to the total size of the print—or the negative must be of considerably better quality than one that is to be enlarged *in toto*.

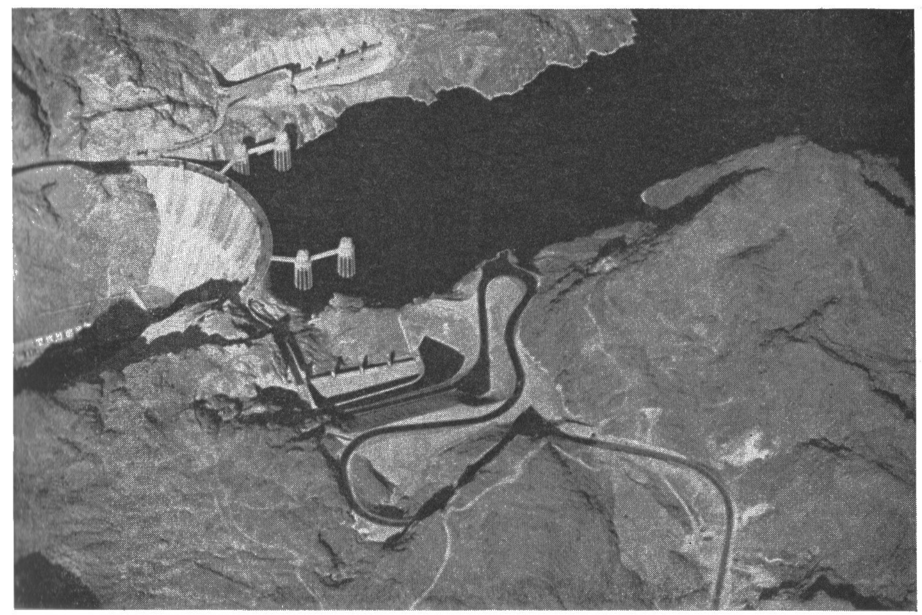
This then, is the problem of the miniature camera: Its negative corresponds in size only to a portion of the negative usually used for large prints, hence its detail must be greater in proportion if the prints are to be satisfactory. Such detail is not easy to attain; to justify it, there must be a reason better than the small size of the camera or the low cost of the film. There is, how-

ever, ample justification for the miniature camera; this is its ability to use very fast lenses and still maintain adequate *depth of field* in the final print.

Depth of Field • Depth of field, sometimes miscalled depth of focus, has already been defined as the distance between the points nearest to and farthest from the camera that are still acceptably sharp in the print. Note here, particularly, the use of the phrase "acceptably sharp." Obviously, no lens will produce a perfectly sharp image of any object not actually in the plane focused upon.

It is necessary, therefore, to settle on what may be considered "acceptably sharp." As has already been noted in the discussion of resolving power, the eye cannot distinguish detail much smaller than 1/100 inch in the final print at a viewing distance of 10 inches. Thus, as far as the print is concerned, any detail 1/100 inch in size or smaller is acceptably sharp. Since objects in the plane of focus will be imaged as considerably smaller points than this, it is evident that there will be a range on either side of the principal object the details of which will still be smaller than 1/100 inch, and a zone of acceptable sharpness will therefore exist.

But the figure of 1/100 inch applies only to the final print. Obviously, if the final print is 5 times as large as the negative from which it was made, these same acceptably sharp points must have been 1/500 inch in the original negative.



7. Hoover Dam from 12,000 feet through the porthole of an airliner. 90mm Elmar, f/9, 1/500 second. Photo by Herbert V. Mitchell.

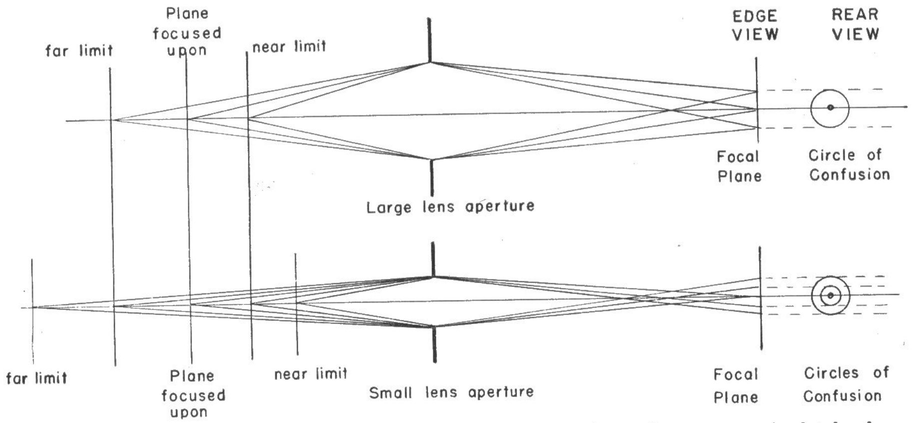
So we cannot establish a value for the acceptable degree of sharpness without knowing by what amount the negative is to be enlarged. Other things being equal, small negatives will be enlarged more than big ones. And, as has been noted, small negatives are usually made with lenses of relatively short focal length.

Therefore it seems logical *not* to specify the acceptable degree of sharpness as a single figure—say 1/500 inch. A better method is to make the acceptable degree of sharpness bear some relation to the focal length of the lens (which in turn determines the image size, and the degree of enlargement likely to be required.) Then, if the final prints are to be viewed at distances proportionate to their size, the detail in the image represents a constant *angle* at the eye.

For precise work, then, one may take as a measure of acceptable sharpness 1/2000 of the focal length of the lens. Thus for a 2-inch lens, the acceptable degree of sharpness will be 1/1000 inch, and the negative can be enlarged 10 times for normal viewing.

Now it you examine the diagram in Figure 8, you can see that while only one point of the three shown is imaged as a true, infinitesimal point on the film, the remaining two will be imaged as small circles. These are known as *circles of confusion.* It should be clear now that the size of the circle of confusion is not a measure of the merit of a lens, but is merely the degree of unsharpness that the photographer tolerates in order to secure a usable depth of field.

If the lens remains focused on the same point but its diaphragm is closed down, as in B of the same figure, the circles of confusion corresponding to the two points just mentioned become smaller, while two new points have circles of confusion that can be considered adequately small. Since these two circles of confusion correspond to points farther forward and back than the

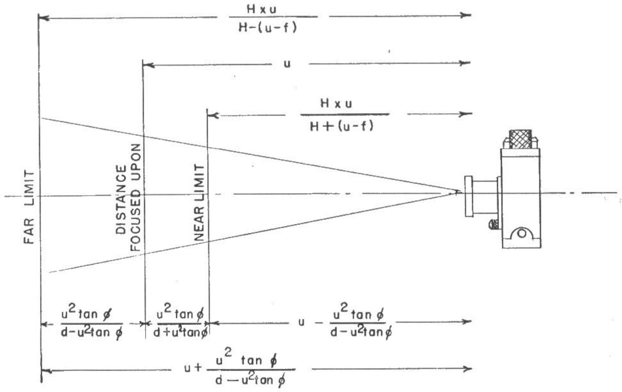


8. *(Top)* With a given lens aperture, only points in the plane focused upon are absolutely sharp, others being imaged as small circles called Circles of Confusion. *(Bottom)* If a smaller lens aperture is used, the circles of confusion for equal distances are correspondingly smaller; for equal circles of confusion, the depth of field is increased.

two previously discussed, it is evident that the depth of field has been increased by stopping down the lens.

This means, in short, that depth of field is a function of the lens aperture and of the acceptable circle of confusion. But, as already noted, the acceptable circle of confusion is measured in terms of the focal length of the lens, and if this is true, it may also be expressed in terms of the angle (ϕ) already mentioned in the discussion of resolving power (Figure 6).

9. Mathematical relations between depth of field, circle of confusion in angular measure, and hyperfocal distance. When the circle of confusion is taken as 1/2000 of the focal length of the lens, ϕ = 0°2′ and tan ϕ = .00058. (See Text)



In this case, the depth of field can be defined by the following pair of formulas (see Figure 9):

$$\text{near limit of depth of field} = \frac{u^2 \tan \phi}{d + u \tan \phi}$$

$$\text{far limit of depth of field} = \frac{u^2 \tan \phi}{d - u \tan \phi}$$

where

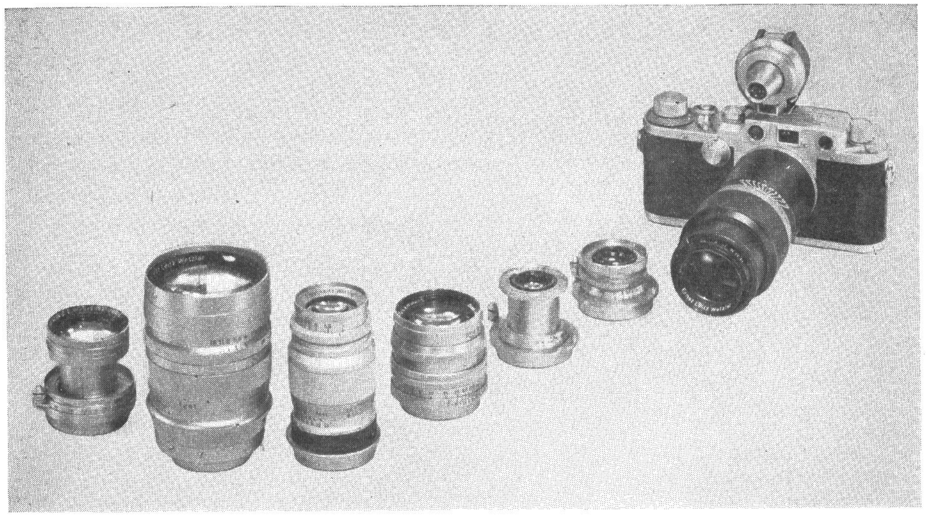
u = distance of object focused upon,
d = effective diameter of lens aperture,
ϕ = angular size of circle of confusion.

If the acceptable circle of confusion is taken as 1/2000 of the focal length, the angle ϕ will be 0° 2′, and its tangent (tan ϕ) = .00058. Then the formulas reduce to the following simplified forms:

$$\text{near limit} = \frac{.00058\ u^2}{d + .00058\ u} \qquad \text{far limit} = \frac{.00058\ u^2}{d - .00058\ u}$$

But this leaves *u,* the object distance, and *d,* the diameter of the lens, as the only factors affecting depth of field.

Here, then, we have the most important reason for the success of the miniature camera. Because if *u,* the subject distance, is constant, then obviously *all lenses having the same diameter will have the same depth of field.*



10. The Leica and its 7 currently available lenses. Left to right:
Summitar 50mm f/2, Summarex 85mm f/1.5, Elmar 90mm f/4, Summarit 50mm f/1.5, Elmar 50mm f/3.5, Summaron 35mm f/3.5, and Hektor 135mm f/4.5 (on camera). 200mm Telyt f/4.5 also available.

Take for example a lens 1 inch in diameter. If this lens has a focal length of 8 inches (as it would have for a 5 x 7 view camera), it has an aperture (or speed) of f/8. For the Leica, where the normal focal length is 2 inches, a lens 1 inch in diameter has a "speed" of f/2. But since both lenses have the same diameter, they have the same depth of field; the f/2 lens, however, transmits 16 times as much light as the f/8. Therein lies the real advantage of the miniature camera — its ability to make pictures under adverse light conditions without loss of depth of field.

Depth-of-field calculations. The above formulas are not usually used in practice when a single camera, such as the Leica, is concerned. Since only one negative size is considered, it is usually preferable to calculate the depth-of-field tables for all lenses for equal circles of confusion. In this way, the sharpness of the final print is the same, regardless of whether normal, wide-angle, or telephoto lenses are used.

In any case, it is seldom necessary to perform the calculations described to obtain the depth of field for a given case. Depth-of-field tables have been published for the various Leica lenses, based on a circle of confusion of 1/30mm. But even these need seldom be referred to; the Leica lenses carry an integral depth-of-field calculator, engraved on the lens barrel.

To use the built-in depth-of-field calculator, it is necessary only to focus the lens on the principal object. On the depth-of-field calculator, to either side of the index arrow that points to the distance focused upon is a series of figures corresponding to lens stops. Opposite these graduations on the

focusing scale will be found the points nearest to and farthest from the camera that will still be acceptably sharp at the corresponding lens aperture. For example, if the 50mm lens is focused on an object 10 feet away; at f/6.3, objects from 7½ feet to 14 feet away will be acceptably sharp.

It will also be noticed that if the left-hand figure corresponding to the lens stop in use is placed at infinity (∞), the right-hand figure will be opposite a distance exactly half that focused upon. In this case, the figure opposite the index arrow is the *hyperfocal distance* for the lens aperture in question. Its value is obvious—when a lens is focused upon the hyperfocal distance for the aperture in question, *everything from half that distance to infinity* will be acceptably sharp. Thus the hyperfocal distance can be considered a fixed-focus setting for outdoor shooting.

The hyperfocal distance can be found by the above method, or by the formula below*. For rapid work, it is probably easiest simply to ignore the hyperfocal distance altogether and place the infinity mark on the left-hand figure corresponding to the lens stop in use. For example, if the exposure calls for an aperture of f/8, place the infinity mark of the focusing scale on the left-hand f/8 mark. Then the index mark points to 10 feet, and the other f/8 marker is at 5 feet, the closest point that will be acceptably sharp.

The Leica Lenses.

A wide variety of lenses has been available in the past for the Leica camera. Some of the very earliest, such as the Elmars, have been of such outstanding performance that they have never been superseded. Others that met a special need at the time of their introduction have since been discontinued or replaced by lenses of wider applicability. Nonetheless, many of these older lenses are still in the hands of Leica users, and for the benefit of those readers who may still own one or more of the older lenses, a description of all Leica lenses is included here.

The basic mechanical feature of all Leica lenses (except one or two of

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* The hyperfocal distance is given by the following formula:

$$H = \frac{fd}{c}$$

Where H = the hyperfocal distance,
f = the focal length of the lens,
d = the effective diameter of the lens,
c = the acceptable circle of confusion.

But be sure to note that the effective diameter of the lens (d) is not the same as the diameter of the front element nor the same as the actual diameter of the diaphragm opening. It is the diameter of the diaphragm opening as measured through the front element of the lens, and is best obtained by calculation, dividing the focal length of the lens by the f-number: Summar 50mm f/2 = 50:2 = 25mm those discontinued) is the interchangeable lens mount, so accurately made that any Leica lens will fit any Leica camera, and not only will be in accurate focus, but will also operate the coupled range finder correctly.

All Leica lenses have the depth-of-field scale engraved on the lens barrel; all but the 28mm and 35mm focal lengths have an additional index mark for use with infrared films. Since the infrared rays of light do not come to a focus in the same plane as the visible rays, after focusing with the range finder it is necessary to shift the lens barrel slightly, moving the figure corresponding to the distance focused upon from the regular index arrow to the infrared mark — an engraved R on the lens ring.

The 28mm Hektor f/6.3 · This is the "widest" wide-angle lens in the family of Leica lenses. As such it has the greatest depth of field, and under most circumstances can be used as a fixed-focus lens. Its hyperfocal distance at f/6.3 is 12 feet, so if the focusing scale is set at 12 feet, everything from 6 feet to infinity will be sharp. Its maximum speed of f/6.3 may appear to be slow, but it is actually a triumph of lens design when considered in connection with its angle of view at full aperture — 76° from corner to corner of the field. Its vertical angle of view is 46° and its horizontal angle fully 65° based on the Leica image of 24 x 36mm. A special view finder for this lens was formerly available, but this has been superseded by a special 28mm adapter that screws into the front of the Imarect Finder.

⊙ *The 35mm Elmar f/3.5* · The most popular member of the Leica wide-angle lens family is the 35mm Elmar f/3.5. With an angle of view almost 50 per cent greater than the standard 50mm lens, its aperture is adequate for many types of indoor photography. Stopped down slightly, this lens can be used for quick snapshooting at a fixed-focus objective; for example, with the lens diaphragm set at f/6.3 and the lens focused at 20 feet, everything from 10 feet to infinity will be sharp. For use wide-open the lens is of course focused in the normal way, since it couples to the range finder in the same manner as all other Leica lenses. The lens itself is shallow enough so that it does not require a collapsible mount; it is always in position for quick shooting. Its field of view is 38° in the vertical plane, 55° in the horizontal.

The 35mm Summaron f/3.5 · This is a new six-element wide-angle lens that supersedes the 35mm Elmar f/3.5. The 35mm Summaron f/3.5 has a total field of 68°, a vertical field of 38°, and a horizontal angle of view of 55°. It is factory-coated for minimum reflection, haze, and lens flare, and is mounted in a rigid, noncollapsible barrel with click-stop diaphragm. Like the former Elmar f/3.5 of 35mm focal length, this lens can be conveniently used as a

⊙ This symbol indicates that the lens described is no longer being manufactured. The description is retained in this book for historical and reference purposes.

fixed-focus lens; at f/4.5, for example, with the lens set at 26 feet, everything from 13 feet to infinity will be acceptably sharp.

The 50mm Elmar f/3.5 · This is the original Leica lens, and was responsible for the great success of the Leica camera — nearly 35,000 Model A Leicas with permanently mounted 50mm Elmars were sold before the interchangeable lenses were introduced. The 50mm Elmar f/3.5 (sometimes called the standard lens) reaches its peak of correction at about f/6.3 — its depth of field is remarkable, in spite of its somewhat longer focal length, and its perspective is most natural, since its angle of view approximates that of the eye. Its total field is 48°, its vertical angle of view is 27° and its horizontal angle is 40°.

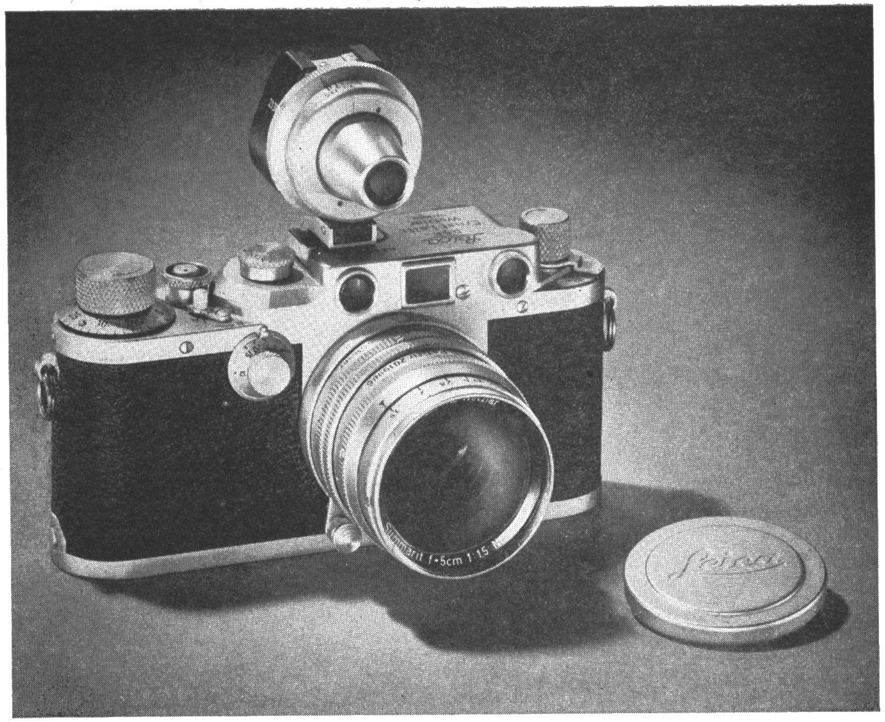
⊙ *The 50mm Hektor f/2.5* · This lens was the first higher-speed objective for the Leica. As the name 50mm Hektor f/2.5 implies, it is based on a optical design different from that of the Elmars; it is 100 per cent faster than the f/3.5 lens, with only a slight decrease in sharpness at maximum aperture. However, in color correction it is slightly superior to the Elmars; this makes it advantageous with panchromatic or color films. Its angle of view is the same as that of the 50mm Elmar.

⊙ *The 50mm Summar f/2* · Three times as fast as the 50mm Elmar, the 50mm Summar f/2 retains excellent resolving power for enlargements up to and beyond 8 x 10. This is the lens that made candid and stage photography possible under normal illumination. It is mounted in a collapsible mount with coupled-range-finder focusing, and a diaphragm having stops from f/2 to f/12.5. Its angle of view is the same as that of the 50mm Elmar.

⊙ *The 50mm Xenon f/1.5* · Still faster than the f/2 Summar, the 50mm Xenon f/1.5 is the largest-aperture objective available for the Leica. It is larger and heavier than the 50mm Summar, and is mounted in a rigid, non-collapsible barrel. Its speed is 75 per cent faster than that of the f/2 Summar and five and a half times as fast as that of the f/3.5 lenses. Its angle of view is the same as that of the 50mm Elmar.

The 50mm Summitar f/2 · A recent addition to the Leica lenses is the 50mm Summitar f/2. In appearance it is similar to the 50mm Summar f/2, except for a larger front element. The aperture is the same as that of the Summar, but the increased size of the front element considerably improves the evenness of illumination and reduces the falling-off in the corners of the image. In addition, the Summitar has improved chromatic correction, which is advantageous with panchromatic and color films. Its angle of view is the same as that of the 50mm Elmar.

The 50mm Summarit f/1.5 · The latest, coated, speed lens for the Leica camera, the 50mm Summarit f/1.5, is especially corrected not only for excellent definition at full aperture, but for an actual increase in sharpness



11. The Leica equipped with the high-speed Summarit 50mm f/1.5 lens and the Imarect Universal View Finder.

on stopping down. Thus the 50mm Summarit is useful not only as a high-speed lens for special occasions, but as an all-round objective for general photography. Corrections for light distribution throughout the field, and for freedom from distortion, have been carried out to a degree beyond those of any previous high-speed lens. The Summarit couples to the range finder of the Leica camera in the usual manner; its lens barrel does not rotate during focusing, which is accomplished by turning a knurled grip on the lens barrel. Owing to its large diameter, the lens barrel is not collapsible. The angles of view are the same as for the 50mm Elmar f/3.5.

⊙ *The 73mm Hektor f/1.9* · With only a trace of softness at full aperture, the 73mm Hektor f/1.9 combines high speed and a slightly longer focal length. This fits it especially for the field of portraiture, both because of the larger image it produces at normal working distances and because its slightly shallower depth of field aids in subduing the background when used at large apertures.

The 85mm Summarex f/1.5 · A superspeed lens with aperture equal to the 50mm Xenon f/1.5 and a somewhat longer focal length, the 85mm

Summarex f/1.5 is a highly corrected lens of critical sharpness. It is specially coated for reduction of flare and scatter, and for increased light transmission and image contrast. Its angle of view is 16° vertically and 24° horizontally.

⊙ *The 90mm Elmar f/4* · An all-round, semi-long-focus lens, the 90mm Elmar f/4 is suitable for both outdoor long-distance photographs and indoor portraiture. Because of its focal length, it has naturally less depth of field than the shorter-focus Leica lenses; however, at the greater subject distances common in outdoor photography, this is of little consequence. Its speed is high considering its compactness and its focal length. Its angle of view is 15° vertically and 22° horizontally.

The 90mm Leica f/4.5 · An American-made objective, the 90mm Leica f/4.5 is similar both mechanically and optically to the 90mm Elmar f/4. It gives the same performance, angle of view, and magnification, and is specially coated to increase transmission and reduce flare and scatter.

⊙ *The 90mm Thambar f/2.2* · The 90mm Thambar f/2.2 combines a long focal length with high speed, in addition to which its ingenious optical design offers a choice between critical sharpness and several degrees of diffusion. This is accomplished by the retention of a small amount of spherical aberration at the extreme margins of the lens itself. Thus when the lens is stopped down enough to eliminate the edges of the lens, the image is critically sharp. Wide-open, a pleasing degree of softness is produced, in no way "fuzzy" or out-of-focus in appearance. If still softer results are desired, a special center-spot disk is used over the lens, eliminating some of the rays from the fully corrected center zone of the lens. The center-spot disk must not be used at small apertures, as the spot would image itself in the picture. The high speed of the lens at full aperture, and its somewhat shallow depth of field, suit it particularly for portraiture where subdued, out-of-focus backgrounds are preferred. The angle of view is the same as that of the 90mm Elmar.

⊙ *The 105mm Elmar f/6.3* · Similar to the 90mm Elmar f/4 but of longer focal length, the 105mm Elmar f/6.3 is a lightweight lens suitable for tourists and traveling photographers desiring lightweight, compact equipment. Now discontinued, this Elmar lens had a vertical angle of 13° and a horizontal angle of 19°.

The 127mm Leica f/4.5 · This is an American-made objective, made on the same optical formula as the 90mm Elmar f/4. The 127mm Leica f/4.5 has excellent color correction, produces critically sharp negatives, and is coated to reduce flare and increase contrast. Its magnification is two and a

⊙ This symbol indicates that the lens described is no longer being manufactured. The description is retained in this book for historical and reference purposes.

half times that of the 50mm lens, its vertical angle of view 11°, and its horizontal angle of view 16°.

The 135mm Hektor f/4.5 · A lens for long-distance photography, aerial work, and the like, the 135mm Hektor f/4.5 may actually be found to have too long a focus for portraiture. The distance at which this lens must be used to secure a full head-and-shoulder image may be so great as to cause flattening of perspective. In spite of its long focus and its appearance, the 135mm Hektor is not a telephoto lens; it is a fully corrected anastigmat of high color correction and critical sharpness. Because of its specific plane of color correction, it is especially suitable for long-distance photography with infrared film. Its vertical angle of view is 10° and its horizontal angle is 15°.

⊙ *The 135mm Elmar f/6.3* · The 135mm Elmars have been discontinued for some time, their place having been taken by the Hektors. Some of the earliest of the 135mm Elmars were manufactured for the Leica Model C and do not have a coupling mechanism to operate the range finder of the later Leica cameras.

The 200mm Telyt f/4.5 · The 200mm Telyt f/4.5 is a true telephoto lens; that is, the distance from lens to film plane is less than the focal length. This is accomplished by an optical design that places the principal plane of the lens outside the objective, in front of the front element. The result is a lens having a focal length 65mm longer than that of the 135mm Hektor, yet having an over-all barrel length only 3.3mm longer. The 200mm Telyt has been carefully designed to eliminate distortion of the image, and its color correction is especially high, so that it can be used with panchromatic film and red filters, or with infrared film for long-distance photography.

The extreme focal length of this lens, and its correspondingly narrow angle of view (7° vertical, 10° horizontal), make the use of ordinary finders and coupled range finder impractical. Therefore the Telyt is always fitted with the Mirror-Reflex Housing, which combines the advantages of extremely accurate ground-glass focusing with the ability to study the entire picture through a 5x magnifier. A 30x magnifier is also available for critical work.

The magnification of the 200mm Telyt is 4 times that of the normal 50mm lens; and it must necessarily be used on a very rigid support or tripod. Its focusing mount is scaled from infinity to 10 feet, at which distance it covers a field 12 x 18 inches. Extension tubes are available for this lens, permitting its use as close as 4 feet from the subject, at which distance it covers a field 4 x 6 inches.

The 400mm Telyt f/5 · Second in the series of true telephoto lenses for the Leica is the 400mm Telyt f/5. As in the case of the 200mm Telyt, it must be used with the Mirror-Reflex Housing, yielding a magnification of 8 times that of the normal 50mm lens. Its angle of view is 3 1/3° vertically

and 5° horizontally. The minimum distance on the focusing scale is 25 feet; extension rings can also be used for closer working distances.

Additional Tele Objectives · While it is not available at the time this book goes to press it is expected that a new Tele objective similar to the 200mm and 400mm Telyts will be available soon. This new lens will be of 800mm (32-inch) focal length; its magnification will be 16 times that of the normal 50mm lens.

Use of the Mirror-Reflex Housing for Other Leica Lenses · The Mirror-Reflex Housing can also be used with other Leica lenses, particularly the 135mm Hektor f/4.5 which can be supplied in a special shortened mount without range-finder coupling. With this fitting, the 135mm Hektor can be used at all distances on its focusing scale to infinity, and is simply screwed into the housing in place of the Telyt.

Other Leica lenses of shorter focal length can be used with the Mirror-Reflex Housing for close-up photography. When used in this manner, the Mirror-Reflex housing is equivalent to an extension tube of 62.5mm, and the lenses cannot, of course, be focused on infinity. With these lenses attached to the Mirror-Reflex housing, and their focusing scales set at infinity, the ratios of reduction or enlargement are as follows:

RATIOS OF LENS REDUCTION AND ENLARGEMENT

Lens	*Focal Length*	*Ratio of Reduction*
Hektor	135mm	1:2.2
Leica	127mm	1:2
Leica, Elmar, Thambar	90mm	1:1.5
		Ratio of Enlargement
Summarex	85mm	1:1.4
Hektor	73mm	1:1.2
Elmar, Leica, Hektor, Summar, Summitar, Xenon, Summarit	50mm	1.2:1
Elmar, Summaron	35mm	1.8:1
Hektor	28mm	2.2:1

To estimate the correct exposure with lenses used in the Mirror-Reflex Housing, it must be remembered that because of the extra extension, the f-stops marked on the lens barrel are no longer the actual apertures at which the lens is operating. Formulas for calculating the effective apertures when additional extension is used will be found in the chapter on Copying and Close-up Photography.

Supplementary Lenses · When the Mirror-Reflex Housing or extension tubes are not available, another method of making extreme close-ups is by the use of the Leica Front Lenses. Nos. 1, 2 and 3, supplied in mounts to fit the 50mm Elmar f/3.5 only. These are simple supplementary lenses that come in various focal lengths for copying objects at different distances.

If such a simple lens is focused at infinity, the image of the object focused upon will appear on the opposite side of the lens, at a distance equal to its focal length. You can reverse this situation; if you place an object at the focal point of a simple lens, its *image* will apparently be at infinity. Now if a camera focused upon infinity is placed on the opposite side of the simple lens, the image of the object at its focal point will be imaged by the camera just as if it were at infinity, hence the image will be quite sharp.

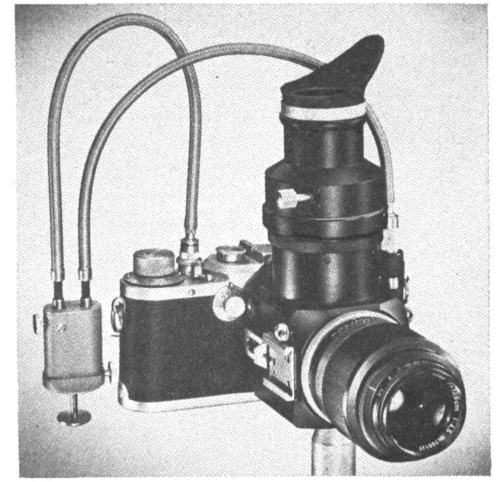
Thus there is a simple rule for the use of front lenses: To focus an object at a given distance, use a front lens whose focal length is equal to that distance and set the camera focus at infinity. Some adjustment can of course be made with the focusing adjustment of the camera, but the range will be very narrow.

There are definite advantages when front lenses are used in this manner. For one thing, if the supplementary lens is of a fairly low power, and reasonably thin, it will have little effect on the chromatic correction of the lens. Likewise, since its image apparently lies at infinity and the camera lens is focused on infinity, the rays of light between the two lenses are parallel; thus there is little effect on the other corrections of the lens, and the distance between the supplementary lens and the camera lens is not critical. Some residual spherical aberration is present, however, and it is always necessary to stop down when using supplementary lenses. Since the depth of field is at a minimum at such close ranges, it would in any case be necessary to stop down considerably, and this is no disadvantage.

One of the greatest advantages of the use of supplementary lenses is the fact that the extension of the camera remains unchanged. Since the lens remains at its infinity position, all f-stops retain their correct values and there is no loss of lens speed when making close-ups in this manner.

Care of Lenses · Optical glass is considerably softer than ordinary window glass and consequently is easily scratched. The cardinal rule for the care of lenses is: *Keep the lens covered whenever it is not in use.*

Tight-fitting front and screw-on back caps are available for all Leica lenses. If they are constantly used, there will seldom be any need to clean a lens, and there will be little danger of scratching or damaging the highly polished surface. Lenses that are kept covered most of the time will seldom need



12. The Leica equipped with the Hektor 135mm f/4.5 lens in a short mount attached to the Mirror Reflex Housing. The twin cable release moves the mirror and activates the camera shutter in proper sequence and timing.

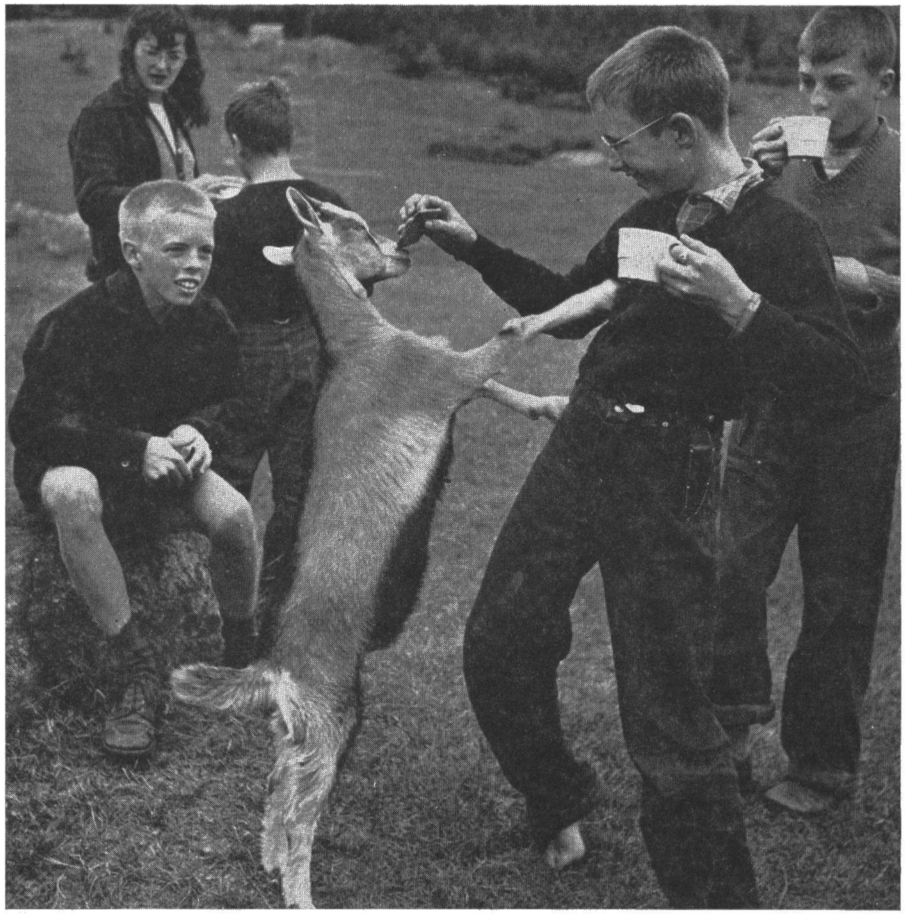
more than a dusting with a camel's-hair brush to remove loose dust from the surface. In extreme cases, breathing on the lens and wiping *carefully* with soft lens tissue will remove any heavier deposits.

All current Leica lenses are factory-coated to reduce internal reflections, lens flare, and image haze. This coating is as hard as the glass itself; nevertheless it is microscopically thin, and excessive rubbing will eventually scratch and remove it.

Some photographers occasionally become alarmed at finding a number of small bubbles within the glass of the larger-aperture lenses. Such bubbles are a characteristic of the special glasses which must be used to make a high quality lens; in fact, their presence may often be taken as a guarantee of quality in a lens, since they indicate the use of these special glasses.

Such bubbles have no effect on the definition or image quality of lenses; their only effect is to block a very tiny part of the light passing through the lens element. Thus a bubble 1/25 inch in diameter (.04 inches)—a big one—in a lens one-inch in diameter, will cause a light loss of less than 2/10 of 1 per cent. It would take 16 bubbles, each 1/100 inch in diameter, to cause an equal loss. Under the circumstances, the occasional small bubble found in high quality lenses is a matter of trifling importance.

One final warning: All Leica lenses are mounted in dustproof barrels. This mounting is done in rooms that are kept as dust-free as possible, and is done with the utmost care. There is never any necessity for disassembling a Leica lens to clean its inner surface, and it would be nearly impossible for the user to reassemble the lens without getting some dust inside. Should Leica lenses require any internal adjustment or cleaning, they should be returned to the manufacturer, who has ample facilities for handling them.



MILK AND CRACKERS — Barbara Morgan

Sudden spontaneous whimsical movements of kid and kids at summer camp are fully covered with the ample depth of field when using the 50mm Summitar lens at f/9, 1/500 second, fast pan film.

THE 35MM FILM—SELECTION, EXPOSURE, AND DEVELOPMENT

AUGUSTUS WOLFMAN

The ultimate aim in photography is the making of good prints. However, before this can be done it is necessary to have good negatives. This entails good judgment in the selection of the film to use, its exposure, and its development.

Before considering the details of these subjects, bear one thing in mind: The philosophy behind Leica photography is that a small, compact, precision camera is used to produce small negatives which are so critically sharp and full of detail that they can be enlarged many times to produce almost any size of print. Since negatives are considerably enlarged, any physical defects, such as scratches, dirt, and fingerprints, will also be greatly enlarged. Therefore care and cleanliness are absolutely essential in the handling and processing of Leica negatives.

Film Selection · The Leica uses 35mm perforated film, the same type employed by professional motion-picture studios. This is a considerable advantage, since the Hollywood studios consume an enormous amount of film and therefore film manufacturers constantly strive to produce better 35mm films, many of which are eventually made available for use with miniature cameras. At present the Leica photographer can make his choice from a number of black-and-white films on the market. Before doing so, he should consider the basic characteristics of films in relation to the type of pictures he is going to make.

Characteristics of black-and-white films

1. *Color sensitivity* · This refers to the way in which a black-and-white film reproduces various colors. Basically, there are two types of black-and-white films for use in a camera, *panchromatic* and *orthochromatic*. Panchromatic (commonly known as "pan") films are sensitive to all colors, while orthochromatic films (commonly referred to as "ortho") are sensitive to all colors but red. Red objects are reproduced by ortho films as if they were black. At present no ortho films are available for the Leica. There is one type of film that is referred to as *color-blind*. This is a positive film used primarily for making positive prints for projection purposes. It is sensitive practically only to blue.

2. *Speed* · Speed refers to the sensitivity of a film to light, or the relative amount of light needed for a correct exposure. Films fall into three groups: fast, medium, and slow. The speed of a particular film can, within certain limits, be controlled by development.

3. *Graininess* · Just what is grain? If you examine a negative under a microscope you will find that the image, which is metallic silver, is made up of many irregular clumps of silver. If these clumps are large and coarse, enlargements made from that negative may appear spotty or grainy. Actually, what is seen in such prints is not the clumps of silver themselves but reproductions of the spaces between the clumps. One aim in Leica photography, therefore, is the making of negatives in which the clumps of silver (grains) are small and evenly distributed, so that enlargements will not have a spotty or grainy appearance. Selection of the film has a great deal to do with the size of the grain in the negative. Development also affects graininess.

4. *Contrast* · This refers to the brilliance or the range of tones between black and white in a negative. If a film is capable of rendering many shades or gradations of grays, between black and white, it is known as a *long-contrast, soft-gradation,* or *long-scale* film. If there is a short range of tones between black and white in the negative, so that it appears brilliant or "hard," the film used is referred to as having a *high contrast* or a *short scale.* Generally the shorter-scale films have a finer grain. Although contrast is basically a function of the film, it can also be controlled by exposure and development.

5. *Latitude* · The ability of a film to withstand overexposure or underexposure and still produce a usable negative is referred to as *latitude.* All films have some degree of latitude. If this were not true, it would be necessary to "hit the exposure on the button"—otherwise a good negative would not be produced. Generally, the higher-speed, long-scale films have more latitude than slow-speed, contrasty films.

Types of Films · The reason various types of films are made available for the Leica is that no single film is best for all photographic applications. Another fact to remember is that the cost of film is not necessarily a measure of its quality but is a reflection of the cost entailed in the manufacture of the film. In many instances a relatively inexpensive film is better suited for a particular type of work than is a more costly one. In order to simplify the selection of film for any type of photographic work, films described here are divided into five groups.

Group No. 1: High-speed panchromatic films · These films have the greatest sensitivity to light and are therefore particularly suited for making pictures where the illumination is dim, such as indoor candid photography by natural room light, stage photography, and the like. As a rule these films have

a speed of about 100 Weston or ASA in daylight and 80 Weston or ASA in artificial light. They produce negatives with a relatively coarse grain, low contrast, and a long scale of tones. They also possess excellent latitude and will yield good negatives even though overexposed or underexposed several times. The main characteristic of these films is their high speed, and usually, their use should be predicated on this characteristic.

EXAMPLES: Kodak Super-XX, Ansco Ultra-Speed Pan, DuPont Superior 3 (Type 127).

Group No. 2: Medium-speed panchromatic films · The films in this group have a speed of about 50 Weston or ASA in daylight and 32 Weston or ASA in artificial light. The negatives they produce are more brilliant, and have a much finer grain, than the Group No. 1 films. They also have good latitude and good gradation. In short, they are good "all-round" films.

EXAMPLES: Ansco Supreme, Kodak Plus-X, DuPont Superior 2 (Type 126, nitrate base, and Type 306, safety base), Gevaert Panchromosa.

Group No. 3: Slow-speed panchromatic films · Films in this group have sufficient speed for general daylight photography—24 Weston or ASA in daylight and 16 Weston or ASA in artificial light. However, they produce negatives that are more brilliant (contrasty), having less gradation than negatives made with Group No. 2 films. Group No. 3 films also have less latitude, but they produce negatives with a finer grain. Consider them when you need films that have reasonable speed, gradation, and latitude and which also yield very fine grain negatives, so that big enlargements, 11x14 or larger, can be made without objectionable grain.

EXAMPLES: Kodak Panatomic-X, Gevaert Microgran.

Group No. 4: High-resolution, low-speed films · Films in this group are intended for copying purposes or for photographing still objects where the utmost in reproduction of detail is desired. The speed of these films is very low—3 Weston or ASA for artificial light. Daylight speed figures are not given because these films are not intended for general outdoor photography. Both latitude and gradation are low, contrast is high. Grain is extremely fine, and resolution (the ability of the film to record fine detail) is comparatively high. Films in this group are divided into two types: (a) panchromatic; (b) colorblind. The first are to be used when photographing copy or objects that have color and when filters are to be used. Color-blind film, which is positive film primarily intended for making positives for projection purposes, can be used as a negative film for copying black-and-white materials.

EXAMPLES: a. DuPont Microcopy Negative (Type 312), Kodak Micro-File.
b. Positive film of any manufacture.

Group No. 5: Special films • This group consists of films designed for special purposes, such as infrared films and direct positive or reversal films. Color films could also be put into this classification. However, this chapter is confined to black-and-white photography. Color films are discussed elsewhere in this book.

Infrared films • Theoretically, light travels in waves, and the wavelengths of light (distance from the crest of one wave to the next) determine its color. The shortest of the visible light waves is violet, while red has the longest wavelength. There are wavelengths that go beyond violet (being shorter) at one end of the visible spectrum; these are known as *ultraviolet* rays. At the other end of the visible spectrum there are rays whose wavelengths are longer than red. These are known as *infrared* rays. Neither ultraviolet nor infrared rays can be seen by the human eye. Practically all films are sensitive to ultraviolet rays. This is not true with infrared rays. However, there is a special film, known as infrared film, that has been so treated that it will record infrared light. This makes it possible to produce a photographic record of some things that cannot be seen by the human eye.

Infrared rays have the ability to penetrate atmospheric haze so that distant details, which cannot ordinarily be seen, can be recorded on film. These rays can also penetrate certain objects. Photographs of documents made with infrared rays will, many times, reveal defects, erasures, and so on, that are not apparent to the eye. Human skin transmits infrared, so that in some cases certain subsurface details not normally visible will be revealed in infrared photographs.

Infrared photography can also be employed to obtain unusual pictorial photographs. The sky lacks scattered infrared light and therefore appears practically black, so that white clouds, if they are present, stand out with unusual contrast. Green leaves and grass reflect infrared rays well, so green foliage appears very light, as if bathed in moonlight or covered with snow. Since there is no diffuse infrared light to illuminate shadows, these appear very dark, without detail. This combination of black sky and green foliage appearing to be illuminated by moonlight and deep shadows creates a night effect. Infrared photography is employed by the professional motion-picture industry to make "night" shots in broad daylight.

There is only one infrared film at present available for the Leica camera: Kodak Infrared film. Besides recording infrared rays, this film is also sensitive to blue. If a deep-orange or a red filter is slipped over the camera lens, blue light will be effectively held back, while the infrared rays will freely pass through the lens to the film. *Therefore, when you are making infrared pictures with infrared film, use a deep-orange or a red filter.* If you use no filter, the pictures will be similar to those made with ordinary films.

Exposure with infrared film is a matter of guesswork and experience. Since infrared rays are not visible, it is not possible to judge their concentration and adjust exposure accordingly. Exposure meters cannot be used for this purpose, since they are primarily designed for visible light. As a guide, an exposure of 1/20 second at f/4.5 will produce satisfactory results when you are using a red filter and making pictures on a bright sunlit day. For distant scenes you can stop the diaphragm down to f/8. When you use infrared film for copying or other purposes, you must experiment to determine the proper exposures.

There is another factor to be considered when you are making infrared pictures. Lenses do not bring infrared rays to a point of focus in the same plane as visible light. Images formed by infrared rays focus slightly farther back of the focal plane formed by visible light. Therefore if you focus the Leica on an object in normal fashion, that object will be out of focus in infrared photography. In order to compensate for this, rack the lens out about 1/200 of its focal length.

All Leica lenses being made at present have a special infrared index mark on their mounts, indicated by the letter R. Focus on the object with the range finder, notice the distance opposite the regular index mark on the lens, and then turn the lens so that the R index mark is opposite this distance. For infinity pictures, the R index mark is set at infinity. Some of the older Leica lenses do not have the R index marks. In such cases you can set the lens properly by referring to the table reproduced below.

FOCUSING TABLE FOR INFRARED FILM AND RED FILTER

Use as focusing mark the following aperture mark v (on the side toward infinity) on the depth-of-field scale instead of the normal index line on the mount.

Lens used		*Lens used*	
Elmar 50mm	f/6.3	Elmar 90mm	f/6.3
Hektor 50mm	f/6.3	Elmar 105mm	f/9
Summar 50mm	f/2	Elmar 135mm	f/6.3
Hektor 73mm	f/4.5	Hektor 135mm	f/6.3

Direct positive film • This film is used for making black-and-white positive transparencies for projection without the necessity of first making negatives that are to be printed later on positive film. Direct positive film is processed in a special manner. After its development as a negative, it is reversed to form the final positive transparencies. (It is also known as *reversal* film.) Formulas and procedure for processing this film are given in the Photo-Lab-Index.

There is only one direct positive film available for the Leica at present: Kodak Direct Positive film. It has a speed of 64 in daylight and of 50 in artificial light.

Selecting the Right Film • You will find that for general photography, such as making average outdoor photographs and indoor pictures where insufficient illumination is available, a Group 2 film will serve you best. Films in this group have sufficient speed for most purposes. They have good latitude, and produce negatives with a pleasing contrast and fine grain. If you wish finer grain for outdoor subjects, use a Group 3 film. Generally, Group 1 films should be confined to those purposes where the highest film speed is needed, in either outdoor or indoor work. In the following table general recommendations are given for the types of film to be used for various purposes. However, you should also use your own judgment, taking into consideration the characteristics of the different types of films and the results you desire to obtain.

FILM RECOMMENDATIONS FOR VARIOUS SUBJECTS
(Black-and-white-photography)

Subject	*Special Considerations*	*Film Group*
General Use	Outdoors	2 or 3
	Indoors, according to illumination	2 or 1
Aerial	Depending upon light conditions and type of filters used	1 or 2
Action and sport	In daylight	2
	In artificial light	1
Architecture	Exteriors	2 or 3
	Interiors (according to illumination available)	2 or 1
Candid	According to illumination available	2 or 1
	For copy having color	4a
Copying	For black-and-white copy or other material where no color is present	4b
Entomology (insects, etc.)	Depending upon shutter speed necessary to stop motion, if any, diaphragm stop, and illumination	1, 2 or 3
Flowers, plants, gardens, etc.		1, 2 or 3
Geology (minerals)		2 or 3
Landscape and pictorial	General use	2
	Where fine grain is desired for big enlargements	3
Medical	When shutter speed and illumination require high film speed	1 or 2
	General Use	3
Night and stage		1
Photomicrography	With and without color filters	3 or 4a
	For living organisms	1
Portraiture	If adequate illumination is available	2
	For adverse light conditions	1

How Film Is Supplied · Film for the Leica is available in 3 forms: 1) complete cartridges ready for insertion into the Leica, 2) bulk film and 3) semibulk film.

Daylight-loading cartridges · These are metal or plastic light-tight containers holding enough film for either 20 or 36 exposures. The film is fed out of the cartridge through a felt light trap and the start of the film is properly cut as a leader. The cartridges are cylindrical in shape and slip into the film magazine compartment of the Leica.

Bulk Film · Film for the Leica can be obtained in bulk rolls of 100 feet or more for loading into standard Leica magazines. This offers a number of advantages. One of the first benefits is the much cheaper cost of the film, especially when compared to cartridges. Obtaining a quantity of film in bulk, all from the same emulsion batch, offers the advantage of uniformity in characteristics for the entire quantity. It is also possible to load shorter lengths of film into a Leica magazine when a full 36-exposure or even 20-exposure loading is not needed for a particular job. Another great advantage is that if it is carefully handled, scratches are less likely to occur on negatives than is the case with daylight-loading cartridges. Hard particles of dirt may become lodged in the felt light trap of cartridges, causing scratches as the film is pulled through the trap. It is also possible that through faulty manufacture or careless handling a portion of a cartridge light trap may become tightly wedged, which also causes scratches. Such troubles are minimized through the use of bulk film. Leica magazines are sturdily constructed and open up to allow free passage of the film when the Leica baseplate is closed after loading.

1. OUTBOARD RACER. A skillful combination of fast film, fast shutter speed, and long focus lens. 135 mm Hektor, f/6.3, 1/1000 sec. Photo by Herbert V. Mitchell.

Semibulk film · In this form bulk film for the Leica is supplied in a 27½-foot roll in which each 36-exposure length is properly tongued and notched to make a total of five 36-exposure loadings.

Exposure · As has been previously noted, the ultimate aim in photography is to make prints that will picture subjects the way you would like to see them. This necessitates getting the negatives that will enable such prints to be made. It must also be borne in mind that Leica negatives are enlarged, therefore dense negatives are undesirable, since long exposure times are required when making prints. Generally, the ideal negative is one in which the highlight portions are not too dense (it is possible to see through such areas to observe detail when the negative is held up to the light) and the shadow areas are not totally transparent, but exhibit detail that can be reproduced on a print. In order to get such negatives, films must be properly exposed.

All films have a certain amount of latitude, which means that they can be given some degree of underexposure or overexposure and still produce usable negatives. The faster the film, the more latitude it generally has. However, latitude would be regarded only as a safety factor to be called upon when necessary. Old-time photographers compensated for underexposure or overexposure by observing an exposed film while it was being developed, increasing or decreasing developing time accordingly. But in Leica photography a single roll of film has on it 20 or 36 exposures. Therefore exposure for each of the negatives must be so calculated that when a roll of film is developed all the negatives will be of the proper type. Underexposure or overexposure is also undesirable in Leica photography because it results in loss of resolution.

The human eye is a poor judge of light intensity, except of subjects in sunlight, because there are too many factors that determine the intensity of the illumination falling on a subject. An overcast day, for instance, depending on the degree of overcast, can vary more than 30 times in intensity. Therefore some means must be found to determine the proper exposure to give for different light conditions. This is accomplished by exposure tables, calculators, and meters.

Exposure Meters

Tables and calculators · These are simple guides to proper exposure. Some are in the form of tables listing different lighting conditions, both indoor and outdoor, and indicating recommended exposures. Others are in the form of calculators having a moving slide or disk set according to type of film used, type of day, lamp-to-subject distance in the case of indoor illumination, and so on. You will find that these devices produce good results for most average subjects. Tables and calculators are generally designed to show about double the exposure that would be indicated by more accurate devices, such as photoelectric exposure meters.

Visual exposure meters · These devices, which are also known as *extinction meters,* are held to the eye while being pointed at the subject. They generally depend upon the minimum of light that can be observed. Thus in some visual exposure meters you see a series of numbers with the number just barely visible serving as the basis upon which the exposure is calculated. The major disadvantage of the extinction meter is the way in which the human eye accommodates itself to different intensities of light. If you use an extinction meter outdoors, you must allow some time for your eye to accommodate itself from the brightness of the outdoor light to the dim interior of the meter. On the other hand, if you hold the meter to your eye too long when taking a reading, your eye may see dimmer light than is required for proper exposure determination. The chief advantage of the visual exposure meter is its ability to give a reading under unfavorable light conditions, such as dim interiors. After some experience you can use this type of meter with success.

Photoelectric exposure meters · These are precision instruments that represent the most accurate devices for determining correct exposure. This type of meter is built around a photoelectric cell that converts light into electrical energy, which is then used to activate a sensitive milliammeter that indicates the exposure to be given directly or shows a light value which is then interpreted into proper exposure through a calculator. While this type of meter is relatively expensive, it eventually pays for itself in terms of film saved and getting difficult pictures that otherwise would be lost.

There are two types of photoelectric exposure meters: 1) the *reflected-light type* and 2) the *incident-light type.* Reflected-light meters are based upon the measurement of the light that is reflected from the subject. When taking a reading, you must therefore hold them with the sensitive photoelectric cell facing the subject. The incident-light meter measures the light falling upon the subject (incident light) and you must therefore hold it with the cell away from the subject, facing the light source. Attachments are available that permit some reflected-light meters to be used for incident-light readings, and vice versa.

Both types of photoelectric exposure meters are highly accurate. However, an exposure meter has no power of selectivity or interpretation. It will measure the total light falling upon its photoelectric cell without any consideration of the importance of that light in determining the proper exposure for the main subject. Therefore, despite its accuracy, you must use judgment in the use of a photoelectric exposure meter.

When using reflected-light meters · The exposure indicated by a reflected-light meter is determined by the light reaching it at an angle of anywhere from 30° to 80°; the actual angle varies with different meters. This could include subject matter (other than the main subject being photographed) the effect of which on the meter would cause a wrong exposure determination. For example: Suppose you are posing a girl in medium-colored clothes against a white wall. If you take a reading with a reflected light meter from a distance, the light reaching the meter from the light wall will cause the meter to indicate an exposure reading that would underexpose the girl. If the wall were black, the reverse would be true: the girl would be overexposed. When you are faced with such a situation, the correct way to take an exposure reading is to walk up close to the girl and hold the exposure meter near her face. This procedure eliminates the influence of the background upon the exposure meter. Take care that the meter does not cast a shadow upon the face, as this would influence the exposure reading.

When you are making pictures of outdoor scenes, take into consideration the influence of the sky on the exposure reading. Should the sky be bright blue without white clouds, its brightness is almost the same as the landscape and has little effect on the meter. An overcast sky, however, is much brighter than the landscape. Therefore, as a rule, in taking a reading of a scene, tilt the meter down to exclude the sky, unless you are primarily interested in photographing clouds without regard to the way in which the foreground will reproduce.

When objects are very small, such as jewelry, medical specimens, and so on, or when it is not possible to get close to the subject, you can obtain correct readings through substitution. Hold a piece of paper, cardboard, or cloth of about the same tone as the subject in such a position that the light striking it is the same as that falling on the subject, and take a reading from this substitute. When you are making photographs of people outdoors, a good substitute is to take a reading of your outstretched palm. Generally, when scenes are very bright, such as beach scenes, it is advisable to cut in half the exposure indicated by the meter. When scenes are dull, such as on heavily overcast days, double the exposure.

When using incident-light meters · This type of meter, as has been mentioned, measures the light falling on the subject. Hold it close to the subject with the cell facing the camera. For distant scenes, hold the meter at the camera position if the light illuminating this position is the same as that falling on the subject. In distant scenes, small shadow areas merge with brighter ones and are of no consequence. However, in close-ups you will usually desire resolution of detail in shadow areas. Therefore for distant scenes cut the exposure indicated by the incident-light meter in half, and double it for close-ups. As a rule, cut in half the exposure indicated by the meter for bright scenes or objects and double it for dark subject matter.

Film Speed Ratings · The 2 types of film speed ratings in general use today are: 1) Ratings obtained through a procedure adopted by the American Standards Association. The speed figures obtained through this system are known as *ASA Exposure Indexes.* 2) Ratings obtained through a system

originated by the Weston Electrical Instrument Company. These are known as *Weston Ratings.*

Exposure meters are calibrated for one or the other system. Previously the General Electric Company had its own G-E speed ratings; a system known as the Scheiner system was employed with the American and European Scheiner ratings varying, and German manufacturers created a standard known as the DIN system. In view of the fact that some photographers may have older meters, or foreign-made meters, and film speed ratings in the United States are now generally given in ASA or Weston figures, a comparison table of the different speed figures is reproduced here.

2. FAMILY PORTRAIT. The wide-angle lens is used to good advantage for this close-up picture. 35mm Elmar, f/6.3, 1/200 sec. Photo by Chris Butler.

COMPARISON OF VARIOUS SYSTEMS

of Emulsion Speed Values

This table of comparison of the various systems of ratings of film speed values is offered here only as a general guide, sufficiently accurate for practical purposes. Scientifically accurate conversion of the several systems into one another is quite impossible because of the different methods employed in arriving at the ratings of each respective system.

When using exposure meters calibrated in degrees Scheiner, it is advisable to use only the film speed values as furnished by the meter manufacturer, rather than obtain them by conversion. The same applies to the Weston, General Electric, and other exposure meters on the market.

†*ASA Exposure Index*	*Weston*	*H&D**	*American Scheiner*	*European Scheiner*	*DIN*
——	.3	7.5	4	10	——
——	.35	8.75	5	11	——
——	.5	12.5	6	12	——
——	.6	15	7	13	——
1.0	.7	17.5	8	14	1/10
1.2	1	25	9	15	2/10
1.6	1.2	30	10	16	3/10
2.0	1.5	38	11	17	4/10
2.5	2	50	12	18	5/10
3	2.5	63	13	19	6/10
4	3	75	14	20	7/10
5	4	100	15	21	8/10
6	5	125	16	22	9/10
8	6	150	17	23	10/10
10	8	200	18	24	11/10
12	10	250	19	25	12/10
16	12	300	20	26	13/10
20	16	400	21	27	14/10
25	20	500	22	28	15/10
32	24	600	23	29	16/10
40	32	800	24	30	17/10
50	40	1,000	25	31	18/10
64	50	1,250	26	32	19/10
80	64	1,600	27	33	20/10
100	80	2,000	28	34	21/10
125	100	2,500	29	35	22/10
160	125	3,120	30	36	23/10
200	160	4,000	31	37	24/10
250	200	5,000	32	38	25/10
320	250	6,250	33	39	26/10
400	320	8,000	34	40	27/10
500	400	10.000	35	41	28/10
650	500	12,500	36	42	29/10
800	650	16,250	37	43	30/10
1,000	800	20,000	38	44	31/10

† ASA Exposure Indexes are identical with Kodak and Ansco Exposure Indexes. For a complete explanation see PHOTO-LAB-INDEX No. 8-FS-8.

* H&D values are based upon the reciprocal of the inertia multiplied by 10:

$$S = \frac{10}{1}$$

It will be noted that Weston Emulsion Speed Values, as shown in column 2, correspond to those found on Emulsion Speed Dial of latest models of Weston Exposure Meters.

Film-speed figures are supplied by manufacturers of all exposure meters and films. When these are available, it is advisable to use the figures supplied by the exposure-meter manufacturer, since it may be assumed that these figures were determined for the particular meter. However, despite recommended speed figures, you may find that with your photographic equipment and processing procedures, it is advisable to give either more or less exposure. In such a case, do not hesitate to increase or decrease the speed rating of the film you are using. In the final analysis, the exposure meter, while being an accurate instrument, has no brain, and it is up to you to use it in a manner that produces the desired results.

Film Development • Development of the negative is a very important step because the manner in which it is done has a great bearing on the quality of the print. A negative that has been properly exposed and developed is a more or less permanent medium from which you can make prints whenever you wish. Throughout the developing procedure always bear in mind that you are dealing with small negatives from which greatly enlarged prints will be made. Very small defects on a negative will appear as large defects on the enlargement. Thus the need for care and cleanliness in developing Leica negatives cannot be overemphasized. Do not place your fingers on the film, particularly on the emulsion side. Hold the film by the edges so that no part of your hand touches the surfaces.

Steps in Developing Negatives · A roll of Leica film passes through 6 basic steps when it is processed. These are:

1. It is loaded into the developing tank.
2. It is treated with a developer for a specified time.
3. The developer is poured out of the tank and the film is then treated with a stop bath and a hardening solution.
4. The stop bath is poured out and the film is immersed in a fixing solution until all unused emulsion is dissolved.
5. The fixing solution is removed from the tank and the film is washed.
6. The film is dried.

What is gamma? · "Gamma" is a term you are bound to come across when reading literature on film processing. It is a numerical expression of development contrast or degree of development. Determining gamma is a laboratory procedure in which a film is subjected to highly controlled conditions of exposure and development, the results being charted on a graph. The procedure necessary is not within reach of the average photographer. However, gamma figures given for a particular developer do serve as a guide in the development of the film. Generally Leica negatives should be developed to a gamma between 0.6 and 0.8. Therefore if the instructions for a developer indicate different developing times to achieve various gammas, the time to choose at first is the one that will produce a gamma of 0.7. If the negatives should subsequently be too light and soft or too dense and contrasty, adjust the developing times accordingly. Density and contrast increase with developing time.

Developers · The type of film used, as has been said, largely determines the fineness of the grain in the negative. Slow speed films generally produce much finer grain negatives than do high-speed films. However, the type of developer used also affects fineness of grain. It is for this reason that special fine-grain developers are employed for Leica negatives. Such developers have a low contrast. These developers are available in prepared form, or you can mix your own solutions in accordance with the recommended formulas given at the end of this chapter.

Prepared developers · If you have limited space or time, you will find prepared processing solutions a great help. There are on the market a number of excellent prepared fine-grain developers, as well as fixing baths that require only mixing with the proper amount of water to be ready for use. The fact that these preparations are already mixed at a factory should not lead you to believe that they are inferior to developers and fixers you can mix yourself from published formulas such as those given at the end of this chapter. Actually, the prepared products are made by manufacturers under highly controlled conditions that are beyond the reach of the average photographer.

Formulas that you can mix yourself offer the advantage of lower cost, which can be an important factor when you are to process large quantities of film. If you are experimentally inclined, you can also start with a recommended formula as a base and then make modifications to achieve certain results. However, for most purposes, when you are to process small or moderate quantities of film and you are interested in the most efficient and simple manner of obtaining good negatives, I recommend prepared solutions. Here are a number of suggested prepared fine-grain developers:

Panthermic 777 (Harvey Photochemicals)	X-33 (FR Corp.)
Finex (Ansco)	Minicol (Edwal Labs)
Microdol (Eastman Kodak)	Super 20 (Edwal Labs)
D-76 (Eastman Kodak)	Super 12 (Edwal Labs)

Ansco, Eastman Kodak, DuPont, FR Corp., Edwal, supply prepared fixers. They are all dependable products and the choice of a prepared acid fixing bath with hardener that is recommended for fine-grain work or for fixing films in general will serve the purpose.

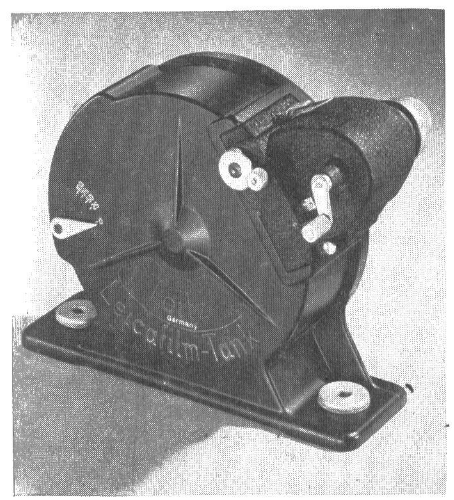
Mixing your own developer · A number of recommended fine-grain developing formulas are given at the end of this chapter. These formulas fall into 2 main classifications: 1) Metol-hydroquinone type; 2) Paraphenylene-diamine type. The Metol-hydroquinone type are high-energy developers. They produce the maximum emulsion speed, and they bring out shadow detail to the best degree. Paraphenylene-diamine developers generally produce the

finest grain. However, they reduce emulsion speed, requiring greater than normal exposure, and they are deficient in bringing out detail in shadow areas. These developers are toxic and may cause skin irritations with some people. They will also stain the skin, the enamel of sinks, and so on if not immediately washed off.

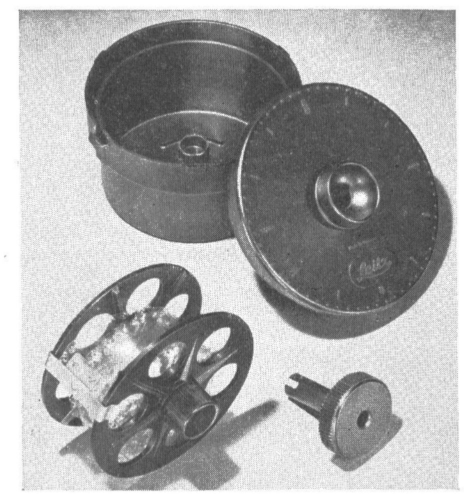
Within the 2 main classes of developers there are subdivisions. In the MQ (Metol-hydroquinone) class the D-76 developer provides the greatest emulsion speed. DK-20 produces finer grain, but provides only from 65 to 70 per cent of the emulsion speed given by D-76. D-23 gives normal emulsion speed, good gradation, and considerable latitude as to overexposure. The grain it produces is slightly finer than that obtained with D-76. D-25 produces slightly finer grain than DK-20, but it requires from ½ to twice the exposure needed by the other MQ developers.

The standard PPD (Paraphenylene-diamine) developer has PPD and glycin as the active agents. It requires at least double exposure, and it produces an extremely fine grain. There are also compromise PPD developers in which a more active developing agent, such as Metol or Pyro, has been added to provide greater emulsion speed and shadow detail. The "compromise" in these developers is a reduction in the fineness of the grain as compared with PPD glycin developers.

Re-using developers · As a developer is used, its active agents are consumed and by-products, which have a tendency to restrain development, increase. It is obvious, therefore, that some compensation must be made as the



3. LEITZ FILM TANK for holding bulk 35mm film for daylight loading of Leica film magazines.



4. LEITZ CORREX TANK with plastic apron for keeping film separated during development and washing.

number of films processed in a developer increases. With prepared products, complete information is generally given on the re-use of the solution. In other cases, as a rule, 8 to 10 rolls of Leica film can be developed in each 1000cc (32 ounces) of solution. Develop the first 3 rolls according to the recommended time given for the formula. After that, increase the developing time by 10 per cent for the succeeding rolls of film, up to 10 rolls per quart. This is a general recommendation and may not apply to all developers.

Replenishers · Within recent years a more scientific method for the re-use of developers has been developed. This is the addition to the developer of a specified amount of concentrated replenisher solution after each roll of film is processed. The developer is restored to its original activity, and no increased developing time is required for succeeding rolls of film. Manufacturers provide prepared replenishers for many of the prepared developers. Replenisher formulas are given at the end of this chapter for a number of the developer formulas.

Hardening stop bath · The use of a stop bath is not peculiar to fine-grain development. It is employed in the general processing of films as well as papers. The stop bath is a slightly acid solution that is used right after development to kill the action of the developer. In Leica film processing, however, the addition to the stop bath of chrome alum to serve as a hardener is highly effective. The emulsion is hardened, making it almost impervious to scratches; film drying is accelerated because of the contraction of the gelatin of the emulsion, and the danger of reticulation is greatly minimized. The formula for a hardening stop bath is given at the end of this chapter. Put this solution into the tank immediately after you have poured out the developer. Let the film remain in the hardening stop bath for 5 minutes, with occasional agitation, after which the film will be fixed. The chrome alum hardening bath cannot be re-used.

Agitation · As development proceeds, the solution at the surface of the film emulsion becomes exhausted. This makes it advisable to agitate the developer, the film, or both at regular intervals to bring fresh solution to the emulsion surface and promote even development. Agitation speeds up development. Therefore avoid constant agitation throughout the development period unless it is required for the particular developer, otherwise agitate the film for about 5 seconds after every minute of developing time.

With some tanks a small hand agitator can be inserted into the solution opening to engage the reel holding the film, permitting the reel to be rotated. With such tanks, rotate the reel and then shake the tank up and down a few times. This provides both vertical and horizontal movement during the agitation. When you haven't a hand agitator, rotate the tank in a horizontal plane and then shake it up and down (vertically).

Temperature · The temperature of a developer affects its speed action considerably. As the temperature increases, the rate of development rises. With every prepared developer a specific development time is to be given at a specific temperature. In some cases a range of developing times and temperatures is provided. Follow instructions closely; otherwise the film will be overdeveloped or underdeveloped. When only one developing time and temperature combination is given, you will find in many instances that the developer is just not *that temperature*. For such conditions, the following table is offered as a guide for changing time of development. The table is given for 2 main temperatures recommended: 65°F (18°C) and 68°F (20°C), and is expressed in terms of the percentage of standard developing time, which is taken as 10 per cent. The table is not specific for all developers, and is offered merely as a basis for experimentation.

At temperature of:		*If recommended temperature of developer is:*	
		65°F (18°C)	68°F (20°C)
		Change recommended time of development to:	
°F	°C		
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 about 25 minutes.
at 71°F (22°C) 85% of 18, or about 15½ minutes.

For average work, however, you will find it best to raise or lower the temperature of the developer to the required temperature. If the solution is too warm, put the bottle of developer in a refrigerator for a few minutes. Another simple way of either lowering or raising the temperature of a developer is to place the bottle or graduate holding the developer in a water bath. Fill a sink with hot or cold water, as required, and immerse the container with the developer in the water untill the developer reaches the correct temperature.

Hot Weather Precautions · Keep the temperature of all the solutions used in processing Leica negatives, including the wash water, between 65° to 70°F (18° to 20°C). If it is necessary to process films in solutions above 75°F take a number of precautions. Keep all solutions, including wash water, at about the same temperature (no greater temperature variation than 5°F) or reticulation may result. After development treat the film with the chrome-alum hardening stop bath (formula at end of chapter). Fix the film for no less than 10 minutes and no more than 20 minutes in an acid hardening fixing bath such as Kodak F-5 (formula at end of chapter). Wash the film for only 15 minutes in running water or several changes of fresh clean water. Hang the film to dry.

Reticulation · Reticulation is a peculiar phenomenon that may ruin an otherwise good negative. It is due to local strains in the gelatin, which may be caused by a sudden change in temperature of solutions or by atmospheric conditions. It occurs in different degrees, from an extremely mild form that you may mistake for coarse grain to a severe form in which you can see actual cracks in the emulsion, forming a labyrinth pattern.

Reticulation may occur at any point in the processing of Leica negatives. The first step to be taken in preventing its formation is to see that none of the solutions used in processing, including wash water, vary greatly in temperature from one to the other. Use the chrome alum stop bath immediately after development and before fixation. Its hardening action on the gelatin decreases the possibility of reticulation occuring in subsequent steps.

Fixing and Washing · The final solution used in the processing of Leica films is the fixing or hypo bath, the purpose of which is to dissolve the unexposed silver halide in the film. Fixing baths also have hardening agents added to them to harden the emulsion. You can obtain the hypo solution in prepared form or you can mix it in accordance with the formula (Kodak F-5) given at the end of this chapter. A fresh hypo solution will fix a film in about 10 minutes. However, as a rule, leave films in the hypo for about twice the time it requires to clear the film. Hypo baths can be re-used, but they should be discarded as soon as the clearing time starts to approach nearly twice the time required by a fresh solution.

After fixing, wash the film thoroughly to remove all traces of hypo, or the negatives may in time develop stains. Washing is best carried out while the film is still in the developing tank. Let a steady stream of water, not colder than 65°F (18°C) nor warmer than 70°F (21°C), run into the tank through the opening in its cover for not less than 20 minutes and preferably for 30 minutes. If it is important to wash the film quickly, I suggest that you proceed as follows: Fill the tank with water, agitate it for from ½ to 1 minute, pour the water out. Repeat this operation 6 or 7 times. Make sure that the water used for washing is free from foreign particles that may adhere to the film. It is advisable to put some type of filter on the water faucet to remove dirt particles.

Drying the Film · After the film has been washed, the next and final step is to hang it to dry. Remove it carefully from the reel and suspend it from a string or wire so that it will hang freely without touching any object. Place a small clip at the bottom end of the film as a weight, to prevent curling. As soon as the film is hung, remove excess moisture from its surface to facilitate drying and prevent the formation of water droplets that might cause stains. You can remove excess water with a viscose sponge, a soft, clean chamois, or a wetting agent such as Kodak Photo-Flo or Edwal Kwik-Wet. When you use a wetting agent, soak the film in a dilute solution of the agent for about ½ to 1 minute immediately after washing. When the film is hung to dry, the wetting agent

causes water to run off the film evenly and no droplets are left on the film. This eliminates the necessity of any mechanical agents actually touching the film. I have found this method of removing excess water highly successful.

If for any reason it is necessary to use a mechanical agent to remove water adhering to the film, soak a viscose sponge or a chamois in clean water, squeeze out excess water thoroughly, and wipe both sides of the film carefully. Wipe the emulsion side in one slow, gentle stroke; wipe the back side 2 or 3 times.

If you use a chamois, wash it thoroughly before its first use to remove loose particles. Do not allow the chamois to dry, but keep it in a jar of water. Before each use, wash either a viscose sponge or a chamois to remove any particles of emulsion that may be adhering to it.

A well-hardened film will dry in about 20 to 30 minutes. However, if you don't have to make prints immediately, it is advisable to allow the negatives to hang for a longer period to ensure thorough drying. If you have done the development in the evening, allow films to hang overnight. It is obvious that the place where films have been hung to dry should be as dust-free as possible. Should quick drying be necessary, you can use a fan, but direct the current of air against the *back* side of the film, to eliminate the possibility of the air stream's forcing dust particles into the emulsion.

Storing Developers · Developers become spoiled when exposed to air Therefore always keep them in bottles filled practically to the top, leaving as little room for air as possible. When you re-use developers, keep the developing tank in a tray to catch any of the solution that leaks out of the tank. The more developer you pour back into a bottle, the less will be the air space remaining. When replenishers are used, make a mark on the bottle at the point adjacent to the top of the solution. When you are using the developer, pour the replenisher into the bottle first, then add developer up to the mark. Bottles should be made of dark amber or blue glass to protect the developer from the action of light.

Storage of Films · There are two general methods of storing Leica negatives. 1. The film is kept in the entire roll of 20 or 36 exposures. Small metal or cardboard containers or other means are used for filing purposes. 2. The film is cut into strips of about 6 negatives each, which are in turn inserted into glassine or similar envelopes. There are a number of negative filing systems employing this method.

I recommend the latter system—cutting the roll into strips of about 6 negatives each. When the negatives are kept in the full roll, all 20 or 36 negatives are actually handled when a single negative is to be inspected or printed. This excess handling of the entire roll is likely to cause scratches. When cut into strips of a few each and placed in transparent envelopes, negatives can be inspected while they are in the envelopes and there is no need to handle the film.

Step-by-Step Developing Procedure

Now that the various steps in the processing of a roll of exposed Leica film have been discussed; the entire procedure is outlined in detail below, with the addition of a few facts that have not been given before.

1. Load the film into the Correx developing tank in total darkness. Remove the film carefully from cartridge or magazine. Handle the film only by its edges and insert it into the reel of the developing tank. Be sure to close the cover of the tank properly before turning on the light.

2. Have your 3 essential solutions prepared and ready. 1) developer, 2) chrome alum hardening stop bath, 3) hypo (fixing) bath. If there is dirt in any of the solutions, strain them through cotton.

3. Check the temperature of the 3 solutions. Temperatures should not vary more than 5°F. Consult the directions that come with the developer and determine the exact time according to the temperature of the developer and the type of film. Since it will require about ½ minute to pour the developer into the tank, and the same time to remove it later, deduct 1 minute from the recommended developing time. You can vary the developing time subsequently according to your experience.

4. Pour the developer in a steady stream into the developing tank. When the tank is filled, note the time and then agitate it for about 5 seconds after every minute of development. If the tank leaks developer during agitation, place it in a small clean tray to save the developer.

5. After the time of development has expired, pour the developer out of the tank, shaking the tank at the end to ensure removal of as much developer as possible.

6. Immediately after removing the developer, pour the chrome alum stop bath and hardening solution into the tank. Agitate, then leave the film in this solution for 5 minutes, agitating occasionally. Pour out and discard the hardening stop bath; it is good for one use only

7. Put the hypo bath into the tank. Agitate immediately and then about every 2 minutes. Film should remain for about 10 minutes in a fresh hypo solution a longer period if the hypo has been used before.

8. Pour out the hypo. The film is now ready for washing. Adjust the temperature of the water to between 65°F (18°C) to 70°F (21°C). Colder water will not wash the film properly and warmer water may soften the emulsion. Fill the tank with water, agitate, and pour off the water. Then put the tank under the tap, allowing the water to run into it in a steady stream for about 20 to 30 minutes.

9. If a wetting agent is used, open the tank and add the wetting agent to the water in the tank. Stir to dissolve the wetting agent and then allow the film to remain in the solution for about ½ to 1 minute.

10. Hang the film up to dry in a dust-free area. Suspend the film so it will not touch any object. Put a film clip at the end of the roll to ensure straight hanging of the film.

11. If excess moisture is to be removed with a viscose sponge or a chamois, first wash sponge or chamois and squeeze it thoroughly to remove all excess water. Wipe the emulsion side in one even, gentle stroke, applying gentle pressure. The back side can be wiped 2 or 3 times, applying slightly more pressure.

12. Film will dry in 20 to 30 minutes. However, it is preferable to allow the film to hang a few hours in order to ensure thorough drying.

13. Roll the film into a single roll or cut it into strips of a few negatives each, whichever you prefer for filing purposes.

FINE GRAIN DEVELOPER — *Kodak D-25*

For Low and Medium Contrast

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	¼ ounce	7.5 grams
Kodak Sodium Sulfite (desiccated)	3 oz. 145 grains	100.0 grams
Kodak Sodium Bisulfite	½ ounce	15.0 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given. Use without dilution.

Average development time for Kodak Roll Films, about 35 minutes in a tank, at 68°F (20°C). At 77°F (25°C) the average development time is about 18 minutes in a tank and the properties are approximately the same as those of DK-20 at 68°F. Grain is comparable with that obtained with the popular paraphenylene-diamine-glycin developer, but D-25 is non-toxic and non-staining.

If it is not essential to obtain minimum graininess, or if it is not convenient to work at the higher temperature, use half the specified quantity of sodium bisulfite. The development time will then be approximately 24 minutes at 68°F. Graininess will be intermediate between that for Kodak D-23 and Kodak D-25.

For replenishment, add Kodak Replenisher DK-25R, at the rate of 1½ ounces per roll for the first 50 rolls processed per gallon (12 rolls per liter) and at ¾ ounce per roll for the next 50 rolls per gallon. The developer should then be replaced with fresh solution.

KODALK REPLENISHER — *Kodak DK-25R*

For Developers D-23 and D-25

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	145 grains	10.0 grams
Kodak Sodium Sulfite (desiccated)	3 oz. 145 grains	100.0 grams
Kodalk	290 grains	20.0 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given. Use without dilution.

FOR USE WITH KODAK D-23 DEVELOPER

Add ¾ ounce (22cc) of the above replenisher for each roll of 36 exposure 35mm, or 8 exposures 120 or 620, or equivalent (80 square inches) discarding some developer if necessary.

FOR USE WITH KODAK D-25 DEVELOPER

The replenisher should be added at the rate of 1½ ounces (45cc) per roll of 80 square inches for the first 50 rolls per gallon (12 rolls per liter). For the next 50 rolls per gallon (or 12 rolls per liter), add only ¾ ounce per roll (22.0cc).

Loss of shadow detail becomes excessive after 100 rolls per gallon (25 rolls per liter) have been processed and the developer should be considered exhausted and discarded at this point.

ELON-HYDROQUINONE BORAX DEVELOPER — *Kodak D-76*

For Low Contrast and Maximum Shadow Detail on Panchromatic Films and Plates

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	29 grains	2.0 grams
Kodak Sodium Sulfite, desiccated	3 oz. 145 grains	100.0 grams
Kodak Hydroquinone	73 grains	5.0 grams
Kodak Borax, granular	29 grains	2.0 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Use without dilution. For tank use, develop about 20 minutes at 68°F (20°C) in the fresh developer. For tray use, decrease the time about 20 per cent. A faster working developer can be obtained by increasing the quantity of borax. By increasing the borax quantity 10 times, from 116 grains to 2 ounces 290 grains per gallon (from 8 grams to 80 grams per 4 liters), the development time will be about ½ that of regular D-76. Maximum activity can be obtained by substituting Kodalk for the borax. With 2 ounces 290 grains of Kodalk per gallon (80 grams per 4 liters), the development time will be about ¼ that of regular D-76.

APPROXIMATE TIME OF DEVELOPMENT AT 68°F (20°C)
For 35mm and Bantam Films

	Tank	Tray
Panatomic-X	14 minutes	11 minutes
Plus-X Panchromatic	16 minutes	13 minutes
Super-XX Panchromatic	20 minutes	16 minutes

Greater or less contrast may be obtained by developing longer or shorter times than those specified.

REPLENISHER SOLUTION — *Kodak D-76R*

For Tank Use with Formula D-76

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	44 grains	3.0 grams
Kodak Sodium Sulfite, desiccated	3 oz. 145 grains	100.0 grams
Kodak Hydroquinone	¼ ounce	7.5 grams
Kodak Borax, granular	290 grains	20.0 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Use the replenisher without dilution and add to the tank to maintain the level of the solution. It is frequently advisable to discard some of the developer before adding the replenisher to maintain proper negative quality. The life of Formula D-76 will be at least 5 times as great if this replenisher is used.

KODALK FINE GRAIN DEVELOPER — *Kodak DK-20*

For Roll Films, Film Packs, Cut Films and Plates

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	75 grains	5.0 grams
Kodak Sodium Sulfite, desiccated	3 oz. 146 grains	100.0 grams
Kodalk	29 grains	2.0 grams
*Kodak Sodium Sulfocyanate (Thiocyanate)	14½ grains	1.0 gram
Kodak Potassium Bromide	7¼ grains	0.5 gram
Add cold water to make	32 ounces	1.0 liter

*An equal weight of Potassium Sulfocyanate (Thiocyanate) may be substituted.
Dissolve chemicals in the order given.

Average time of development for all Kodak Roll Film, except Kodak 35mm and Bantam Super-XX Panchromatic, is about 15 minutes at 68°F (20°C) in a tank of fresh developer. For maximum emulsion speed, develop Kodak 35mm and Bantam Super-XX Panchromatic about 25 minutes at 68°F (20°C) in a tank of fresh developer. Develop Panatomic-X Roll Film for 20 minutes at 68°F (20°C).

For tray use, decrease the tank development time about 20%.

Increase or decrease all times for greater or less contrast.

REPLENISHER SOLUTION — *Kodak DK-20R*

For Fine Grain Developer Formula DK-20

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	¼ ounce	7.5 grams
Kodak Sodium Sulfite, desiccated	3 oz. 146 grains	100.0 grams
Kodalk	290 grains	20.0 grams
Kodak Sodium Sulfocyanate (Thiocyanate)	73 grains	5.0 grams
Kodak Potassium Bromide	14½ grains	1.0 gram
Add cold water to make	32 ounces	1.0 liter

*An equal weight of Potassium Sulfocyanate (Thiocyanate) may be substituted.
Dissolve chemicals in the order given.

Add the replenisher before the liquid level of the developer tank has dropped more than two inches.

CHROME ALUM HARDENING BATH

The following solution seems to have many features which should make it indispensable in the processing of Leica films:

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

Dissolve Chrome Alum completely before adding Sodium Bisulfite; stir until Sodium Bisulfite 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 5 minutes.

This solution should be prepared just before required and discarded once used.

Actual use of this solution on many rolls of Leica films proves its value. It gently checks development and gradually hardens the emulsion, the hardening process being continued in the acid fixing bath which follows.

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 gelatin 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.

FINE GRAIN DEVELOPER

DuPont ND-3

For 35mm Films

This developer is noted for the fine grain produced on high-speed negative emulsions. In general, for equal over-all density at equal contrast, greater exposure is required for development with DuPont ND-3. *The lens aperture should be opened from 1 to 1½ full stop more when development in this formula is contemplated than with a standard developer such as DuPont ND-2.*

Water (125°F or 52°C)	24 ounces	75.0 cc
Sodium Sulfite, desiccated	3 ounces	90.0 grams
Paraphenylene diamine (base)	146 grains	10.0 grams
Glycin	29 grains	2.0 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve ingredients in the order given above. For use cool to 68°F (20°C).

NOTE: *Paraphenylene diamine hydrochloride is not interchangeable with the paraphenylene diamine base which is called for in this formula.*

Paraphenylene diamine base is rather difficult to dissolve in cold water, hence it is best to start with warm water at the temperature indicated in the formula and dissolve the sodium sulfite first, following then paraphenylene diamine, and finally the glycin.

DuPont Superior No. 2 should be developed for 30 minutes with intermittent agitation (every 2 minutes), while DuPont Superior No. 3 — for 35 minutes at 68°F (20°C) to reach gamma .7.

If it is not possible or impractical to maintain temperature of developer and that of subsequent baths at exactly 68°F (20°C), the following adjustment of developing time, to secure gamma .7, is recommended: at 71°F (22°C) — shorten time of development by 10 to 15% (of the recommended standard); at 65°F (18°C)—lengthen development by 15 to 25%; at 62°F (17°C) lengthen development by 35 to 45%. These compensations will produce approximately equivalent results with those of the recommended standards of development.

Compromise Developers.

The DuPont ND-3 Fine Grain Developer is excellent for processing of high-speed negative emulsions, provided these are adequately exposed. Exposures of 2 to 3 times normal (1 to 1½ stops greater) should be given to yield negatives having the required detail. This developer is not satisfactory and should not be used for films exposed under adverse light conditions.

For this type of work developers were evolved which are capable of bringing out good shadow detail, excellent gradation and adequate contrast, while holding the grain structure of the film emulsion to an acceptable minimum. Two such "compromise" developing formulas are offered here: one, having pyro combined with paraphenylene-diamine, not suitable for re-use, and another employing Metol and paraphenylene-diamine, having the capacity to develop about 8 to 10 rolls of film (36 exposures per roll), provided each subsequent roll of film is developed about 10 per cent longer than the previous roll.

PYRO FINE GRAIN DEVELOPER

For Negatives Scantily Exposed.

	Avoirdupois	Metric
Water (about 135°F or 57°C)	24 ounces	750.0 cc
Sodium Sulfite, 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 68°F (20°C). This developer should not be re-used after addition of pyro. Store without pyro, adding it just before use. Developing time: Ultra-Speed Pan and Super-XX—38 minutes. Films of Group 2: 30 minutes. Films of Group 3: 25 minutes. Infrared film: 34 minutes. All at 68°F (20°C).

METOL FINE GRAIN DEVELOPER

For Negatives Normally or Scantily Exposed

This "compromise" developer formula is based on the well-known property of metol to bring out shadow detail and good gradation.

	Avoirdupois	Metric
Water (about 125°F or 52°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 Sulfite, 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.

Develop at 68°F (20°C): Ultra-Speed Pan and Super-XX—23 minutes; Films of Group 2: 18 minutes; Films of Group 3: 12 minutes. Infrared Films: 21 minutes with intermittent agitation.

ELON-SULFITE DEVELOPER

Kodak D-23

For Low and Medium Contrast

Water (125°F or 52°C)	24 ounces	750.0 cc
Elon	¼ ounce	7.0 grams
Kodak Sodium Sulfite	3 oz. 145 grains	100.0 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Average developing time about 19 minutes in a tank or 15 minutes in a tray at 68°F (20°C).

This developer produces negatives of speed and graininess comparable to D-76. Its low alkalinity and high salt content as well as its low fogging propensity make it suitable for use up to 80°F or 85°F, if the chrome alum stop bath, Kodak SB-4, PHOTO-LAB-INDEX No. 6-SB-169, is employed between development and fixing.

If used without replenishment, increase the processing time by 10% after each roll of

35mm or 120 roll film (80 square inches) has been processed. The developer should be discarded after processing 10 rolls per liter (or 32 ounces).

This developer may be replenished with the Kodalk Replenisher, DK-25R, PHOTO-LAB-INDEX No. 6-DR-64; ¾ ounce (22cc) should be added for each roll of film (80 square inches) processed. Most consistent results are obtained if it is added after each roll has been processed (or after each 40 rolls in a 10-gallon tank). With replenishment, the developer has a life of 100 rolls per gallon (or 25 rolls per liter or quart of developer).

A white scum of calcium sulfite frequently occurs on films processed in high sulfite, low alkalinity developers such as D-23. This scum is soluble in acid stop baths and in fresh acid fixing baths, especially if the film is well agitated. It is slowly soluble in wash water, and may also be wiped or sponged off the wet film, although light deposits may not be noticed until the film is dry. The non-swelling acid stop bath, Kodak SB-5, is especially recommended for its removal.

ACID HARDENING FIXING BATH

Kodak F-5

For Films, Plates, and Papers

Water (125°F or 52°C)	20 ounces	600.0 cc
Kodak Sodium Thiosulfate (Hypo)	8 ounces	240.0 grams
Kodak Sodium Sulfite, desiccated	½ ounce	15.0 grams
*Kodak Acetic Acid (28% pure)	1½ fl. oz.	48.0 cc
†Kodak Boric Acid, crystals	¼ ounce	7.5 grams
Kodak Potassium Alum	½ ounce	15.0 grams
Add 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.

†Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Dissolve the hypo in the specified volume of water (about 125°F or 52°C) and then add the remaining chemicals in the order given, taking care that each chemical is dissolved before adding the next. Then dilute with water to the required volume.

Films or plates should be fixed properly in 10 minutes (cleared in 5 minutes) in a freshly prepared bath. The bath need not be discarded until the fixing time (twice the time to clear) becomes excessive, that is, over 20 minutes. The solution remains clear and hardens well throughout its useful life. About 20 to 25 8x10 films or plates (or their equivalent in other sizes) may be fixed per 32 ounces (1 liter).

The F-5 fixing bath has the advantage over the older types of fixing baths, which do not contain boric acid, that it gives much better hardening and has a lesser tendency to precipitate a sludge of aluminum sulfite throughout its useful life.

COLOR FILTERS AND THEIR USES

HENRY M. LESTER

Some people learn about filters through the advice of a friend or a camera-shop salesman. The lesson is something like this!

"You ought to have a yellow filter."

"Why?"

"Brings out the clouds."

This is a very vague approach indeed. True, a yellow filter will bring out some clouds—not all of them. Little white wisps on a milky midsummer sky will need much more than just a yellow filter. On the other hand, there is little need for any filter when an approaching storm composed of blue-black cumulo-nimbus is being photographed—that can be done on any film, without any assistance.

One gets tired of clouds after a while: some photographers specialize in cloud photography. But almost everyone has had the experience of focusing his camera on a magnificent landscape—or what looked like one in the view finder! The negative, a mass of undifferentiated gray tones, is in most cases a great disappointment; nonetheless, it contains a valuable lesson.

That lesson, simply stated, is as follows; All black-and-white photography entails the reproduction of a variety of colors in terms of a scale of gray tones. From this, it follows that *optimum* reproduction of any object or group of objects depends on how accurately the sensitivity of the film to various colors parallels the sensitivity of the eye to these same colors.

But this we know the film does not do. It is true that modern panchromatic films are sensitive to all the visible rays of light, whatever their color. They have, however, two defects. First, they do not respond to each of these colors to the same degree as does the eye. Second, all films have some sensitivity to the invisible ultraviolet rays.

The photographer has no direct control over the color sensitivity of his film; this is "built in" by the manufacturer. He has, however, an indirect means of control—he can regulate the quantity of light of any given color reaching the film, and in this way neutralize any excess sensitivity for a corresponding reduction in the amount of light acting on the emulsion.

This is accomplished by means of filters. Generally speaking, a filter is merely a piece of colored glass or gelatin placed over the lens of the camera. The action of this piece of transparent colored material is to transmit light of certain colors and to absorb part or all of the rest. For example, a red filter transmits only red light; it absorbs blue and green completely. A yellow filter transmits both red and green light, absorbing (according to its density) some or all of the blue.

It is thus possible to make filters that transmit some colors freely while absorbing others completely. On the other hand, by proper choice of dyestuff or coloring matter, a filter can be made that will only partly absorb light of certain colors. From the viewpoint of the film, the first type eliminates its response to a given color, while the second type merely reduces the response to that color to a desired fraction of its basic sensitivity. Each type of filter has its specific use in photography, and this chapter is devoted to a discussion of these uses, and of the various filters available.

It is obvious that the first type of filter cannot produce correct color rendition, since it eliminates the response to certain colors completely; it is used, therefore, for special effects, such as differentiating two objects of different color but of substantially equal brightness. The second type of filter is more often used to reduce the excessive sensitivity of the various films in certain regions of the spectrum, and to bring their tone reproduction more nearly into line with the visual appearance of the subject.

Other types of filters, available for special work, include *haze filters* for reduction of aerial haze, *color separation filters* for making tricolor separation negatives for color printing, *neutral density filters* for reduction of exposure without color correction, and *polarizing filters* for subduing reflections.

Filters and Their Uses • The first rule in the use of a filter may be stated as follows:

Use no filter unless you know exactly what you want that filter to accomplish! More pictures have been spoiled through the haphazard and indiscriminate use of filters than by the lack of any filter whatever. Unless the effect of the filter on the picture as a whole is considered carefully, the use of a filter to "correct" one part of the picture may result in a falsification of other parts that is more objectionable than the original lack of balance.

For example, a deep-yellow or orange filter is frequently used to darken the sky in an outdoor scene. But this same filter will tend to lighten or completely wash out skin tones, lip color, and so on in people appearing in these scenes. Hence in outdoor portraiture such a filter must be used with extreme caution, if at all; otherwise facial detail will be lost in an attempt to secure the desired dark sky background.

Likewise, some thought must be given to the fact that the color of natural objects is not always a true guide to the light-reflection properties of these objects. For example, foliage that appears a deep green actually reflects a good deal of red and infrared light. The use of a red filter, therefore, will not always darken green foliage to anything like the desired degree; in fact, a deep-red filter and infrared sensitive film will actually portray foliage as a snow-white!

With these exceptions in mind, however, a simple rule can be stated to aid in the choice of a filter for any specific purpose:

A filter of a given color will cause objects of the same color to appear lighter in tone; objects of the color complementary to that of the filter will appear darker in tone.

Thus, for example:

A FILTER COLORED	WILL DARKEN	WILL LIGHTEN
yellow	blue	red, green
green	red, blue	green, yellow
red	blue, green	red, yellow
blue	yellow, red	green, blue

These are, of course, general rules; the exact degree of darkening or lightening depends on how strongly colored the filter is, while the precise shade of color in the subject that will be darkened or lightened depends on the transmission band of the filter. Likewise, the fact that some natural colors (like that of foliage, already mentioned) and a great many artificial colors (such as dyestuffs used in clothing) do not have the precise spectral characteristic suggested by their visual color makes it necessary to perform actual photographic tests in many critical cases.

Where only an approximate correction or change is desired, however, it is often possible to estimate the effect of a filter on a given scene by viewing the scene itself through the filter in question. Test charts, consisting of small pieces of filter gelatin mounted in a cardboard, are available for quick appraisal of the required filter. Such charts avoid the necessity for handling a number of separate filters, and aid in keeping the actual photographic filters clean; however, the final decision as to a given filter must always be based on experience gained from previous photography of similar subjects.

However, the way to learn the uses of various filters is *not,* as has often been recommended, to make a large number of tests with various filters and study these tests. Actually, little can be learned from such tests unless they parallel the type of photography that will later be done.

A much better way to learn the use of filters is to make a large number of pictures without any filter at all. From the results you can judge, first of all, what subjects are satisfactorily rendered without any filter. You can then study those which are unsatisfactory to find the cause; since the subject matter of all of these pictures will be well known to you it should be obvious to the eye that certain objects of known colors have been rendered too light or too dark to be satisfactory. And with this information, when you are photographing similar subjects in the future, it will be a simple matter to choose a filter that will produce optimum rendering of such objects.

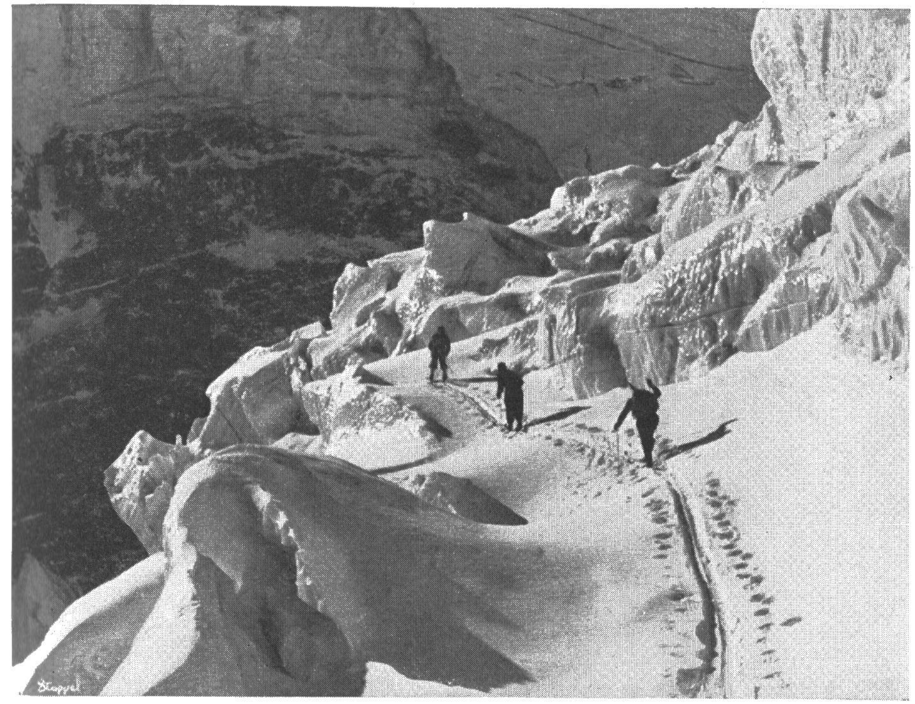
Construction of Filters • Filters are made either of colored glass or of dyed gelatin. The latter type is frequently used plain, just as manufactured, but is more often cemented between glass disks for protection and for convenience in handling. Solid-colored glass filters, as sold by E. Leitz, are most permanent; they are very unlikely to be damaged by any means short of a deep scratch or actual breakage.

Gelatin filters, whether cemented in glass or unmounted, are less permanent in color, and are more easily damaged by excessive heat or moisture; they have the advantage of being less costly, and of being available in a very wide variety of colors and densities. Kodak Wratten Filters are available in unmounted gelatin squares and circles, lacquered for protection from fingermarking and moisture. In addition, they may be obtained cemented between good-quality optical glass (B glass) in squares, circles, and metal-rimmed glass disks to fit the Kodak Combination Lens Attachments. For extremely critical work, Kodak Wratten Filters are available cemented between hand-surfaced, optically flat glass plates (A glass), at somewhat higher prices.

Leica filters are available in slip-on mounts with clamping screw for the Hektor 28mm and 50mm lenses, the Elmar 35mm and 50mm lenses, the Summar 50mm, and all 90mm, 127mm and 135mm Leica lenses. They are also available as unmounted disks to fit the Adjustable Lens Shade and Combination Filter Holder. In addition, they are available in screw-in mounts for the Summitar f/2.

Filter Factors • Since the function of a filter is to absorb some of the light reflected from the subject, transmitting the remainder, it follows that only a certain fraction of the reflected light actually reaches the film. In turn, this calls for an increase in exposure to compensate for the loss of the absorbed light. The amount of increase in exposure is expressed as a number by which the exposure without filter must be multiplied; this number is called the *filter factor*. The filter factor depends not only on the color of the filter and the light that it absorbs, but also on the color sensitivity of the film and on the nature of the light source.

A table of filter factors for the Leica filters and for the most popular of the Kodak Wratten Filters appears on page 93. There are several ways in which these factors may be used. For example, the Leitz Green Filter has a factor of 4 with DuPont Superior-2 film in daylight. The exposure that would be used without the filter must then be multiplied by 4 to obtain the proper ex-



1. Clariden Gracier, Switzerland. Elmar 50mm lens, f/12.5, 1/200 second, Panatomic-X, light yellow filter. Photo by Stoppelman.

posure with the filter. One way of doing this is with the lens diaphragm; since each stop opening doubles the exposure, opening the lens 2 stops from the basic setting will be equivalent to a 4x increase in exposure.

Or the shutter speed may be divided by 4—that is, if the exposure without filter is 1/200 second, it will be necessary in the above case to use 1/50 second; in that event, of course, the lens diaphragm will be unchanged. Combinations of both methods can be devised; thus in the case noted the diaphragm can be opened *one* stop and the shutter speed halved to 1/100 second if necessary for certain photographic conditions.

Still another method involves adjusting the film speed rating; this is generally done in connection with the calculator dial of an exposure meter. In such cases, the film speed is divided by the filter factor. The exposure with filter is then read directly from the meter calculator. As an example, in the above case, since the exposure index for DuPont Superior-2 in daylight is 50, it would be divided by the filter factor, 4. Then, since $50 \div 4 = 12.5$ or about 12, the film speed scale of the meter calculator is set to 12 and the meter readings will indicate the correct exposure with the filter. The filter itself should never be placed in front of the exposure-meter cell for the purpose of ascertaining the correct exposure.

Daylight and Artificial Light • It is always necessary to remember that different filter factors apply to daylight and to tungsten light; also that the tungsten factor will vary somewhat with the type of lamp used. The values given in the table will serve as a guide, and in most cases will be well within the limits of the film latitude. For critical work, filter factors must always be determined by test.

The general level of exposure has some effect on the amount of correction secured with a given filter. Usually, overexposure tends to lessen the effect of a filter; underexposure, in many cases, will exaggerate it. Thus if disappointing results are secured with a filter, they may frequently be traced to overexposure. On the other hand, when a sufficiently dense filter is not available for a desired effect, it is possible to enhance the action of a weaker filter by controlled underexposure.

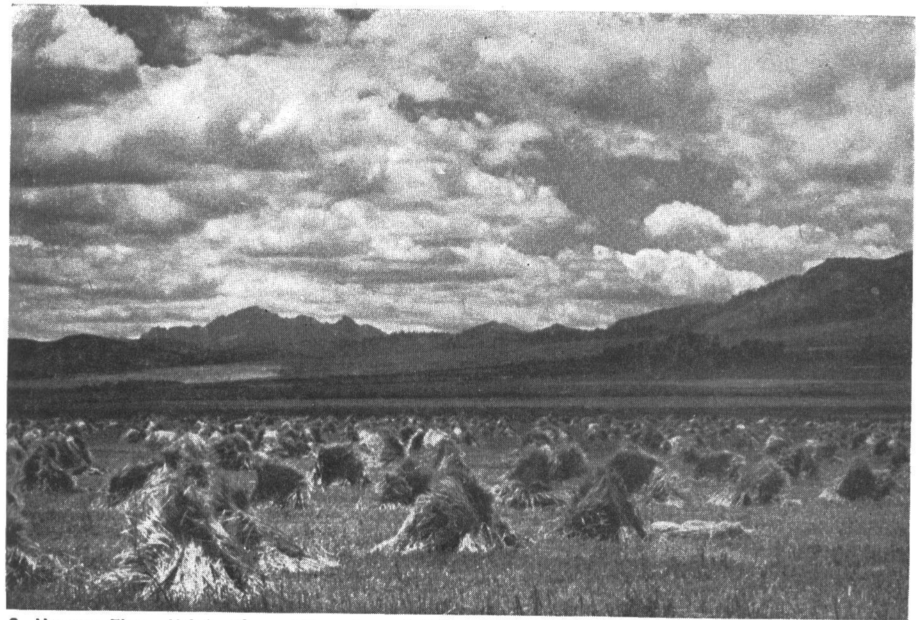
Correction Filters • Most films available for the Leica camera in the United States are essentially similar in their color sensitivity, and correspond roughly to a Type B panchromatic, to use Kodak terminology. Such films have fairly uniform sensitivity to all of the colors of the spectrum when exposed in daylight; however, they still have somewhat excessive blue and ultraviolet sensitivity. They will not, therefore, reproduce a scene exactly as the eye sees it; for example, while blue and violet normally appear darker than green, the film will reproduce these two colors as lighter than green.

Filters to adjust the tone rendition of the film in terms of the visual appearance of colors are called *correction filters.* In most cases these filters are yellow in color, since their main function is to reduce the excess sensitivity to blue and ultraviolet. In this class are the Leitz Yellow-1 and Yellow-2, and the Kodak Wratten K1, K2, and K3.

Since tungsten light contains a larger proportion of red light than does daylight, the filter for correct rendition in tungsten illumination is different; as would be expected, it is green in color. To this class belong the Leitz Green-2, and the Wratten XI Filters.

In general, the Yellow-2 or Kodak Wratten K2 will be used for approximately correct rendition of outdoor subjects, the Leitz Green-1 or the Wratten XI for subjects under tungsten light.

However, films such as DuPont Superior-3 have a considerably higher red sensitivity than the other available types, and correspond roughly to a Type C panchromatic. Such films require no filter at all when used outdoors; on the other hand, their higher red sensitivity, coupled with the extra red radiation in tungsten light, demands additional correction indoors in the form of a heavier green filter. The Kodak Wratten Filter X2 is used for normal correction.



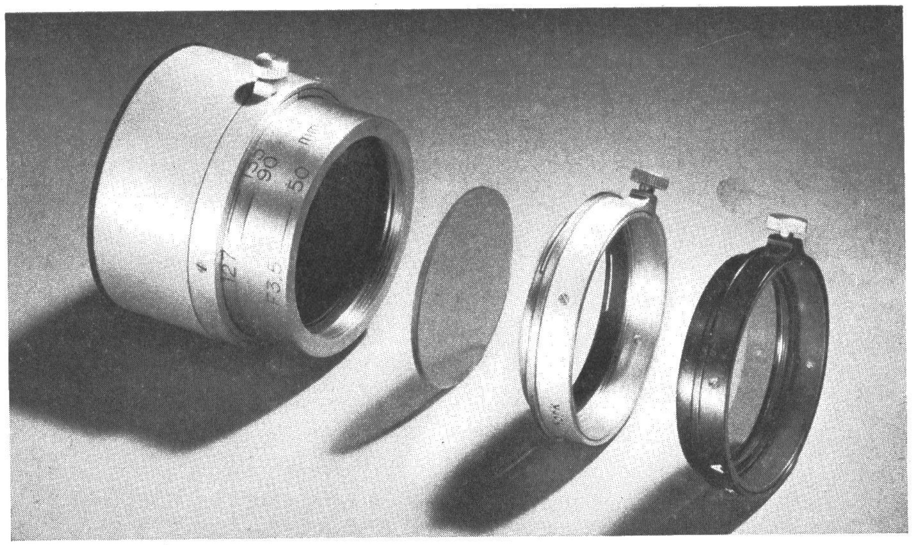
2. Harvest Time, U.S.A. Elmar 50mm lens, f/6.3, 1/100 second, Panatomic-X. No filter correction necessary. Natural heavy contrast in cloud formation. A fine example of when *not* to use a filter. Photo by Herbert V. Mitchell.

Some overcorrection is possible with the heavier filters in the yellow and the green group; that is, these filters may be used for an actual exaggeration of brightness differences. As already mentioned, this requires carefully controlled underexposure to secure the maximum effect from the filter.

Contrast Filters • Cases frequently arise where an approximately correct rendition of color in terms of visual tone values would be less desirable as a picture than a falsified or exaggerated reproduction. Such a case, for example, could be a red apple surrounded by green leaves. Actually, the two objects have nearly equal visual intensities, apart from their colors; if photographed with complete correction, the apple and the leaves would be imaged in nearly identical tones of gray.

But though the red apple and the green leaves are visually alike in tone, psychologically red is a brighter color than green. For the most acceptable reproduction of this subject, then, the photographer ought to render the green leaves considerably darker than the red apple.

For this purpose he uses what are known as *contrast filters.* These are filters of more saturated color, hence having narrower transmission bands than correction filters. Such filters are characterized by nearly complete transmission of one or two colors, and by equally complete absorption of all others. In the case given above, the Kodak Wratten Filter No. 25 (A) transmitting red light



3. Filter Holders. (*Left to Right*) Adjustable Lens Sunshade and Combination Filter Holder with its Filter Disk and Slip-on Mount with clamping screw, in chrome finish. Black Slip-on Mount with clamping screw and filter, for lenses of 34mm diameter.

and absorbing blue and green would be used. The red apple would in this way be rendered very much lighter than the green leaves.

In using contrast filters, you are not, of course, limited to any preconceived notion of correct reproduction. In the case of the above subject, you would be just as correct (or far from correct!) if you used a green filter, such as the Wratten B (No. 58), in which case you would secure the opposite result—a dark apple against light foliage.

Contrast filters currently available from E. Leitz include the Orange-Red and the Green; this latter is really a correction filter, but it may be used to a limited degree for contrast rendering by careful control of exposure. From Kodak there are available regularly the Kodak Wratten A (red), B (green), C5 (blue), E (orange-red) and G (orange). There are almost 100 other filters in the Wratten line, generally available in gelatin form, and cemented in glass on special order.

Haze Filters • Distant landscapes and aerial views appear covered by a bluish haze, even on clear days. This blue-violet color is composed of light scattered by dust, water *vapor,* and the air itself. It must not be confused with fog or mist, which are white in color and are composed of water *droplets.*

Since all photographic materials are sensitive to blue and ultraviolet, the true atmospheric haze tends to cause an over-all fog in the image that is much more serious than its visual appearance would indicate. Since aerial haze scatters little red light, and much blue and ultraviolet, a good deal of the effect

of aerial haze can be eliminated by the use of yellow, green or red filters in the order named, the yellow having least effect and the red the most.

On the other hand, some pictorial effects require a hazy effect for "aerial perspective"; in this case, the existing haze can be exaggerated by the use of a blue filter, such as the Kodak Wratten C5 (No. 47).

Color Separation Filters • Sets of red, green, and blue filters are available for making tricolor separation negatives for color printing. Such work is outside the scope of this book, and the reader is referred to the Photo-Lab-Index and standard textbooks on color photography for information on these filters and their uses.

Neutral Density Filters • Since the Leica photographer has a wide variety of lens apertures and shutter speeds to choose from, he will seldom find it necessary to use neutral filters. These are simple gray filters the action of which reduces the exposure by a given fraction, usually 1/2 or 1/4, corresponding to one or two lens stops. However, in some cases where fast film is being used and it is desirable to use a large aperture (to throw a background out of focus, for example), a neutral filter may be needed to reduce the exposure to a manageable level in terms of available shutter speeds.

Contrary to statements occasionally appearing in print, a neutral filter has no effect whatever on the contrast of a negative—unless the filter itself is defective in some way.

Polarizing Filters • Light is generally considered to be composed of waves that vibrate in all planes perpendicular to the light ray. Light is said to be polarized when its vibration is restricted to only a single plane. In nature, polarized light is found in two instances: first, light reflected from glossy, *nonmetallic* surfaces, such as wood, glass, water, paint. The effect is at a maximum when the angle of reflection is about 35°; it is less at other angles, and disappears altogether at 0° and 90°. Second, light from the clear blue sky is strongly polarized, but only in those quadrants of the sky which are at right angles to the position of the sun.

Since so many cases exist in which reflected light is polarized, and since polarized light may be differentiated from non-polarized light by means of polarizing filters, it is possible to exercise considerable control over reflections appearing in a photograph. Polarizing filters have a micro-crystalline structure and are neutral gray in color. When such filters are adjusted so that their internal (and invisible!) pattern is parallel to the plane of polarization of the light, they will transmit this polarized light freely; placed at right angles to the plane of polarization, they are quite opaque to polarized light, but still transmit unpolarized light. Intermediate degrees of suppression can be obtained by using positions between the two points mentioned. The only way to determine the plane of polarization of reflected light, and the angle at which the polarizing filter must be set, is to view the subject through the filter.

The Leica Polarizing Filter is fitted in a knurled rotating ring mounted on a hinged slip-on mount with clamping screw, which permits the filter to be swung through a 180° angle from viewing to picture-taking position. This type of mount is very important, for even a slight change in angle of the filter will produce a photographic effect differing from that observed visually. After focusing the Leica, clamp the filter on the front of the lens with the hinged part of the mount in the upper position. (The Summitar and Summarit lenses do not rotate so the filter may be placed on the lens before focusing.) Swing the filter to its uppermost position until it stops, still in the upper position, view the subject through the filter while rotating it with the knurled ring until the desired effect is observed. Swing the mount down in front of the lens until it stops, being careful not to rotate the filter.

Since the polarizing filter is neutral in color, its exposure multiplying factor is 2½ for any type of film or light source. In outdoor photography, spectacular results are often obtained by using a Pola-Screen in connection with a color filter, either yellow, red, or green. In such cases, the factors of the two filters must be multiplied to get the combined factor. For example, if the polarizing filter (factor 2½) is used with a green filter (factor 4), the combined factor is $2\frac{1}{2} \times 4 = 10$.

It must be kept in mind, when using the polarizing filter outdoors, that optimum results in terms of darkened sky tones are obtained when the sun is at right angles to the camera. Foreground objects will therefore be side-lighted, and it is the exposure for side-lighted subjects that must be multiplied by the factor of 2½.

Owing to the material of which it is constructed, the polarizing filter has almost complete absorption of ultraviolet; it will therefore reduce aerial haze to some extent at the same time that it is producing a dark sky, or eliminating reflections.

The polarizing filter, being neutral in color, may also be used to produce deeper sky effects with color films. It is, in fact, the only filter that can be used for dark sky effects with color films. Again, it is essential that the light be coming at right angles to the camera to secure the maximum darkening.

In certain types of photography by artificial light—for example, copying oil paintings having bold, glossy brush strokes—it may not be possible to set the lights in such a manner that the light reflected from these random surfaces will be polarized all in one direction. This being the case, complete suppression of reflections cannot be obtained with a polarizing filter on the camera only. In such situations, better control of reflection can be obtained by using polarizing filters over the lights as well as at the camera lens.

Since polarized light becomes depolarized when reflected from matte sur-

faces, while it maintains its polarization on specular reflection, careful orientation of the polarizers on the light sources and on the camera lens can subdue reflections to any desired degree, regardless of their nature. This, for example, is the only method by which reflections from metallic surfaces can be eliminated by the use of polarized light.

Filters for Color Photography • Recommendations for filters to be used with various types of color films will be found in the chapter on Color Photography. The color filters used in black-and-white photography cannot be used with color films, excepting, of course, the polarizing filter. Using colored filters, such as reds, yellows, and the rest, will merely cause the entire picture to take on the color of the filter.

Certain special filters for color photography are available from E. Leitz, Inc. and from the Eastman Kodak Company. Leitz supplies a Kodachrome Haze Filter, a Kodachrome Photoflood Filter (blue in color, for Kodachrome Film, Daylight Type exposed in photoflood illumination), and a Chrome-Flash Filter, which eliminates the excess of blue light when using Photoflash lamps and Kodachrome Film, Type A.

From Kodak are available the Kodak Skylight Filter (Wratten 1A) for haze elimination, the Kodachrome Filter for Photoflood, and the Kodachrome Type A Filter for Daylight. In addition, there is a large selection of Kodak Light Balancing Filters for precise adjustment of film response to the light-source color temperature. For special purposes, such as duplicating color transparencies, copying colored drawings, and so on, there is a series of Kodak Color Compensating Filters. All are available mounted in glass squares or circles, as well as in metal-bound glass disks for use with the Kodak Combination Lens Attachments. For experimental purposes, they are also available in gelatin film form, lacquered for protection against dust and finger marks.

Filters for Infrared Photography • Infrared films have a sensitivity limited to two widely separated spectral regions. Like any other film, they are sensitive to ultraviolet and blue light; they are, however, totally insensitive to green and yellow. Infrared films have some sensitivity to visible red light, but reach the peak of their sensitivity in the infrared, well beyond 700 millimicrons, which is the limit of the visible spectrum.

For this reason, any filter that eliminates the blue light completely will give a substantially complete infrared rendition. Such filters as the Leitz Orange-Red and the Kodak Wratten Filters No. 12 (Minus Blue), No. 15 (G), No. 25 (A) and No. 29 (F) have increasing absorptions of visible light in the order named; the F filter will require somewhat more exposure than the No. 12 (Minus Blue), but not as great an increase as the difference between the two in normal photography.

For some work, it is desirable to eliminate the visible light completely, and make the picture entirely by infrared radiation. For this purpose E. Leitz, Inc. offers three filters, known as Infrared Nos. 1, 2, and 3. From Kodak, there are Kodak Wratten Filters in the following group, having the indicated transmissions:

Kodak Wratten Filter Number	Approximate Lower wavelength limit
70 *	660 mμ †
89A	700
88	710
88A	730
87	760
87C	800

* Transmits some visible red light between 660 and 700 mμ.
† The Greek letter μ represents microns; 1 micron = .001mm.
The abbrevation mμ stands for millimicrons;
1 millimicron = .000001mm.

While filter factors are given for some filters with infrared film in the table on page 93, it is difficult to use these because of the impossibility of measuring the percentage of infrared in ordinary daylight. This percentage is highly variable, and since ordinary exposure meters do not indicate the presence or the absence of infrared, it is difficult to assign a definite film speed or filter factor for such use. In the case of tungsten light, on the other hand, the infrared output is known and fairly constant, hence exposure meters can be used with exposure indexes assigned by the film manufacturers, and the filter factors given will serve as a fair guide.

In general, however, exposure with infrared film must be determined by photographic tests; instructions are packed with the film, with recommended exposures for normal outdoor conditions. Such exposure information will provide at least a starting point for further tests.

The use of infrared film and filters eliminating visible light demands certain corrections in focus, since normal photographic lenses are not designed to bring the infrared to a focus in the same place as the visible light. Instructions for making this correction will be found in the chapter on Leica Lenses.

4. FILTER FACTOR TABLE. Indicates amount of exposure increase necessary when using filters. Select filter, film, and lighting combination; refer to proper block on table for filter factor; multiply exposure without filter by filter factor for correct exposure with filter. For example: Leitz Green filter with DuPont Superior-2 film in daylight has a factor of 4. For correct exposure with filter, multiply exposure without filter by 4.

FILTER FACTORS

BOLD FIGURES – Sunlight   LIGHT ITALIC FIGURES – Tungsten

Maker	Film	Light	Leitz Yellow 0	Leitz Yellow 1	Leitz Yellow 2	Leitz Yellow 3	Leitz Green	Leitz Orange red	Leitz Red 1	Leitz Red 2	Wratten 6 K-1	Wratten 8 K-2	Wratten 12 Minus Blue	Wratten 3 Aero 1	Wratten 5 Aero 2	Wratten 11 X-1	Wratten 13 X-2	Wratten 15 G	Wratten 25 A	Wratten 58 B	Wratten 47 C-5	Wratten 49 C-4	Wratten 29 F	Wratten 23 E	Polo Screen
ANSCO	SUPREME	Sunlight	1.5	1.5	2	3	6	4			1.5	2				4	6	3	11	8	4				
		Tungsten	1.5	1.5	1.5	2	4	3			1.5	1.5				3	4	2	6	6	6				
	ULTRA SPEED	Sunlight	1.5	1.5	2	3	6	4			1.5	2				4	6	3	11	8	4				
		Tungsten	1.5	1.5	1.5	2	4	3			1.5	1.5				3	4	2	6	6	6				
Du PONT	SUPERIOR 2	Sunlight	1.6	1.6	2	2		4	12		1.6	2						2.5	5	6.3	6.3		10		2
		Tungsten	1.3	1.3	1.3	1.3			5		1.3	1.3						1.6	2.5	6.3	20		3.2		2
	SUPERIOR 3	Sunlight	1.6	1.6	2	2		4	5		1.6	2						2.5	3.2	6.3	6.3		5		2
		Tungsten	1.3	1.3	1.3	1.3			2.5		1.3	1.3						1.6	2	6.3	20		2.5		2
KODAK	PANATOMIC-X	Sunlight	1.5	1.5	2	3	3	4	15		1.5	2	2	1.5	2	4	5	3	8	8	5	12	16	5	2.5
		Tungsten	1.5	1.5	1.5	2	2.5	3	8		1.5	1.5	1.5			3	3	2	4	8	10	25	8	4	2.5
	PLUS-X	Sunlight	1.5	1.5	2	3	3	4	15		1.5	2	2	1.5	2	4	5	3	8	8	5	12	16	5	2.5
		Tungsten	1.5	1.5	1.5	2	2.5	3	8		1.5	1.5	1.5			3	3	2	4	8	10	25	8	4	2.5
	SUPER-XX	Sunlight	1.5	1.5	2	3	3	4	15		1.5	2	2	1.5	2	4	5	3	8	8	5	12	16	5	2.5
		Tungsten	1.5	1.5	1.5	2	2.5	3	8		1.5	1.5	1.5			3	3	2	4	8	10	25	8	4	2.5
	INFRARED	Sunlight							20	20															
		Tungsten							2	2															
	MICRO FILE	Sunlight	1.5	1.5	2	3	3	4	15		1.5	2	2	1.5	2	4	5	3	8	8	5	12	16	5	2.5
		Tungsten	1.5	1.5	1.5	2	2.5	3	8		1.5	1.5	1.5			3	3	2	4	8	10	25	8	4	2.5
	DIRECT POS. PANCHROMATIC	Sunlight	1.5	1.5	2	2	2.5		7	40	1.5	2	2	1.5	2	4	6	2.5	6	10	5	12	8	4	2.5
		Tungsten	1.5	1.5	1.5	1.5	2		3	20	1.5	1.5	1.5			3	4	2	3	10	10	25	4	2	2.5

KOKO
Triangle lighting with three G-E No. 6 flashlamps.

Henry M. Lester

FLASH PHOTOGRAPHY

HENRY M. LESTER

FLASH: a sudden and brief outburst of light of definite intensity, known duration, and easily controlled direction and quality. It has been a photographic illuminant of ever growing importance and popularity since 1930, when the first convenient glass flashlamps replaced the old flash powder. Flashlamps—first of the "chemical" type, which burn finely drawn or shredded metal in an atmosphere of oxygen, and more recently of the electronic type, in which an electric spark flashes in an atmosphere of a gas (such as xenon)—are a logical development in photographic illumination.

Even without flashlamps, film is always exposed by some sort of a *flash* of light—but a flash determined solely by the length of time the camera shutter is open. Because the film is always exposed by what amounts to a flash of light—whether it comes from the distant sun or from a nearby lamp—the flash is not new to the film. Thus any light transmitted to the film to produce an exposure is in one way or another "flashing" the film. Flashlamps simply supply a consistent "package" of light that can be admitted to the film in specific bursts wherever necessary.

What the chemical flashlamp brings to the film is a certain *concentrated* quantity of light that is admitted, ideally, when the shutter is open—just as in the case of sunlight. The electronic flash brings to the film an even more concentrated flash of light, of duration so brief that it no longer depends upon the services of the shutter to regulate its reception. The standard shutter cannot approach the speed of the electronic flash; it need only be opened and closed at a reasonable speed so that the flash will record an image on the film.

With the knowledge of some basic facts about flash, you can easily acquire a working familiarity with this convenient and efficient type of illuminant. The Leica lends itself very well to photography by flash lighting, and in many ways often surpasses larger cameras in its adaptability to this type of photography. The latest model, Leica IIIf, with built-in synchronization, described in the chapter on Leica Equipment, offers the most efficient and compact facilities. But any of the earlier models can also be used for flash photography.

The great depth of field and the immediate interchangeability of its short focal-length lenses places the Leica camera in a particularly fortunate position for flash photography. At its relatively large lens apertures, which increase the effect of the light output of any flashlamp, the Leica offers a considerably greater depth of field than do large cameras. This helps not only where considerable depth of field is needed, but also where, as in rapid-sequence work without repeated focusing, a margin for error in judging distance is wanted. The interchangeability of lenses results in the greater economy and flexibility of any given flashlamp, especially when used on or near the camera. For instance, when it is necessary to use a small flashlamp and/or a small aperture, a wide-angle lens permits lighting the subject at closer range so that there is more available light than with a lens of longer focal length. On the other hand, when only large flashlamps happen to be available, a lens of longer than normal focal length will place the camera—and the flashlamp—at a greater distance from the subject, so that there is better control and more even distribution of the light output of the flashlamp.

A Good Start • Anyone can take excellent flash photographs with any Leica camera—without special equipment. A battery case equipped with a reflector and a manual switch and any type of flashlamp are all that is necessary. Set the camera shutter to Bulb, stop down the lens aperture to the proper opening (see Exposure Guide Number Tables), and focus the camera from some firm support. When ready, release the shutter to the fully open position, flash the lamp, and close the shutter. The procedure is that simple! But it is limited to use in darkened interiors or dark outdoors, since abundance of extraneous light would give extra exposure to the film while the shutter is open. Also, if any part of the subject is in motion a double-exposure effect will result.

This method, known as the "open flash" is of course a very elementary approach to flash photography. However, there is much to recommend it. Besides being a dependable way of securing good flash pictures in the absence of special equipment, open flash is the only method that permits the use of *any* type of flashlamp with the Leica camera, since there is no need to synchronize the flash with the camera shutter. The duration of the exposure is governed by the total duration of the flash, which is a constant for each type of flashlamp. Since the entire light output of the flashlamp is utilized in open-flash photography, the efficiency is quite apparent. Generally, the lens can be stopped down considerably to increase depth of field.

Especially suitable for open-flash technique with the Leica camera are the midget flashlamps designated as SM and SF. These lamps have no metallic filler to burn. A coating of phosphorus, heavily applied to the lead-in electrodes, produces a brief but brilliant flash in the atmosphere of oxygen. The duration is 1/200 second; it is possible to stop action even with open flash.

Synchronized Flash • The coincidence of the flash with the opening of the shutter is called *synchronization.* Perfect synchronization occurs when the shutter operates at the same instant that the flash is at peak intensity. This applies to both the between-the-lens and the focal-plane shutters. Synchronization is accomplished with comparative ease in the case of between-the-lens shutters, since they admit light to the entire film area when open. The problem is not quite so simple in the case of focal-plane shutters.

The Leica camera shutter is of the focal-plane type and requires critical adjustment of the synchronized flash mechanism. The shutter consists of a twin curtain directly in front of the film (focal plane), admitting light to the film as the two edges of the curtain pass across its length. (To understand the operation of the shutter, it is a good idea to remove the lens from the camera and observe the curtain as it travels when the exposure button is pushed. You can then see how one curtain edge trails after the other to admit light to the film through a slit.) At exposures of 1/20 and 1/30 second, there is a brief instant when the curtain slit is momentarily wide enough to admit light to the entire film area.

The requirements of flash synchronization with the Leica focal-plane shutter are twofold: 1. The synchronization mechanism must be critically adjusted to coincide with the travel of the shutter. 2. The flashlamps used must have a flash duration long enough to illuminate the film from beginning to end of the shutter travel.

The synchronization of the Leica shutter with a flashlamp circuit is a matter of very critical adjustment. Though there are many synchronizers on the market offered for use with "any" camera, there are few that will work consistently and dependably with the Leica camera at more than a single shutter setting. Only the Leica Synchronized Flash Unit, Model VIII or VIIIa, properly fitted by E. Leitz, Inc., Synchronization Service to a given Leica camera, will offer reliable service over the entire range of shutter speeds, from 1/20 to 1/1000 second.

With the camera properly synchronized, it is then a simple matter to choose the proper flashlamp. The duration of the light output of a flashlamp varies with the lamp type. Lamps of the shortest light duration (about 1/200 second) are the G-E SM and Sylvania SF. That of the longest duration (about 1/20 second) is the G-E No. 31. There are also many other types between these extremes. To cover the entire range of shutter speeds from 1/20 to 1/1000 second only certain flashlamps are applicable. Those specifically intended for focal-plane cameras, and having a flash output of suitable duration are:

General Electric or Westinghouse	Focal Plane No. 6 and Focal Plane No. 31
Sylvania	FP-26 and Press 40

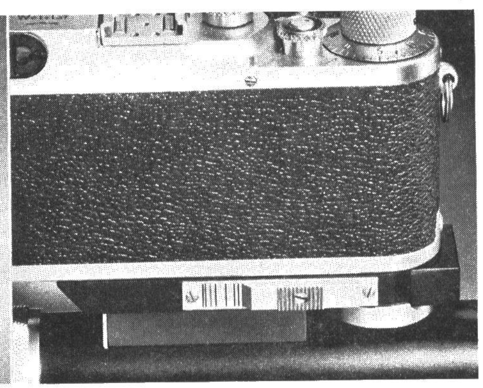
Leica Synchronizer, Model VIII and Model VIIIa • A special camera baseplate that replaces the regular baseplate houses the entire synchronizing mechanism of this device. It can be adjusted for operation on every shutter speed marked on the dial of the Leica camera: from 1/20 through to 1/1000 second. Figure 3 shows how the various rules engraved on the side of the special baseplate correspond to the various shutter speeds of the camera. When the slider is moved so that its indicating edge lines up with the corresponding rule, the synchronizer will close the battery circuit at the very moment required for admission of the optimum light output of the flashlamp. It is important to remember that the shutter must be set to the exact shutter speed for which the slider of the synchronizer has been set. Also, the special synchronizer baseplate should never be attached to the Leica camera until after the camera shutter has been released.

The action of the synchronizer is dependent upon the action of the shutter mechanism. The exact coincidence of the flash with the opening of the shutter can be established only by competent technicians with the necessary tools and special testing facilities. For this reason the Leica Synchronized Flash Units must be sent with the camera to E. Leitz, Inc. for installation and calibration.

Once the special baseplate has been fitted to a Leica camera, it will require no further attention and will remain synchronized if not tampered with. The special baseplate must always be used with the camera for which it was calibrated. While it can be attached to any other Leica camera of the same model, it will not be synchronized with any shutter except the one for which it was adjusted. All other parts of the synchronizing unit are interchangeable.

In addition to the baseplate, the synchronizing unit includes a battery case accommodating three standard 1½-volt dry-cell batteries (size D), obtainable anywhere. At one end the battery case has a slip-in lamp socket with a reflector

2. Special baseplate, part of the Leica Synchronized Flash Units, Model VIII and VIIIa.



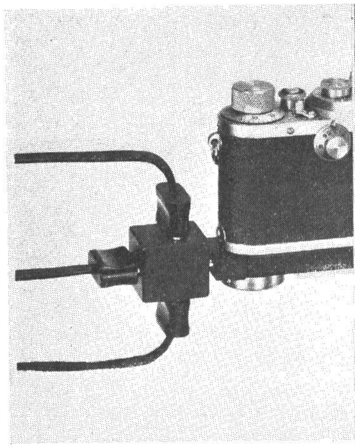
3. Close-up view of baseplate of Leica Synchronized Flash Unit, showing Selective Slider set to 1/20 second.

4. Leica Synchronized Flash Unit assembled ready for use. The camera can be held in vertical or horizontal position, with the flashlamp extending in either direction as required. Photo by Don Mohler.

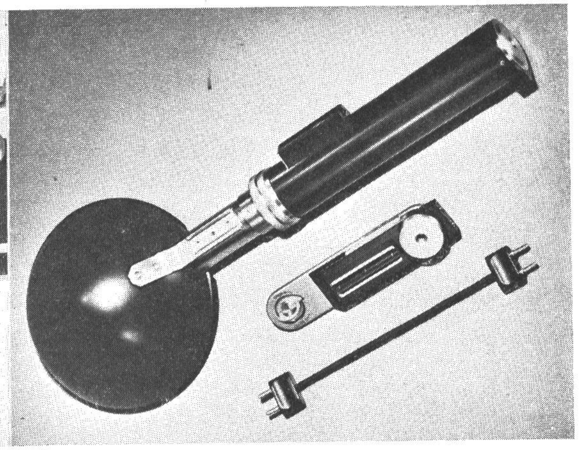
adjustable to three positions for different lamp sizes. At the opposite end, the battery case has a tripod-screw socket in its base, and a receptacle for one of the plugs of a connecting cord. The other end of the connecting cord is plugged into a similar receptacle in the special baseplate. The plugs of the connecting cord are *polarized* to fit the matching receptacles; one of the two plug prongs is heavier than the other, and the plugs will fit into the receptacles in one way only, to assure correct polarity of the electric circuit.

An important habit you should develop to prevent accidental firing of the flashlamps: insert all plugs in their receptacles *before* you place a flashlamp in the socket.

The battery case fits snugly onto the baseplate, to which it is attached by sliding the dovetailed groove over the shoe of the baseplate. The battery case and the lamp holder are then ready for use in the on-the-camera position. For those who prefer to use the flashlamp in the off-the-camera position, either at arm's length or at considerable distance from the camera, accessory connecting cords are available in several practical lengths.



5. Special three-way socket for multiple flash, plugged into synchronizer baseplate.



6. Basic components of Leica Synchronized Flash Units, Model VIII and VIIIa. Battery case with attached adjustable-position reflector, synchronizer baseplate, and connecting cord.

For use in the on-the-camera position, you can easily change the direction in which the reflector faces and set it as you desire by means of a counterlocking knurled ring. Thus the reflector can be placed to throw the light either in the direction in which the lens is pointing or, as many prefer, toward the ceiling, to simulate natural over-all room illumination. This is a pleasant lighting for informal portraiture and shots intended to convey unposed moods.

On-the-camera flash photography is the most simple method of making synchronized flash pictures. For rapid work, where it is essential that camera and light source act as a single unit, this method is the easiest and the most convenient. But while it is simple and dependable, it also becomes monotonous and easily "typed"; the pictures are all lighted alike.

Off-the-camera lighting is the next step toward original and effective lighting. With a longer connecting cord, you can move the same single lamp away from the standard front position to heighten the subject interest as you desire—with high or low front lighting, side lighting, or even back lighting.

The Leica Synchronized Flash Unit separates easily from the camera baseplate, and can be hand-held in the desired position, or supported on a tripod or by a clamp secured to any firm support. A tripod-screw socket in the bottom of the battery case is provided for this purpose. Connecting cords of various lengths (14-in, 6 and 10-foot lengths) are available to supplement the 6-inch connecting cord supplied with the basic Leica Synchronized Flash Unit.

When using the flashlamp off the camera, the exposure calculations are made with the lamp-to-subject distance, not the camera-to-subject distance.

Multiple-Flash Lighting • For further variation of lighting effects, additional flash units can be used, and obviously these must be synchronized

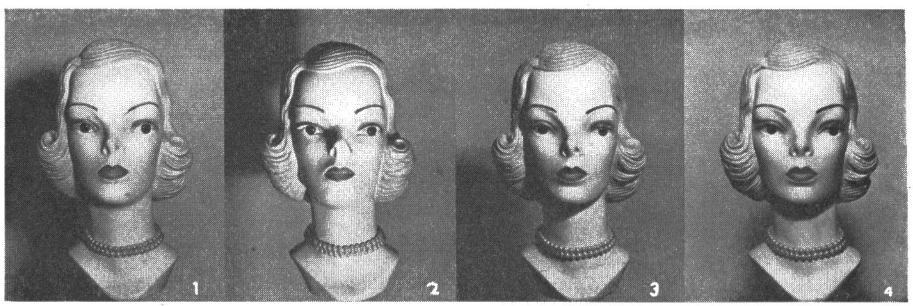
7. Leica Model IIIF, with internal flash synchronization. Shown with compact clip-on battery case, lamp ejector and fan-folding collapsible reflector.

with the primary unit. Two or more extra units can be added to the Leica synchronizer through special accessory three-way sockets. The three-way sockets provide polarized positive electrical connections, through the extension cords, all having matching polarized plugs at both ends. The three-way socket is plugged into the receptacle in the battery case, offering connecting branches for the two additional battery cases. Should you wish more than three lamps, plug a second three-way socket into the first, for five outlets.

The electrical circuit of the Leica Synchronized Flash Unit requires that each of the extension units be a Leica Battery Case similar to the unit supplied with the synchronizer but without dovetail groove. Thus, each unit has its own lamp socket, reflector, and batteries, supplying its own current, ensuring that no flash will fail for lack of power. In multiple-flash exposures the connecting cord that leads to the synchronizer is merely a circuit-closing channel.

Lighting Methods • Once you have learned how to make a technically good photographic likeness of the subject, you are ready to consider the difference between a good and a better picture. Everything else being equal, a better photograph will result from better lighting. This does not mean that it will be better because it is illuminated by more flashlamps, but because you have placed the various lamps judiciously. Single lamps have at times produced masterpieces of photography, but generally speaking, extra lights permit greater control.

The problem of how many lights to use, when, and why, is quite involved. It can best be resolved by a thoughtful appraisal of what one, two, three, or more lamps, differently placed, will produce in terms of lights and shadows. If you wish to learn the effect of one or more light units, I suggest that you experiment first with floodlamps (for economy) and some inanimate subject endowed with endless patience, such as the Leica "Pixie" shown here to explain some basic lighting effects. Since the expression of such a "doll" is permanently built into its face, any apparent changes are due solely to the lighting. This permits a thoughtful study not only of the photographic values



8. *SINGLE LIGHTING*. 1. One flashlamp close to the camera lens. Produces "flat" lighting, without much modeling. Careful exposure required to avoid "washing out" features. Use of handkerchief over flashlamp suggested for working at close distances. (This is the key light for multiple flash illumination.) 2. One flashlamp low to right of lens, slightly in front of the camera. Accentuates eyes and minimizes chin and neck. When the angle of the light is sharp, it helps create a mood of fright, or mystery. 3. Moving the low side light above the lens creates a more placid effect and illuminates the features more like sunlight halfway above the horizon. Compare with picture 2 for roundness and flattering shadows. 4. One light high and directly above the lens. Delineates features evenly, and, by definition, will show up uneven lines. Produces heavy chin shadows on neck, consequently shortening chin.

obtainable with varying lights, but also of their effects in creating mood and expression.

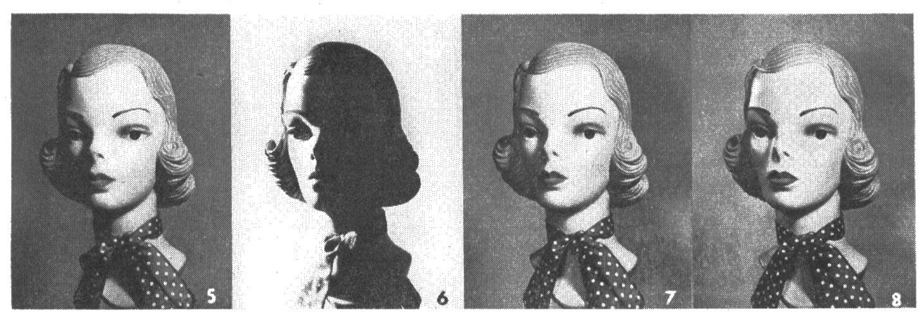
Single lamp · There are as many spots to place a single lamp as there are points on a sphere. But to start out, you can narrow your sphere to a few basic but varied effects. The four pictures of the Leica Pixie at the bottom of page 102 were all made with a single light on or near the camera. Figure 8-1 shows the light close to the lens, which produced a good flat likeness, but certainly not a "picture of distinction." Figure 8-2 was made with the light low to the right of the lens, slightly in front of the camera. Sharp contrast and heavy shadows resulted. In Figure 8-3, the side light was moved above the camera, with less pronounced shadows and a more pleasant effect. In Figure 8-4, the lamp shone from well above the camera lens, creating heavy but even shadows.

From these four simple pictures you can already see that more than one light is necessary for any but the simplest effects.

Triangle lighting · This favorite formula will always produce nicely lighted pictures, and serves as a basis for more elaborate lighting. Most photographers, knowingly or not, are graduates of this basic plan, evolving their own lighting techniques from it by elaboration or modification.

To build up triangle lighting, place the camera in position and measure the distance to the subject. Place a lamp at the side of the camera and close to the lens (point A). This becomes lamp No. 1 (known as the *key light*). If it is the on-the-camera flashlamp, it is automatically positioned.

Determine the position for lamp No. 2 (called the *fill* or *fill-in* light) by marking a spot at a right angle to the camera-to-subject line, and at an equal distance. Call this spot point B, and place lamp No. 2 halfway between A and



9. *TRIANGLE LIGHTING*. 5. One flashlamp halfway down the hypotenuse and above the model's head. Used alone it gives a sharp side lighting effect. But for full triangle lighting, we add two more arms to the triangle. 6. One light placed opposite the hypotenuse light shown in picture 5. Placed above the model, it creates a sharp shadow effect and a heavy mood of mystery. Compare with pictures 2 and 3. 7. Key light at camera (from picture 1) and hypotenuse light (from picture 5) already combine to yield a less contrasty and more rounded image than either light alone. Side of model away from camera still has somewhat heavy shadows. 8. Complete triangle lighting, with good exposure balance on entire model. Key light (from picture 1), hypotenuse light (from picture 5) and light opposite hypotenuse (from picture 6). A dependable, infallible lighting method.

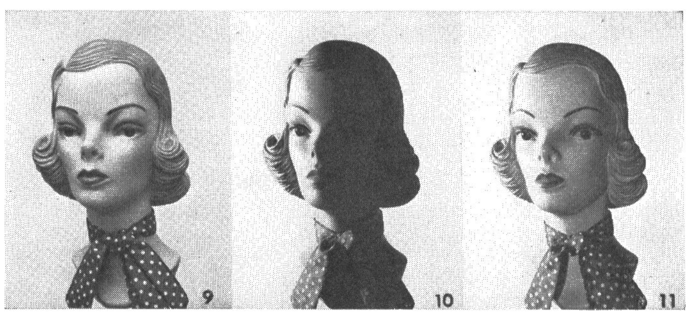
B. The line between points A and B forms the hypotenuse of a right triangle, and thus lamp No. 2 is generally called the *hypotenuse light.*

Note that lamp No. 2, the hypotenuse light, stands at the traditional 45° angle to the camera-to-subject line. Lamp No. 2 should be of the same size as lamp No. 1, and should be placed higher to produce "roundness" and modeling. Figure 9-5 shows the effect of this light. Figure 9-7 shows it together with the key light.

You will secure a different effect if you place a lamp (call it No. 3) diagonally opposite the No. 2 spot, and at an equal distance from the subject. This will now place a light *behind* the subject, on the same side as lamp No. 1 (see Figure 9-6). If you raise this lamp even higher than lamp No. 2, it will light up the top of the subject as well as the side. Always shield the camera lens from direct light striking from the lamp in No. 3 position.

All three lights used together will produce a nicely balanced, pleasant picture of good delineation. To be sure, it will be a picture "out of the book," but it will work as well for a novice in the intricacies of lighting as for a professional who knows exactly what this basic plan will do for him. It is a good staple method of lighting, and will soon provide the beginner with a handy jumping-off point for broader experiment.

Indirect lighting · There are a great many situations in which light coming from one or more directions will not reproduce the prevailing mood of the subject or its environment faithfully. Sometimes a general over-all light simulating normal room lighting is desirable. The Leica has earned an enviable reputation—because of its high-speed lenses used with high-speed emulsions—for photographing things and people in prevailing light. Skillful use of indirect flash lighting can increase the camera's scope in this respect and still not destroy the prevailing mood. It enables you to take pictures of subjects in motion, and to



10. *INDIRECT LIGHTING.* 9. Single light directed above camera lens and reflected off ceiling. Soft, diffused effect, in compact tones of gray, delineates features without sharpness and without pointed drama. 10. One side light reflected from close background, and controlled just to spill on side of face. Compare with direct side lighting in picture 6 to note change of mood. 11. Key light (from picture 1) and reflected background light (from picture 10). A simple example of how you can start experimenting with various lights for different effects, mood and contrast.

take these pictures at smaller lens apertures, increasing the depth of field and improving the delineation of the various planes.

The simplest approach to such illumination is directing the light output of the flashlamp toward the ceiling, or toward one of the walls of the room, so that diffuse light will fall upon the subject from a large area. One effect of such lighting is shown in Figure 10-9, where only light reflected from the ceiling illuminated the Leica Pixie. The ceiling was a good distance away, so that the light was soft. In contrast to this, Figure 10-10 shows a light reflected from a wall close behind Pixie, and placed so as to spill onto the side of her face. To this same light, a front light is added in Figure 10-11, immediately reducing the contrast.

For most indirect lighting, you must remember that the standard exposure guide numbers no longer apply, since the light reflected from a ceiling or a wall is considerably less effective than that reaching the subject directly from the flashlamp. While the difference will vary with the distance from the reflecting surface and with its color and texture, you can make a trial start by opening the lens 3 or 4 stops. For indirectly lighted flash pictures it is best to use the largest possible focal-plane flashlamps in order to retain all the advantages of the flash technique.

Correct Exposure · In flash photography this is easily determined with the universally adopted Flash Guide Numbers. They represent in a single figure the arithmetical product of two factors: the lamp-to-subject distance (in feet) multiplied by the f-number of the lens. If one factor is known, the other is easily found by dividing the Flash Guide Number by the known factor. Any given Flash Guide Number applies only to a given flashlamp that is used with a film of a given film speed and at a given shutter speed.

Thus, for instance, from the table offered on page 106 you will find that a G-E No. 6 flashlamp, used at 1/100 second, with a film of Weston film speed rating (tungsten) 64, has a guide number of 92. This means that if the No. 6 flashlamp is used 10 feet from the subject, with the shutter set to 1/100 second (and of course the slider on the synchronizer suitably set), you divide the guide Number 92 by the distance 10 (feet) and get a lens setting of f/9.2. You can round this figure off to f/9, for a correct and acceptable exposure. While this procedure sounds like trying to divide apples into peaches to get pears, it is actually a logical procedure and will produce a correct exposure every time. If you don't care to do the simple arithmetic in your head, handy dial guides are available to do it for you.

If instead of the above setting of the camera, you wish to use a smaller lens aperture in order to secure greater depth of field—say at f/12.5—you can then divide 92 by 12.5, and the resulting 7.35 will be the lamp-to-subject distance: about 7½ or 7¼ feet.

When you use more fill lights in addition to the main key light, do not include them in the exposure calculation. Since the key light at the camera supplies the main illumination, the exposure is determined by the Guide Number for that lamp and its distance from the subject, as in the above calculation.

The Flash Guide Numbers conveniently grouped here apply to the Leica camera only, when it is individually fitted with the Leica Synchronized Flash Unit, Model VIII or VIIIa, employing reflectors supplied with them. Flashlamps of the "midget" type, having the single-contact bayonet base, will require the use of an easily obtainable adapter. Position the adjustable reflectors carefully with relation to the flashlamp used, so that the lamp appears well centered within the reflector.

FLASH EXPOSURE GUIDE NUMBERS

For the Leica Camera Synchronized with Flash Units, Model VIII or VIIIa**.

Leica shutter speed	Sylvania Press 40			G-E No. 6 Sylvania FP-26			G-E No. 31			Sylvania Press 40	G-E No. 6 Sylvania FP-26	G-E No. 31
ASA	20	40	80	20	40	80	20	40	80			
Weston	16	32	64	16	32	64	16	32	64	Kodachrome Film, Type A*		
1/20	108	154	220	88	128	180	160	180	240	55	45	63
1/30	108	154	220	88	128	180	160	180	240	55	45	63
1/40	88	128	180	78	98	128	135	125	200	44	32	56
1/60	75	108	154	68	83	112	110	120	170	31	27	45
1/100	64	88	128	58	68	92	75	90	140	26	23	32
1/200	50	64	88	45	50	64	55	69	100	21	18	27
1/500	45	50	62	32	45	50	50	57	84	18	15	22
1/1000	36	45	50	26	32	45	45	51	70	15	12	19

*With Leitz Chrome filter or Kodak Light Balancing filter No. 81C. Divide the proper Flash Guide Number by the lamp-to-subject distance in feet. The answer is the recommended lens opening in f-stop for average subjects in average rooms with light-colored walls and ceilings.

**The only difference between Model VIII and Model VIIIa Leica Synchronized Flash is that the baseplate of the latter is intended exclusively for use with the Leica Model IIIc, which is about ⅛-inch longer than all previous models. The model VIII Leica Synchronized Flash will fit Leica cameras of earlier models, but only if their serial number is higher than No. 111,450.

It is most important to remember when using the information offered in this table that not only is it necessary to set the camera to the desired shutter speed, but that the selective slider on the camera baseplate should be set to the line corresponding to the selected shutter speed (see Figure 3).

The focal-plane shutter of the Leica calls for the use of flashlamps having a light output of comparatively long duration, to allow the lighting of the subject to last throughout the time the curtain slit travels past the film. However, at slower speeds the Leica shutter works in such a way that it leaves the the entire film area momentarily open. Thus when it is important to light up large areas, if fast shutter speed is not essential for stopping action, it is possible

to employ flashlamps that have a large light output emitted in comparatively short flashes. However, the use of these flashlamps is limited to a specific camera shutter setting, which is shown in the table for short-peak flashlamps. It is important to note that this table calls for a specific camera shutter setting and for a specific setting of the Selective Slider on the baseplate of the Leica Synchronized Flash Unit. For good results these should be closely followed.

EXPOSURE GUIDE NUMBERS FOR SHORT-PEAK FLASHLAMPS

Flashlamps	Film Speeds (tungsten) Weston 16 / ASA 20	Weston 32 / ASA 40	Weston 64 / ASA 80	Leica Shutter Speed	Slider position
G-E Press 50	125	220	320	1/40	1/1000
Sylvania No. 2	110	160	225	1/60	1/1000
Sylvania No. 2-A	85	120	175	1/60	1/1000

Color Photography with the Leica and its synchronized flash outfit is as simple as black-and-white photography. For reasons detailed in the chapter on Color Photography, a color-balancing filter must be used over the lens with Kodachrome, Type A film. With G-E No. 6 and No. 31 flashlamps, either the Leitz Chrome filter or the Kodak Color Balancing filter No. 81C can be used. With Sylvania flashlamps, I recommend the Kodak Light Balancing filter No. 81D. The chapter on Color Photography also details the proper procedure for using blue-coated flashlamps as auxiliary and fill-in illuminants for outdoor sunlight pictures. Do not use these blue-coated flashlamps for use at night with Kodachrome, Daylight Type film, since they will produce pictures with an unpleasant reddish cast.

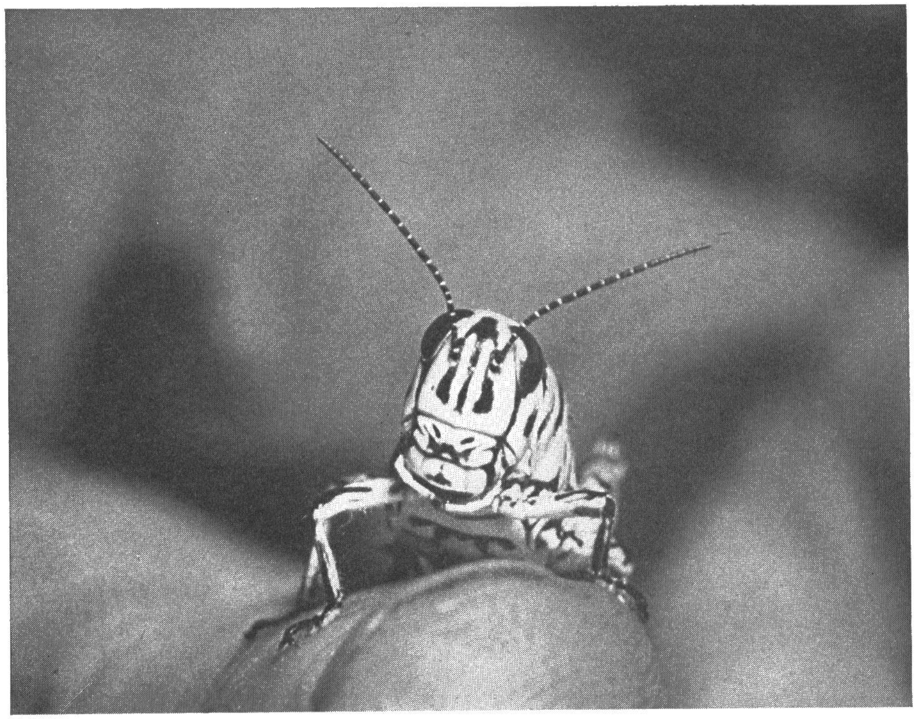
Ansco Color, Tungsten Type film can be used in a manner similar to Kodachrome, Type A, but because it is balanced to a somewhat lower color temperature (see Color chapter) it requires the use of the Ansco UV-16 filter with all flashlamps.

Do not use the open-flash technique for color photography; the opening and closing portions of the flash are too rich in red light, which will appear in the picture as an over-all reddish cast.

Electronic Flash Lighting is described in a separate chapter. It is an important lighting medium, and entirely feasible with the Leica camera. In fact, the Leica is one of the few focal-plane cameras that can be and is being used with the electronic flash. Because the entire light output of an electronic flashtube is extremely brief (about 1/5000 second), the time during which the Leica shutter is wide-open at such exposures as 1/20 and 1/30 second is more than enough to allow the entire flash to reach the entire picture area. The flash itself establishes the duration of the exposure when the Leica shutter is used at slow speeds.

Practically any electronic flash outfit (except those having built-in relays for a 20-millisecond delay) can be used with the Leica camera. There are small portable battery-operated outfits, larger studio units, and even very large units such as have been used to illuminate action shots for Leica photography in Madison Square Garden. Although very high voltages and considerable current are necessary to produce the electronic flash, very little current flows through that part of the circuit which "triggers" the big flash. For this reason it is possible to activate most electronic flash units with the Leica Flash Synchronizer. Special Synchronizer Baseplates are available on order from E. Leitz, Inc. The firm is equipped to adjust them for individual cameras. The standard Synchronizer Baseplate is not suitable to handle electronic flash.

Everything that applies to regular flashlamps (the "chemical" type) and their usefulness in Leica photography applies equally well to the electronic flash. The additional usefulness of electronic flash lies in its exceedingly brief light output. It extends the field of Leica photography to extremely rapid action and enables a photographer to secure such pictures under adverse lighting conditions. Also, the electronic flashtube produces light closely resembling daylight, and can be used with most types of daylight color films.



PORTRAIT OF A GRASSHOPPER — Harold E. Edgerton

50mm Elmar and extension tube. Photographed at 6 inches from lens at f/22 on Daylight Kodachrome by the light of a 100 watt/second electronic flash unit designed by H. E. Edgerton.

ELECTRONIC FLASH

HAROLD E. EDGERTON

One of the biggest thrills in photography is the successful "stopping" of a rapid event, such as a bird in flight, a fleeting golf ball, a bullet at full speed, or even a splashing drop of liquid in a close-up. Life presents a sequence of subjects that are too fast for the conventional mechanical shutter, such as the focal-plane shutter, with its slow upper limit of 1/1000 second. There is much to be desired when photographs of such subjects are made with mechanical shutters.

In this day and age everyone recognizes "strobe" (stroboscopic) photographs at once because of the striking clearness of the frozen action that is unattainable with shutters. Both newspapers and magazines, as well as pictorial photography, are effectively illustrated by examples of electronically lighted photographs. Many amateurs have become strobe fiends!

Electronic flash offers the photographer a new outlook on the problem of fast photography because of its ability to produce a burst of light that is both very intense and very short in duration. Thus ample light can be obtained to photograph the subject, and the exposure time is not limited by the mechanical shutter. In fact, the shutter on the camera with electronic flash serves mainly to *keep out* the continuous light.

For example, when I am photographing hummingbirds in full daylight with color film, the sun's light does not contribute materially to my exposure, since color film is not affected when the aperture is f/16 at 1/400 second. Thus the peak intensity of light on the subject from the electronic flashtubes greatly exceeds that from the sun.

Synchronization • The synchronization of the electronic flash with the shutter is often the most bothersome technical detail to be solved, especially with focal-plane shutters. With the Leica, one fact must be kept in mind always: *The shutter must be "full open" when the flash occurs.* This "full-open" condition only occurs at slow shutter speeds, such as 1/20 second or possibly 1/30 or 1/40 second. If a fast shutter is required to exclude other lights, then an auxiliary shutter of the between-the-lens type must be used in addition to the regular shutter.

The shutter of the Leica camera consists of two curtains that act independently to open and close the area directly over the film. At slow speeds the "opening" curtain travels completely across the film before the "closing" curtain starts to operate. However, at faster speeds the "closing" curtain starts to operate before the "opening" curtain has completed its cycle. Chemical flashbulbs designed to operate with focal-plane shutters have a long flash duration that is flat-topped, for uniform light while the two curtains are moving.

From the statements above, it should be obvious that an electronic flash will "catch" the curtains wherever they are on their travels, and therefore only a fraction of a full photograph will result. Flash synchronization for a Leica is limited to the speed at which the film is completely exposed to the picture. For one Leica that I have used a great deal, I find that 1/40 second is satisfactorily "synched," but 1/60 second shows the "closing" shutter curtain about one-fifth of the way across the frame. I can observe this by looking into the camera with the lens removed and using the light from the flash. A piece of white paper in the film gate assists in this observation.

Synchronization is best effected by the mechanism that operates the "opening" curtain. An electrical circuit should be closed at the exact instant that the curtain reaches the completely open position. With such a positive system, the photographer gains confidence, since when the lamp flashes, he knows that the entire camera is performing its required sequence.

At least two positive methods of synchronization are available to Leica owners. One of these methods uses a contactor mechanism on the disk on the top of the camera that carries the shutter-speed markings. The other method involves the procurement of a new baseplate with built-in contacts. For this second scheme, the camera must be sent to the Leitz Company so that a factory modification in the shutter mechanism can be made. A disadvantage of the first method is the obscuration of some of the camera speed markings, plus the delay in attaching the mechanism.

For any system of synchronism there will be two wires from the camera synchronized. These two wires close an electrical circuit that causes the electronic lamp to flash. It is *very* important that these wires be properly polarized; otherwise the lamp may flash whenever the photographer touches his camera. Also the flashlamp may continuously flash by itself as soon as the capacitors are charged. The Leica baseplate plug is polarized so that the interconnecting plug cannot be inserted in the wrong position. The camera owner must pay attention to the proper connection for the particular type of electronic flash unit that he desires to synchronize.

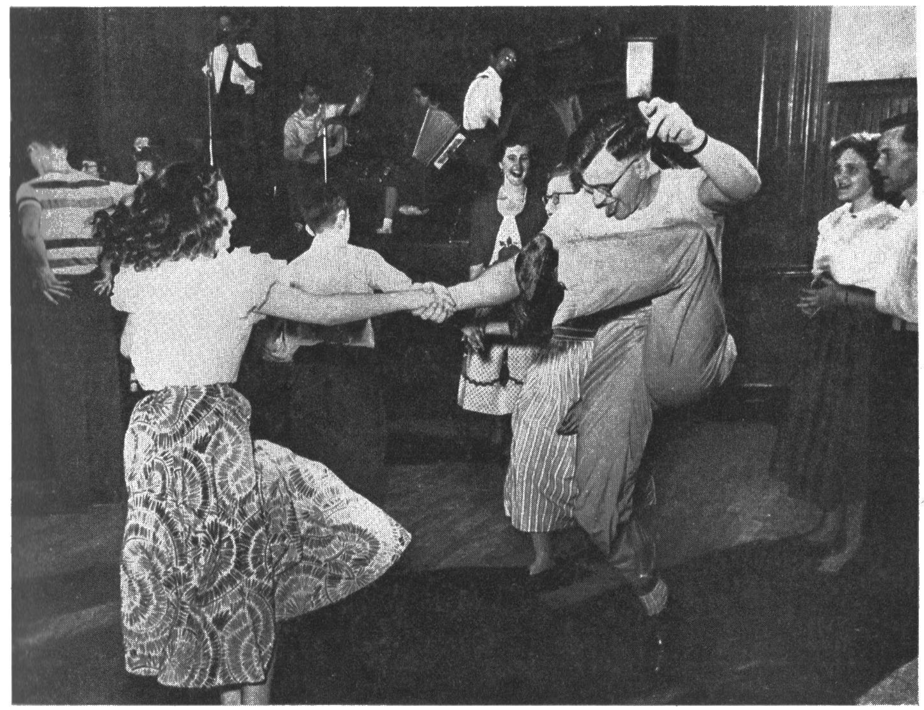
The following simple test should be made after connecting any flash unit to a Leica—or any other camera. Touch the metal of the camera frame to

the metal body of the flash equipment. If the tube flashes, the synchronizing wires are connected wrong and must be reversed. Arrange the plugs so that the incorrect connection is impossible.

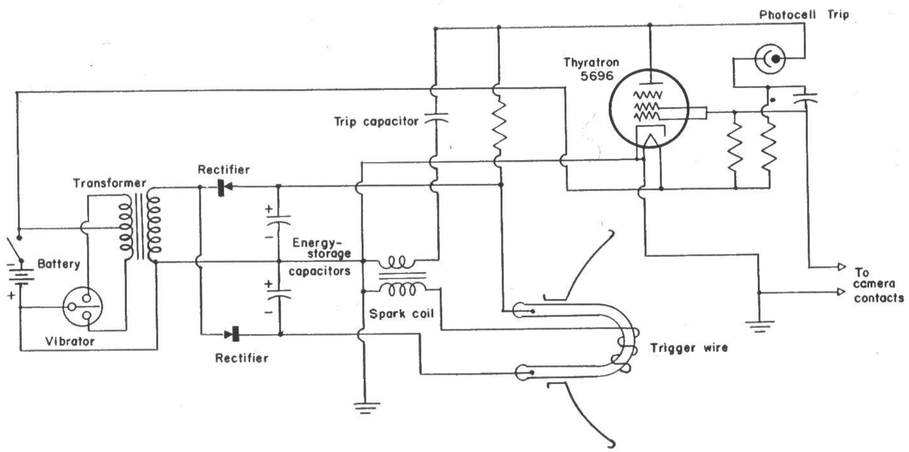
A few flash units, especially those of the older types, use a mechanical relay to connect a flashtube directly across the capacitor. Such equipment may have a delay between the time the circuit is closed and the instant of flash. These relay units are not discussed in this chapter, since the additional delay introduces complicating factors that do not ensure positive synchronization of camera and light.

If the 1/40-second shutter time of the Leica is too long for any specific problem, such as the color photography of action in direct sunlight, use a front shutter of the between-the-lens type.

I arranged a front-shutter combination with a 12-inch lens for photographing hummingbirds and other nature subjects. A cable release is used with a clamp, so that the Leica shutter can be held in the (time) position until the front auxiliary shutter operates. Such photography requires considerable manipulation, so a reflex viewer and a tripod are essential to aim the camera and hold it on the subject.



1. Candid photoograph with photocell-controlled flashtubes. Light from flashtube on camera triggers two side lights set up on tripods. Photo by Harold E. Edgerton.



2. Wiring diagram of a typical battery-operated flash unit with electronic triggering and photo-tube trip. Diagram by Harold E. Edgerton.

Theory of Electronic Flash • Everyone who uses electronic flash should know a few of the fundamental facts about this equipment. These will now be given in describing a typical circuit diagram, Figure 2. A few selected references will be given at the end of this article for those seriously interested in the subject.

The size, weight, and cost of speedlite (strobe) flash equipment depends directly upon the energy that is stored in the capacitors. All things being equal, the weight of flash units is directly proportional to the energy storage. For any particular equipment, the stored energy can be stated in watt-seconds (joules), computed from the equation:

$$\text{Stored Energy} = \tfrac{1}{2}\ CE^2 \text{ watt-seconds}$$

where C = capacitance in farads,

E = voltage to which the capacitor is initially charged in volts.

Most small portable battery-operated flash units have an energy storage of about 50 watt-seconds, while with large a-c operated flash units, used in studios to take color fashion shots, the stored energy can be as much as 20,000 watt-seconds.

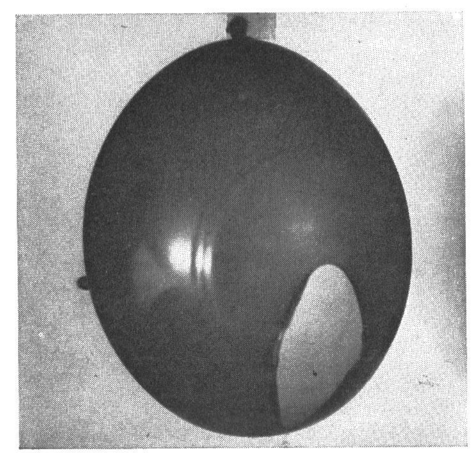
The amount of light from an electronic flash unit is also directly proportional to the efficiency (N) of the flashtube, as well as the stored energy that the capacitor pours into it. Designers of flash equipment and manufacturers of flashtubes are well aware of this fact and are doing all they can to increase it, since an increase in efficiency makes it possible to get the equivalent light from a smaller weight of capacitor. Within the next few years, there will be many improvements in capacitors, flashtubes, and other components—all tending to make electronic flash a more useful light for photography.

The gas used in most flashtubes is xenon, a rare inert gas that is obtained from the air, where it occurs with a concentration of 1 to 100,000,000. Xenon gas when excited electrically with a large density of energy has the ability to emit efficiently light of excellent color quality for photography. Efficiency of energy conversion is usually in the range of from 15 to 50 lumens per watt. This compares favorably with the most efficient continuous-light producers.

Measurement of the light output of a flash system is difficult, if not impossible, with the conventional light meter as commonly used in photography. However, a special meter for measuring the light output from a flashtube, or from an assembly of flashtubes, is now available from the General Radio Company, Cambridge, Mass. This instrument integrates the light from the entire flash and thus gives the output of a flash unit in terms of beam-candle-seconds (b-c-s). Thus different flash units can be compared by the meter. Also the guide factors can be calculated for any particular lighting situation. A meter of this type is most useful in studios, since it enables the photographer to know exactly what is going on. Likewise, the person who is developing flashtubes and capacitors and such equipment needs to measure the results of his experiments continuously. In the stroboscopic-light laboratory at the Massachusetts Institute of Technology, there are 4 meters of various types for integrating the output of flashlights, and these meters are used a great deal.

Color Photography • Color photography with electronic flash is a joy, since in addition to the speed, the quantity of light is extremely constant per flash. The equivalent color temperature is about 7500°K; in other words, the light is slightly bluer than daylight (6500°K). The xenon speedlite can be used with daylight color materials without a filter, although the results may

3. Rubber balloon pierced by bullet just emerging from rear. Note circular wave produced by the impact, and split in rear of the balloon. Exposure time about 2 microseconds. Leica camera, open-flash, with a microphone to trip light from sound of gun. Plus-X film, f/5.6. Photo by Harold E. Edgerton.



4. Informal portraiture with light from flashtube reflected off ceiling and wall. Produces diffused, natural effect of room lighting. Photo by Henry Doody.

be slightly bluish with some flashlamps. Most photographers prefer a filter that absorbs about 20 per cent of the blue light. One such filter is the Eastman 81B (or CC15, old designation). Even a clear haze filter will help, since the xenon flash has some ultraviolet output.

There are slight variations of the color temperature and exposure time with different types of electronic-flash equipment that may cause minor changes in the several types of color processes in use today. As time goes on, the experiences with these flash systems and processes will result in specific instructions. At the present moment, I urge the user to find a suitable filter combination for his particular problem.

When daylight and flash are to be used simultaneously, the filter should be put on the lamp bulb or reflector.

Guide Factors • Each flash unit has a *guide factor* for a particular kind of film. This guide factor is most useful, as it enables a photographer to set his aperture immediately when the light-to-subject distance is known, in the absence of exposure due to ambient light. Aperture is obtained by dividing the guide factor by the distance in feet, since for successful photography the guide factor is the product of distance by aperture. Thus if a

flash unit has a guide factor of 35 with daylight color film, photographs can be taken at f/3.5 at a distance of 10 feet.

A rough estimate of the guide factor for a specific flash unit and sensitive material can be calculated in terms of the light output as follows:

$$DA \text{ (Guide Factor)} = \sqrt{KQM} \text{ feet x aperture}$$

where D = the light-subject distance in feet
A = the camera aperture
Q = the light output of the flashtube in lumen-seconds *
M = the ratio by which the central light beam from the lamp is increased by the reflector
K = a constant (which must be experimentally determined for a suitable photographic result for each exposure time or type of flash equipment)

* as determined by a light meter of the integrating type or from the relationship

$$Q = N\frac{CE^2}{2}$$

where N = efficiency in lumens per watt.

PRELIMINARY VALUES OF K FOR VARIOUS SENSITIVE MATERIALS

Film type		*K*
Color		
Kodachrome Prof. Film, Daylight Type		0.012
Ektachrome Prof. Film, Daylight Type		0.012
Kodachrome Daylight 35mm and Bantam		0.015
Ansco Tungsten Color Positive Conv. Filter No. 12		0.038
Black-and-white	*Thin negative*	*Well-exposed*
Black-and-White Film ASA, exposure index 250	1.25	0.31
Black-and-White Film ASA, exposure index 200	1.0	0.25
Black-and-White Film ASA, exposure index 100	0.49	0.12
Black-and-White Film ASA, exposure index 50	0.25	0.06

This approximate equation for the guide factor has been a most useful one one for designing flash equipment to meet the desires of photographers. Note that the only items of interest to the photographer are D and A of the equation. The items of interest to the equipment designer are Q and M, with the K factor as a common number, depending upon the type of film. Once a photographer decides on what value of distance (D) and aperture

(A) he wants for a given film, then the equipment designer can select a flashtube of suitable efficiency, capacitors, and operating voltage, and reflector to accomplish the desired result.

The basic exposure information furnished by the guide factor for each single lamp is always the starting point for any lighting system using widely spaced multiple sources. Flashlamps can be used in the same combinations as continuous lights.

Negative Development • It is a recognized fact that the H&D curve of a negative exposed with electronic flash lacks contrast (lower gamma) or has a lower apparent contrast as compared with a similar photograph taken with a chemical flashbulb or a continuous-light source. Whether this is due to the short exposure time, the color of the light, or other effects is immaterial. Something must be done to get the contrast that is required. Several methods are in common use, such as:

1. An increase in development time (30% to 100%) to increase the gamma
2. The use of a more powerful developer
3. An increase of exposure so that a higher portion of the H&D curve is used

Photographers who use electronic flash for the first time are thereby encouraged to use a different darkroom procedure than they use with continuous-light photography.

Conclusion • Electronically produced and controlled flashlighting offers the serious photographer much that cannot be obtained otherwise. As time goes on this new light source will find many applications where the unique ability to produce in brief instants controlled amounts of light of consistent color quality are essential.

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DARKROOMS, EQUIPMENT AND ENLARGING PROCEDURE

WILLARD D. MORGAN

Photography with the Leica camera is really not complete until you have made arrangements to do your own developing and enlarging. Once you have constructed a darkroom in which to do all your own processing it quickly becomes a focal point for many things. In this sanctuary of photography you can try out those new formulas, new enlarging papers, and the latest equipment, or prepare exhibition prints, lantern slides, photomontages, and even a small photomural to decorate your game room or study. As most amateur darkrooms become a convenient meeting place for friends and other photographers, they should be made as attractive and inviting as possible.

In addition to cleanliness and neatness there are a few important requirements for any darkroom:

1. Provision for turning the room into total darkness when required. A window can be blocked out by using a panel of building board cut to fit into the frame. Tack weather stripping around the outer edges of the panel for additional safety. The entrance door should also be lighttight. Here again the weather stripping can be used if there are light leaks. Sometimes an opaque curtain can be used if there is no bothersome outside light in the house when working at night.
2. Efficient layout to give maximum convenience while working under a safelight or in total darkness. This means that the developing and other processing, or wet operations, should all be in and around the sink. Don't have the sink on one side of the room and all the developing tanks and trays on the opposite. It is much easier to handle the wet operations on the right or the left of the sink. Locate the developing and fixing trays between the enlarger and the sink. If the sink is large enough, place the trays on a wooden grating right in the sink.
3. A good darkroom sink is a joy forever. You can get by with a minimum sink measuring about 1 x ½ x 2 feet, but a larger one is preferable. Sometimes a large sink can be found at a supply place for used plumbing. A sink made of stainless steel is excellent but expensive. Enameled-iron sinks are good and easy to obtain. In my own darkroom I have a sink made of cypress wood with inside dimensions of 26 inches by 6 feet.

It has tongue-and-groove joints, and steel tierods hold the sides in position. Two coats of Kodacoat paint give a good inside finish for the wooden tank. A wooden grating in the sink keeps all the trays and tanks above the water line. Keep at least 1 inch of water in a wooden sink all the time, to keep the wood from drying out. Install two cold-water outlets. Another outlet for hot water is useful. The ultimate of convenience can be secured by installing a hot-cold water mixer to keep the water at an even temperature.

4. Ventilation is a must for the small darkroom. A reversible fan installed in a light trap with an outlet through window or outside wall is worth the cost. Another lighttight intake baffle for ventilation should be installed near the floor on the opposite side of the darkroom. A simple house fan set on a shelf can be used to change the air frequently if no other ventilating means is available. If the small darkroom does not have good ventilation, it will suffer a decided rise in temperature from the use of safelights and the enlarger, as well as from body heat.
5. Install an electric line around part of the room, against the wall, about 18 inches above the work table and higher above the sink. This line must be protected in a conduit in conformity with local specifications. Locate 3 or 4 double outlets along this line for plugging in enlarger, fan, time clock, safelights, viewing box, and other equipment. Be sure to have the regular ceiling light for general illumination on another circuit.
6. A long table or workbench along one side of the darkroom is important for all the odd jobs connected with photography—such as loading films, trimming papers, mounting prints, mixing chemicals, spotting prints, and many other operations. Give the table a good working height so that a medium-sized stool can be used when necessary. Install plenty of shelves above and under the worktable, over the sink, and at the end of the room. A rack for developing trays and ferrotype tins can be constructed under the sink.
7. String one or two copper wires across the room about a foot above your head for hanging wet films to dry.
8. Place a hook for a hand towel at one end of the sink.
9. Cover the floor and the drainboards of the sink with linoleum for convenience in cleaning. A linoleum strip can be used in back of the sink as a splashboard. Curve the lower part of the linoleum over the sink edge and seal with waterproof cement.
10. And—don't forget the metal wastebasket for discarded wet prints and other waste.
11. Locate the darkroom in a place where it will be neither too damp nor too hot in the summer. A basement darkroom is satisfactory if there is

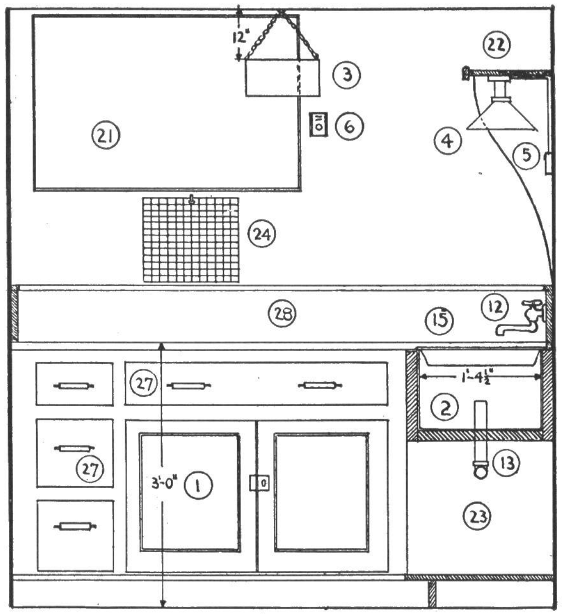
enough ventilation to prevent excessive dampness. Any mild seepage of moisture through basement walls can usually be stopped by painting with a good coating of waterproof cement. A first-floor or second-floor room is fine if available. The attic is usually too hot in summer and too cold in winter, unless proper insulation and ventilation is provided.
12. Paint the ceiling white and the walls a light-green or buff color. It makes it too gloomy to paint everything black.

Equipment for the Darkroom.

1. At least two darkroom safelights, one over the sink and the other near the enlarger, equipped with the proper filters for enlarging papers or films.
2. An 8 and a 32-ounce measuring graduate, also mixing beakers.
3. Darkroom scales and weights for measuring chemicals.
4. Enameled developing and fixing trays; large washing tray for prints.
5. Prepared developers and fixture solutions.
6. Miscellaneous equipment: stirring rods, tank thermometer, viscose sponge, cotton, automatic tray siphon, clips for hanging films, supply of bottles for solutions, timber, supply of enlarging papers, developing tanks for 35mm films, and equipment for contact printing, print tongs, 11 x 14 paper cutter.
7. Focomat enlarger.
8. Ferrotype tins and roller for making glossy prints.

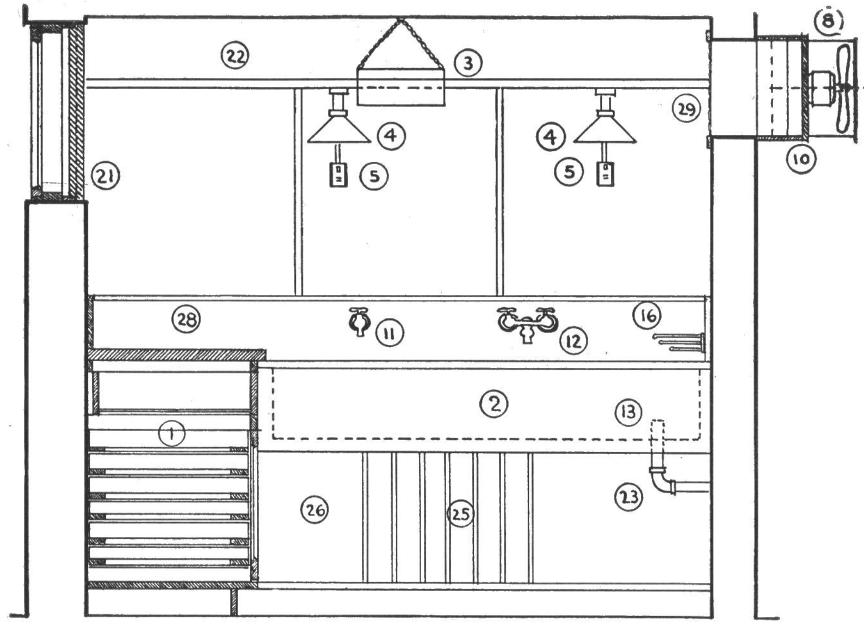
The Complete Darkroom • The day will come when you are ready to graduate from the temporary facilities and plan the model darkroom. Every darkroom is built to fit both the space available and the personal requirements of the photographer. Before starting your own plans it is advisable to study other darkroom layouts for ideas. The amateur darkroom constructed by Lee Parsons Davis, shown in the accompanying illustrations (Figs. 000) is well designed, and workable for one or two people. It is only 6 by 7 feet; it is surprising how much can be placed in this room and still leave working space. The secret of this space utilization is that there are many storage drawers and several shelves for storage of chemicals and other equipment. Space has been made for print-drying racks, ferrotype tins, and a large sink 5 feet long by 16 inches wide and 1 foot deep. The sink is constructed of California white pine 1¼ inches thick (cypress wood is better). The side and end boards are 12½ inches wide, and the bottom board is 1 inch thick. These boards were grooved to fit at a planing mill and set together without glue or nails, bolted at the ends and the bottom.

Over the sink there are 3 faucets, 2 of which are hot-cold mixers for the regulation of water temperatures. One of the faucets has a small undervalve with an outlet for tray washing of prints. A removable drainboard for the

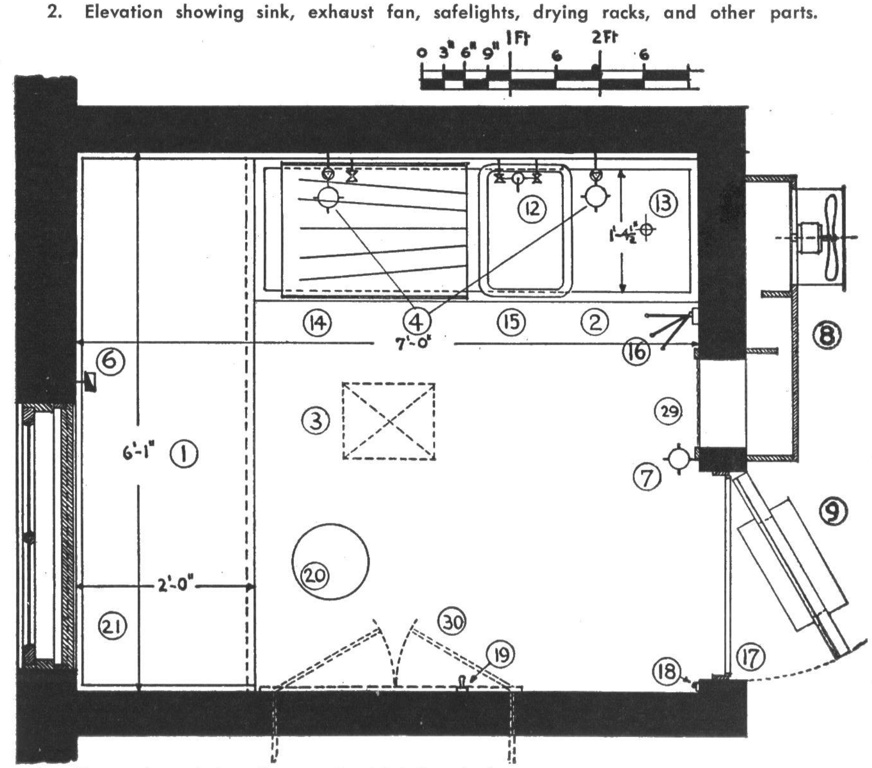


1. Elevation of one side of darkroom showing enlarging table, cabinets, and cross-section of sink at right.

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



2. Elevation showing sink, exhaust fan, safelights, drying racks, and other parts.



3. Floor plan of Lee Parsons Davis' Leica darkroom.

sink provides for additional working space when required. The 11x14 developing trays fit across the sink, while the space below can be used for a larger washing tray. Plenty of electrical connections, safelights, and regular white lights are provided.

Ventilation is skillfully planned in this model darkroom. A fresh-air inlet has been provided for through the door of the darkroom, the foul air is sucked out through a lighttight duct by the electric fan. Such an arrangement permits constant circulation of air.

Many variations can be made in constructing the darkroom. The room can be larger and a second finishing room can even be added. More elaborate cabinets and lighting fixtures can be installed. Then there are many items to select from the wide choice of darkroom equipment, such as contact printers, print washers, drying cabinets, air-conditioning equipment, water heaters, dehydrators. The important thing is to construct the basic darkroom first, then there will be a place to add anything that takes your fancy. A Focomat enlarger should be one of the basic installations right at the start, along with a few special Leica enlarging accessories. The Leica bulk film-loading equipment is also worth having.

Leitz Enlargers and Accessories • Since the Leica camera was first introduced there have been thousands of Leitz enlargers sold. The Focomat Ic and IIa are the current Leitz enlargers. However, there are many of the former models still giving excellent service in darkrooms all over the world. The earlier Filoy, Fylab, and Valoy Leitz enlargers did not have the automatic focusing features used in the former Focomats and the present models Ic and IIa. All these enlargers have the basic lighting design and high quality of workmanship.

The best Leica negative in existence will produce a mediocre print if enlarged with inferior equipment. After purchasing a top-quality 35mm camera, it is poor economy to stint on your enlarging equipment.

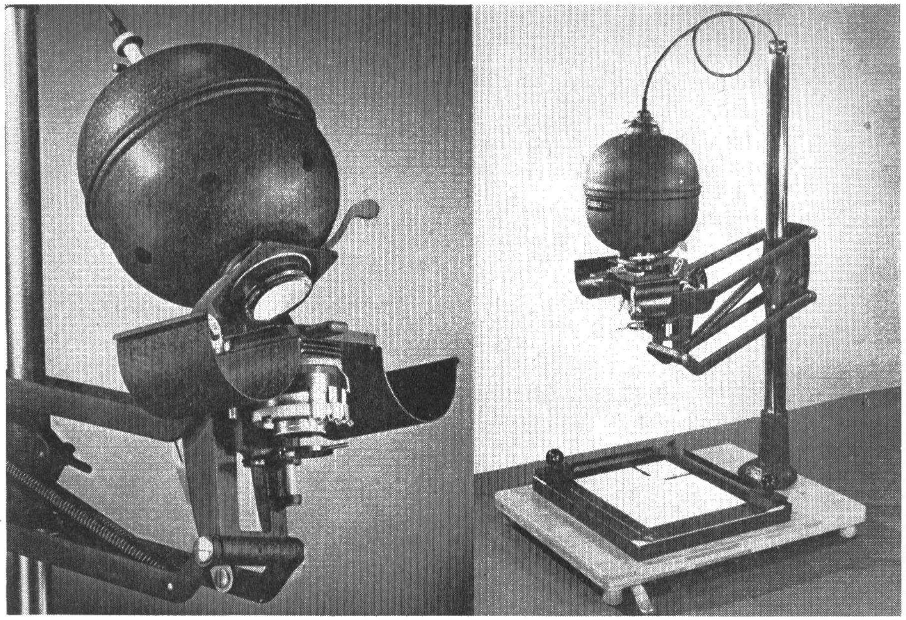
There are 3 types of enlargers available; the condenser type, which passes parallel rays of light through the negative; the diffused-light type, which passes scattered light through the negative; and the Leitz enlargers, which have a diffused source of illumination with a single-element condenser of special design.

A double-condenser enlarger of good design uses a near-point source of illumination, and by means of two condensers completely and evenly illuminates the negative with parallel rays of light. It has the advantages of producing greater contrast, faster printing, and the sharpest detail. It also has the disadvantage of exaggerating and showing up every little aberration, spot, dust speck, and clump of silver grains in the negative. For large-size negatives it is the preferred enlarger, but for 35mm work, where the negatives

are commonly enlarged from 5 to 15 diameters, the resultant grain and scratches that appear on the print leave much to be desired.

A diffusing type of enlarger uses a diffused source of illumination and passes diffused light from all directions through the negative. The advantages of this type of enlarger are its inexpensive construction and the minimizing of grain and scratches. The disadvantage is an enlargement that is not always very rich in detail, has less contrast, and frequently shows uneven illumination of the negative area.

The Leitz enlargers employ a diffused source of illumination and a specially designed single-element condenser, accurately ground and polished. A scientifically designed reflector, forming the upper part of the lamphouse, concentrates the diffused light at the condenser, and this in turn distributes the light evenly over the entire negative area. In addition to the generally diffused light, a certain amount of direct light from the bulb is collected by the condenser and passes through the negative as parallel rays. This combination of "diffused-parallel" light renders a sharp enlargement full of detail, yet free from excessive grain and spots.



4. FOCOMAT Ic. This popular 35mm enlarger is adjusted for automatic focusing. The tilting head gives complete access to all parts for cleaning and checking.

The Leitz enlargers are constructed with the same precision as the Leica camera. The negative carrier remains parallel to the printing board, holding the negative flat, and provides a means of film transportation without danger of scratching. The lens is of high correction, placed in a smooth-operating focusing mount, permitting fine adjustment and so mounted that its optical axes will always be perpendicular to the film plane. The light source is of excellent design, adjustable for even illumination when bulb replacement becomes necessary, and all optical elements are easily accessible for cleaning. The autofocal enlargers provide calibrations for individual lenses that vary slightly in their focal length, and all operating parts are accurately machined and of high quality, to stand wear and maintain calibration after prolonged and severe use. The enlargers are rigidly constructed and vibration-free. Two Leitz enlargers currently available, Focomat Ic and Focomat IIa, are both of the autofocal type. They are fitted with adjustable cams for individual calibration, and the enlarging head may be positioned on the upright, being held by a pin placed in either of two holes for automatic focus direct on the baseboard, or when using the Leitz easel.

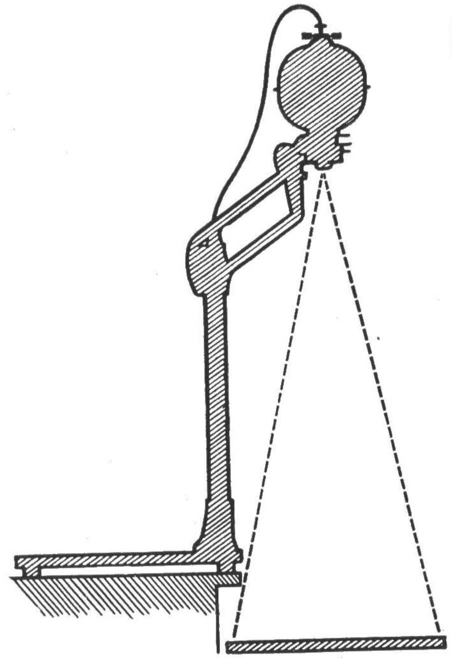
Focomat Enlarger Model Ic • The Focomat Ic has an automatic range of enlargement from 2 to 10 diameters, with greater enlargements possible by manual focus. Enlargements larger than 10x15 inches are made by raising the enlarging head on the upright. If the baseboard will not accommodate the required size, the head may be swung around and the image projected onto a low support. Special negative carriers are available for the Leica in sizes 24x36mm, 30x40mm, and 40x40mm.

The negative is held flat by the condenser, and when a new frame is to be brought into position, the condenser is raised by a lever. The undersurface of the condenser can be reached for cleaning by tilting back the enlarging head, or it can be removed entirely by taking off the upper part of the lamphousing and unlocking the retaining ring.

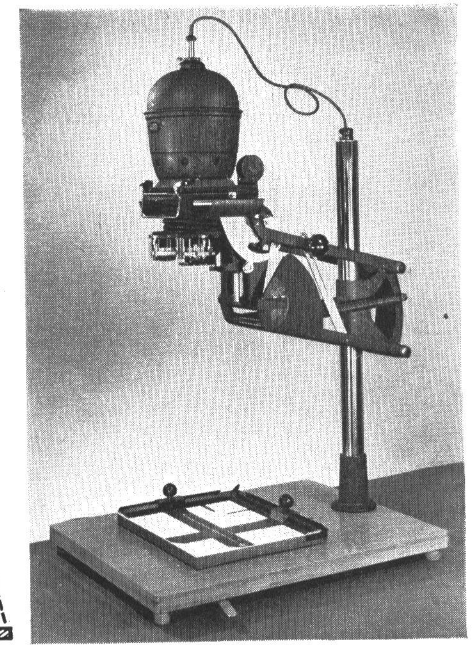
The enlarger is threaded with a standard Leica lens opening, enabling the Leica owner to use his own 50mm Leica lens. The 50mm, f/1.5 lenses cannot be used. Once the autofocal cam is adjusted, it need not be changed until a different lens is placed in the enlarger.

A new finger-grip control, incorporated in the Focomat Ic, when squeezed, releases the head for changing the size of enlargement. The balanced parallelogram arms assure correct alignment of the head, and the degree of enlargement at any position of the head is indicated on a scale. A detailed instruction book is supplied with the enlarger.

Focomat Enlarger Model IIa • The Focomat IIa has an automatic range of enlargement from 2 to 13 diameters for negatives up to 40x40mm and from 1½ to 4¾ diameters for larger negatives, up to 2¼ by 3¼ inches,



5. Greater enlargements can be made by swinging the enlarger head around the upright by 180° and projecting onto a lower support for the easel.



6. FOCOMAT IIa. This automatic-focusing enlarger accepts negative sizes up to 2¼x3¼ inches. The 50mm lens gives an enlarging range from 2 to 13 diameters.

with greater enlargements possible by manual focus. Enlargements larger than 13x19½ inches are made by raising the enlarging head on the upright. If the baseboard will not accommodate the required size, the head may be swung around and the image projected onto a low support. Special negative masking plates are supplied with the enlarger for Leica 24x36mm and up to 2¼x3¼ inches.

The negative is held flat by a hinged glass carrier plate, and when a new frame is to be brought into position, pressure is released by a lever on the side of the enlarger. The negative carrier can be removed for cleaning and the condenser removed by taking off the upper part of the lamphousing and lifting it out.

The enlarger is fitted with a special 50mm f/3.5 and a 95mm f/4.5 coated enlarging lens, with click stops, mounted in a revolving turret. Leica camera lenses cannot be used with the IIa enlarger. There are two autofocal cams that engage an adjustable roller actuating the focusing bellows, one of which is ground for the 50mm lens, used for negatives up to 40x40mm, and the other for the 95mm lens, used for larger negatives. The cams are calibrated for the fitted lenses when the enlarger is shipped. The head is released for changing the size of the enlargement by loosening a knob on the right side of the balanced parallelogram arms. For both lenses, the degree of enlargement at any position of the head is indicated on one of the two scales.

Special Enlarging Lens • While excellent results are obtainable with the Focomat Ic by using a standard 50mm Leica lens, it is necessary to stop its diaphragm down to f/4.5 or f/6.3. All photographic objectives are corrected to work their best at infinity, and when working close, as in enlarging, some spherical aberration is introduced.

The special 50mm f/3.5 coated "DOOGS" enlarging lens is fitted with click diaphragm stops, and as it is corrected for close working distances, can be used at full aperture with sharp results. Likewise, the lenses supplied with the Focomat Model IIa are corrected for enlarging.

Slip-on Ring • Leica owners who use their 50mm f/3.5 Elmar lens in the enlarger find it inconvenient to adjust the diaphragm located on its face. The Valoo Slip-on Ring, which has click stops and is calibrated in the f-system, fits over the lens and actuates the diaphragm from the side. This accessory may also be used on the Leica in the field, as it incorporates its own lens shade.

Negative Carriers • The Focomat Model IIa, as shipped, is supplied with a universal negative carrier and masks of different size to accommodate Leica and larger negatives. For enlarging single negatives cut from the strip, a special glass sandwich is obtainable.

The negative carrier supplied with the Focomat Model Ic is for the Leica size only. Because of its small aperture, this carrier needs no glass plate to hold the negative flat.

Negative carriers with a lower glass plate for the 30x40mm and 40x40mm negatives are available as accessories. Likewise, a glass sandwich for single negatives is available for the Focomat Ic.

Easel • The Leitz easel is constructed of laminated warp-resistant wood, and has adjustable masking bands to accommodate picture sizes up to 9x11. Built-in adjustable stops also provide for margins. The easel is 1 inch thick and the upper hole in the enlarger upright is spaced exactly 1 inch from the lower hole to assure critical automatic focus when using the easel. If you use an easel measuring other than 1 inch in thickness, position the arm holding the enlarger head on the upright above the lower hole at a distance equal to the thickness of the easel.

The baseboard of the enlargers is fitted with a special clamping arrangement, which by means of the clamping lever holds the easel to the base at any desired position. Grooves in the underside of the easel fit into the dovetail clamping bar on the base.

Orange Filter • Frequently a photographer desires to view and frame the Leica negative directly on the sensitized paper. This is possible by using the

orange filter, which mounts in a special screw socket on the underpart of the enlarging head and can be swung in front of the lens, thus preventing exposure on the sensitized paper.

Correx tank for Leica films • The Bakelite Correx tank has a light-tight cover, a reel, and a special clear celluloid apron with indentations along the edges to keep the 35mm film separated from itself. As the film is wound on the reel with the apron, only the film edges touch the indentations, thus preventing the film surfaces from touching while the developing solution completely envelops the film. The apron is unaffected by photographic solutions. There is an opening in the lid for pouring and draining solutions and for the insertion of a thermometer. The agitator rod also fits into this opening and engages with the inside reel, which can be agitated from time to time without opening the tank. As the tank is lightproof, development can be carried on in daylight.

Making the Actual Enlargements • You are now ready to make your first enlargements. First, check up on the darkroom equipment and make certain that the following materials are available:

1. The Leitz enlarger.
2. Developer, stop bath, hypo solutions, and trays. The trays can be selected for the size of enlargements to be made. A set of 5x7 and 8x10 trays are always of value.
3. Enlarging paper (see chapter on Enlarging Papers and Printing).
4. Check up on the proper safelight and other accessories for darkroom use.

There is very little equipment required for making Leica enlargements. You can easily confiscate the kitchen sink and drainboard for this work after the windows have been covered with a blanket or a black cloth.

Before placing the Leica negative in position in the enlarger, make certain that there are no dust particles clinging to the film. If there are, remove them with a soft brush or a clean lintless linen cloth. Always inspect the movable condenser for dust or dirt particles. These points are very essential, because small dust particles can spoil an otherwise perfect enlargement if they are not removed beforehand.

When the correct negative has been selected, insert the film in the negative carrier of the enlarger *with emulsion side down.* Snap on the light and move the film so that it appears in the frame that 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 lamphousing 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 negative to be enlarged is inserted. 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 overexposed 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 method is very convenient for securing critical focus.

Set the enlarging easel for the proper size of the enlarging paper. The two adjustable masking bands can be moved to make 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 by one or two diaphragm stops. A small pencil flashlight can be used to make the adjustment of the lens diaphragm. This flashlight 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. Use two or three different exposure times on this test. A small card can be moved across the test strip at 1-or-2-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, you can count seconds 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. . . . There are excellent darkroom clocks with second-hand dials for use in timing negatives on enlarging papers.

Automatic interval timers with resetting features are a great convenience when making enlargements. Such instruments are plugged in between the power outlet and the enlarger. They give accurate, split-second exposures and do away completely with variations in timing. They permit the making of consistently better-exposed enlargements and are especially valuable when making a group of prints from one negative. The interval timer guarantees that all the prints will be exposed for the same length of time.

After the test strip has been exposed, place it in a developer and develop as recommended by the paper manufacturer. 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 stop bath. From the stop bath place the print in the acid fixing solution for about 15 minutes. See the chapter on Enlarging Papers and Printing for information about formulas.

After the picture has been thoroughly fixed, it should be washed in a tray in running water for at least one hour before placing it to dry on blotters or in the special blotter roll that 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 satisfactory prints after once getting the feel of making them.

Consider 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.

The emulsion of the paper coats the surface very much like a coat of paint. Paint consists of a vehicle, which is usually linseed oil or some other more or less volatile substance, and tiny particles of pigments suspended in the vehicle. The emulsion of the sensitized paper consists of gelatin, 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 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 reaches the surface of the emulsion, only those silver grains become affected by it which are nearest the surface. The greater the amount of the light that reaches a certain point of the paper, the deeper the light 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 gelatin. The particles of developer gradually penetrate into the thickness of the emulsion until they reach all the way through.

This is the reason for the requirement that paper be developed for a minimum time before withdrawing it from the developing solution. In most instances that minimum time for bromide and chlorobromide papers is set at 1½ minutes. That is the *minimum* time of development. If after the print has been developed for 1½ 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 1½ minutes is frequently indicated. Some prints acquire a certain tone quality through longer development. Thus it can be said that with certain developers, after 1½ minutes of development almost all details of the picture are available and if the development is continued for another ½ minute very little apparent change takes place in the print. But when finished and dry such a print will have that quality and richness which we always look for.

Printing Control during Enlarging • The enlarging of a negative permits much greater latitude in the actual printing control than does contact printing. During enlargement, it is possible to introduce soft-focus lenses, special diffusion screens, and also to 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 during exposure.

Dodging may be necessary when printing a negative in which the sky is considerably overexposed while the foreground is normal or even underexposed. The correct exposure is made for the foreground and then a cardboard is used to mask out the foreground while 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 can be projected as required for bringing out certain effects in the print. Also, small cardboard disks 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 practice will eliminate this. Enlargements can be shaded simply by moving the hand below the enlarging lens and thus blocking out any part of the picture.

Some enlargements can be greatly improved by skillfully using an ordinary flashlight for overexposing certain areas while the rest of the paper is covered. In doing this, move the orange filter 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 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 flashlight 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. Place this cardboard over the sensitized paper in the enlarging easel. Move the card into one corner; there will be two sides left with a margin of possibly ⅛ or ¼ inch. Pass the flashlight slowly 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 print.

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 considerable size, it is quite essential that they have fine-grain development in their original processing.

Reproduction of Leica Negatives by Projection • Considerable interest can 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, place a 3cm, 6cm, or even a 9cm extension tube between the enlarger and the enlarging lens. In this way it is even possible to reduce a Leica picture to ¼-inch in diameter if necessary. Such small miniature pictures can be used for ring or locket settings as a novelty.

Microslides 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 you can print all these test strips on one large sheet of paper and then place the entire sheet 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 can be placed at the top of the sheet of paper. If desired, a master 8½ x 11-inch negative can 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 (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 size as the original negative. While working in the darkroom you may be doubtful about the emulsion side of the paper. A quick test can be made by touching the tongue to one corner of the paper. The side that feels slightly sticky is the emulsion side, which is also 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. Do this, of course, under the usual darkroom safelight for paper. Turn the white light 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, place one or two sheets of tissue paper in the film plane of the enlarger to be used to soften the illumination. After exposure develop the paper.

However, most workers prefer a neat printer for making their contact prints. Such a printer can be either made or purchased. The Eldia and Eldur printers supplied by Leitz can be used for making paper contact prints as well as for contact printing on film or glass slides.

The chapter on Lantern Slides for Projection gives detailed information about using the Eldia and Eldur printers. In the Eldia Printer, you can wind the paper around the spool with the negative. Then turn the empty spool on the opposite side of the printer so that paper and film both advance at the same time. Make the exposures by turning on the enlarger light or some other strong source of illumination. The Eldur Printer can be fitted with a small metal pressure plate for fuse when making individual contact prints on 2x2-inch paper that has been previously cut for the purpose.

After the contact print has been made, the single print 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 prints for filing.

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 can be seen in even a small contact print.

ENLARGING PAPERS AND PRINTING

ANSEL ADAMS

The basic principles of photography apply to all phases of the art. There is no essential difference between a print made by contact from an 8 x 10 negative and one enlarged from a Leica 35mm negative. The methods employed in executing the two differ slightly, but the fundamental factors governing the production of a good print do not. What distinctions there are lie chiefly in esthetic factors. These quasi-intangible elements of the photographic print—such as sharpness, the impression of brilliance, solidity of tonal values, and print color—are both actual and psychological. A quality such as a certain amount of brilliancy may be actually, by measurement, contained in the print, or it may be an *illusion* intentionally created by the photographer in making the print. Both these factors, the physical and the impalpable, can be controlled to a large extent by the photographer's taste, skill, and knowledge of printing procedures. But before discussing the variety of controls by which the best possible print can be achieved, it is well to examine the basic mechanico-chemical process of making any print.

The Leica photographer possesses or has access to the fundamental physical requirements that are necessary for ideal miniature-camera work: a camera with a precise body and shutter, and containing an exceptionally fine optical system; negatives carefully developed to assure fine grain; and a well-designed, accurate enlarging apparatus, such as the Focomat, including a first-class projection lens.

Basic Procedure • Now, with the usual darkroom equipment at hand (see the Darkroom chapter), you are ready to go through the basic steps of making a print. Select a negative, dust it carefully with a camel's-hair brush (a darkroom *must*) and place it in the negative carrier with the emulsion side facing the lens. (It is easy to remember that the negative emulsion should always face the paper emulsion.) Then, having placed a sheet of smooth white paper in the easel on which to focus, turn out all but the safelights and turn on the enlarging light. Compose and scale the image on the enlarging easel, and then focus critically at full aperture. When the size and the sharpness of the image are what you desire, stop down the lens as needed. It is rarely necessary with a good enlarging lens to stop down farther than f/8. Now turn off the enlarger light, replace the focusing sheet with a sheet of printing paper, and make the exposure with an adequate timer. How to determine the correct exposure and grade of paper will be discussed later; for now it is assumed that you have made your tests and are following through the steps of developing procedure.

Immerse the print face up in a tray of developer of moderate temperature, preferably 68°F. Agitate it constantly, except when you use water-bath or static development techniques (see *The Negative*). A simple way to do this is to rock the tray gently, so that the solution moves constantly over the surface of the print. It is important that both the tests and the final print be agitated to the same degree. Merely allowing a test to soak in the developer will not give proper indication of the values of the final, well-agitated print.

There are a number of good prepared developers available, which come either in solution or dry. Some are strictly proprietary formulas; others are well-known formulas that you can mix yourself, or you can buy them prepared. The package of the bought formula will indicate the manufacturer's recommendation for proper temperature and developing time, usually between 1½ and 5 minutes. The list of some of the best-known of these is given on page 150.

When development is complete, immerse the print in the next tray, containing the stop bath, and agitate for 30 seconds or so. This acid bath arrests development by neutralizing the alkalinity of the developer solution. A good working solution is 48cc of 28 per cent acetic acid added to 1000cc of water.

After the stop bath, immerse the print in the fixing bath or hypo, and agitate constantly for at least a minute. If you examine it too soon, fog may ruin the image. However, as soon as the print is "cleared," that is, as soon as the milky deposit of undeveloped silver halides disappears, you may view the print under a full, normal light.

This solution is called the fixing bath because its chemical action clears and "fixes" the print into a stable image. Fixing should not be prolonged; overlong fixing is as detrimental to permanence as insufficient fixing time. Instructions as to correct fixing times are given with prepared fixing baths. I find the best method is to fix the print for about 3 minutes in a standard fixing bath (see formula, page 150), then transfer it to a fresh bath for another 3 minutes. A plain hypo bath (page 150) will do for this second one if solution, washing, and drying temperatures are moderate—not over 68°. For extreme assurance of permanency, use a third fixing bath (plain) and limit the fixing time in each bath to about 2½ minutes. Prepared fixing baths are available from the manufacturers of Ansco, Kodak, and other makes.

After fixing, place the prints in a tank or tray of running water and rinse well to remove the excess hypo solution. They can then remain in a tray of fresh water indefinitely. At the end of the working period, the rinsed prints can be set to wash. At least one hour is required for singleweight papers at normal temperatures (around 65° to 68°F). Doubleweight paper requires up to two hours. Of course washing is not merely allowing some water to run into a tray of prints and out the other side, with the prints resting in a quiet mass in the center of the trays. Subject prints to a constant stream of running water that circulates them freely, but is not strong enough to fold and "break" them. Be sure all prints circulate freely; a few prints might stick together and they would *not* be washed. It is a good plan to drain off the wash water thoroughly every 10 minutes or so and then start the prints circulating in a fresh stream. It is also advisable while washing to turn the prints one at a time face up or face down, as the case may be, to be certain they are separated. Insufficient washing will cause prints to fade or become discolored later.

When the prints are washed, give them a final rinse and place them to drain in an inclined tray or on a draining board. Wipe off both front and back of the print with a viscose sponge under a small stream of water. A final hosing-off, then allow the prints to drain, then place them to dry.

Prints can be dried by laying out face down on *clean* cheesecloth stretched on a frame. Or they can be hung up by the corners somewhat as negatives are handled. Or they can be put through drying machines or ferrotyped to a high-gloss surface. When they are dry, press them between smooth cardboards to flatten them.

Mounting logically follows. Dry mounting is by far the best method. Refer to the manufacturer's direction sheets for a detailed description of mounting prints and to Book 3 of the Basic Photo Series, *The Print,* for expansion of processing procedures and the techniques of mounting.

It is hardly necessary to add that cleanliness is essential to good results in any darkroom procedure. Trays and all utensils should be rinsed thoroughly after each printing session. Neither acid nor hypo should ever find its way back to the developer during printing; if either does, stains and other defects will result. If you handle the prints directly, with or without rubber gloves, keep the hand you use in the developer out of stop bath and fixing bath, and in any case rinse both hands frequently, either in plain water or in a 2 per cent solution of sodium sulfite. If you use tongs to transfer the prints from one tray to the next, have a separate pair for each solution. A good formula for cleaning trays is given on page 151.

Now that the basic printing process has been considered, it is time to examine the manifold factors which affect this process and influence the quality of the finished print. In order to do this, it is necessary to go back to the beginning and explore step by step the possibilities of control and the factors that govern these. In the first place, the contrast, or opacity range, of each photographer's negatives should be adjusted to the qualities of the enlarger illumination, since condenser and diffused lights differ in their effects. Therefore the requirements of the enlarging light must be studied.

Effects of Enlargement • The greatest contrast and brilliance of image comes from what is called condenser light, technically known as *collimated light*. It also accentuates grain, scratches, and other defects. A diffused-light source, on the other hand, gives a longer tonal scale and minimizes defects and grain. A reasonable compromise between collimated light and diffused light lies in the use of a Leitz enlarger that has a diffused-light source and a single-element condenser. Agreeable results are obtained from this combination. I have found, however, that I would rather have a very slight softening of edge and retain a full, rich gradation in my print than have an optically perfect projection with the attendant tonal harshness and accentuated grain usually given by collimated light. Whichever your personal choice may be, it is apparent that negatives to be used with a collimated-light source should be somewhat softer (of lower opacity range) than negatives designed for diffuse enlarger illumination.

It should be stressed that sharpness is not only delineation. Here one of the intangible elements enters, for the illusion of sharpness is intensified by abrupt differences of tone. A very light tone against a very dark one will seem to have a sharper demarcation line than will two close tones, even though both are of identical optical delineation. Furthermore, if the optical image on the negative is slightly unsharp, the grain can actually accentuate the impression of image sharpness. Grain itself, a normal characteristic of the photographic emulsion, is disturbing only when it depreciates image definition.

Papers • The photographer usually has a clear impression in his mind of what the final print is going to be—that is, he knows what he is working for. In order to achieve the desired effect, there is a great variety of paper suitable for enlargement from which he may choose. Selection can be made in most brands of paper from the following qualities:

1. Contrast—low to high
2. Surface reflectivity—dull to brilliant (matte to glossy)
3. Surface texture—rough to smooth
4. Weight—light to heavy
5. Color—from white to toned paper base, and from cold to warm image tone

The emulsions of photographic papers differ chemically, so that papers vary in their response on exposure to light, just as films do. The chief difference between the characteristic response of one paper and that of another is usually called contrast. When photographers speak of paper contrast, they are referring to what is more correctly termed the *exposure scale* of the paper. Just what is this exposure scale? To begin with, pure white in a print is the paper base itself; yet a maximum silver deposit—that is, maximum black—is obtainable on any contrast grade of paper. If we find the number of units (seconds) of exposure necessary to produce maximum black when one unit will produce the faintest perceptible tone below pure white, we have the *effective* exposure scale of that particular paper. When this exposure scale is short, the paper is a hard or contrasty paper, since all discrete tones of the negative are rendered farther apart. When the exposure scale is long, the paper is called a *low-contrast* or soft paper, and the discrete values of the negative are rendered closer together.

A negative of short opacity scale—that is, one of low contrast—requires a paper of short exposure scale—that is, one of high contrast. A negative of great opacity scale likewise requires a paper of long exposure scale. This is easily understandable after a brief consideration. Think of an average negative, in which the lightest part transmits, say 25 times as much light as the darkest part. This negative has an opacity scale of 1 to 25. Now if the exposure scale of the paper used (or its "contrast") is 1 to 25, *all* the tones in the negative will be rendered in the print—from white to black, and an infinite number of gray tones between. Call this an ideal print. If you use a paper of an exposure scale of 1 to 50 on this same negative, you will obtain a maximum scale of white to dark gray, or black to light gray; but you will not be able to get white to black, and this effect has the appearance of too much "softness." If, on the other hand, you use a paper of an exposure scale of only 1 to 12 on this negative, you will reproduce only a part of the negative scale; if you get the right high value, a good portion of the lower tones will be telescoped, all of them appearing solid black; if you print for the proper black values, an equivalent effect of blank whiteness will occur in the high tones. This print is too contrasty.

You want, then, for satisfactory results, to match the scale of the paper to the scale of the negative as closely as possible. As you can now understand, a soft paper will not necessarily give a soft print. If it is used to print a negative of commensurate range it will give a rich, brilliant print. The same is true of each contrast grade.

It is a first objective in ordinary photography to interpret all the brightnesses of the subject in the negative, and to reproduce all the negative values in the print. Therefore conditions are usually ideal when, as has been noted, the exposure scale of the paper is similar to the opacity scale of the negative. However, this is logical only when the results are expressively satisfying. The phrase "a perfect negative" has no meaning unless it produces a print that satisfies the esthetic intentions of the photographer. Therefore many deviations are permissible for expressive purposes. But it is not enough to look at a negative and say, "This is a soft or thin negative, and I will use a contrast paper." How then are you to choose a proper paper, you may ask, if not by judging your negatives visually? A little later, some tests are given by which you can easily determine the contrast grade of paper required for the negative at hand.

Paper Characteristics • Standard papers are marked according to their relative exposure scale; that is, each brand can be obtained in various grades of contrast. Projection papers of longest scale are marked 1, with each successive grade of 2, 3, and 4 having a progressively shorter scale, or more contrast. A No. 2 paper is generally considered to be the normal contrast grade in projection papers. Actually, this statement has little meaning in view of the wide variety of personal styles and techniques and the fact that paper grades are not standard from manufacturer to manufacturer, or even between different papers of the same brand. A No. 2 grade of one brand may have a different exposure scale than that of a No. 2 grade of another brand. However, with many papers there is a choice of contrast grades, with No. 2 probably representing the "middle of the road" for that particular paper.

Mention should here be made of a relatively new type of paper, Du Pont Varigam, which does not employ different papers for change of scale. A wide variety of contrasts are obtained on one grade of paper by using filters of differing colors over the enlarging lens. Proper safelights, as well as an inexpensive set of filters, are necessary, but otherwise the procedure of use does not differ from that used with standard papers.

There are other characteristic differences in paper responses besides contrast. One paper brand may have an emulsion that tends to separate dark tones more readily than another; a second paper may separate high values better, and so on. Speed is another factor, some papers responding to light more quickly than others.

The brilliancy of a paper surface—whether it is dull, semigloss or glossy—makes a profound difference in the effective contrast of the print as normally viewed. No matter what the exposure scale of the paper itself may be, whether of less or greater contrast, all papers have a limited brilliancy of image according to their different reflective surfaces. An example of what this means in effect is that a black printed on a dull paper will appear a deep gray in comparison with the "richer" black of a glossy print, because of the difference in the way light is reflected from the two surfaces, although both blacks may represent a maximum silver deposit. The more brilliant

the paper surface, the longer the possible range. A rough dull matte will reflect a brilliancy range of perhaps 1 to 15, a semigloss one of 1 to 30, a full gloss one of 1 to 50.

The smoother the surface of a paper, the more minute detail will be revealed in the image, and this is important in enlarging. At the same time, however, grain will be more apparent. While the impression of grain may be absorbed in a rough paper, it is sometimes found that a paper of a very slight pebble-luster surface provides a definite impression of sharpness of image and lack of grain. This is especially true in enlargements of considerable size.

My personal preference for moderate-sized enlargements from 35mm negatives is this: 5 x 7 to 6 x 9½ on a smooth, glossy paper that is allowed to dry without ferrotyping. This implies perfection of negative and processing techniques, as such prints should convey the maximum clarity and brilliancy of image, with a minimum of grain and negative defects. I also prefer double-weight paper rather than singleweight or mediumweight, because of greater sturdiness and ease in processing, although a lighter weight may be advisable where facilities for washing are limited. I have had no direct experience to justify the statements of some of my friends that singleweight paper of the same brand and contrast gives a different-quality image than does the equivalent emulsion on a doubleweight paper. However, I believe the manufacturers have occasionally introduced a slight amount of dye into the coating of the singleweight papers, which gives the whites a little less brilliancy, and thereby makes the papers more suitable for photoengraving use. (In the commercial world, the greatest use of singleweight glossy papers is for reproduction purposes.)

I prefer to use a white rather than any obviously toned paper stock, although I recognize the value of a very faint ivory-toned stock (sometimes called *natural white*). In spite of the fact that print color can be somewhat controlled by toning, it must be remembered that papers have their basic color characteristics built into them. Kodak's Opal, for instance, is a very warm paper. Ansco's Convira may be very cold. Kodak's Azo may show a tendency toward an olive cast. A paper especially designed for portraiture may develop to a warm, brownish tone. These effects can be controlled somewhat by development, but nevertheless they reflect the basic quality of the paper itself.

It is obvious that photographic papers come in such a wide variety of color, surface, texture, surface reflectivity, weight, and contrast that a complete listing of all the characteristics of all the projection papers of each manufacturer would be impossible here, as well as fruitless. Information is readily available at any photographic shop, in inexpensive pamphlets published by the manufacturers, and in the PHOTO-LAB-INDEX published by

Morgan & Lester. With the general knowledge obtained from the foregoing discussion, the beginner will be able to make a choice of paper that seems suitable to his needs, and to make intelligent experiments in order to find the proper one for his work. However, a brief summary of the chief characteristics of some of the more popular projection papers may be of some help to the beginner.

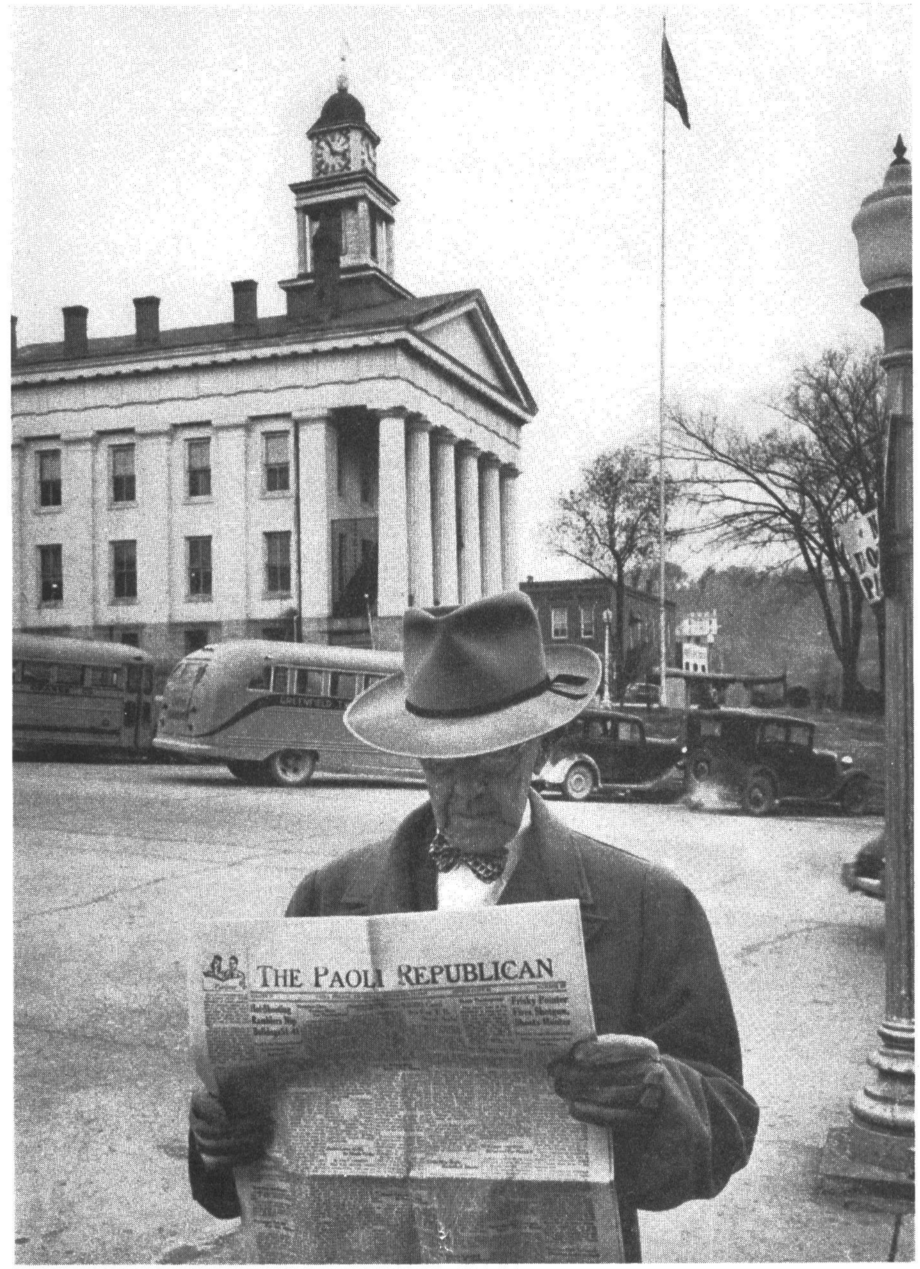
PHOTOGRAPHIC PROJECTION PAPERS

Brand	Name	Weight	Surfaces	Colors	Contrasts	Best For
Ansco	Cykora	SW & DW	3	1	1 to 4	Portraits and commercial
	Brovira	SW & DW	1	4	1 to 4	Pictorial, reproduction
	Indiatone	DW	4	1	1 to Normal	Portraits; warm tone
Dassonville	Charcoal Ember	SW	8	2	1 to Normal	Pictorial, portraits; warm tone
	Charcoal Black	SW	8	2	1 to 4	Pictorial, portraits; cold tone
Du Pont	Velour Black	SW & DW	17	2	1 to 4	General
	Varigam	SW & DW	5	1	variable	General
Eastman	Kodabromide	SW & DW	5	2	1 to 5	General
	Opal	DW	13	3	1 to Normal	Portraits; exhibition; warm tone
	Platino	SW & DW	3	3	1 to 3	Higher-speed printing
	Royal Bromide	SW & DW	1	1	1 to 4	Extreme speed for portraits, general
	Velox Rapid	SW	1	1	0 to 4	General
Gavaert	Novabrom	SW	4	1	1 to 5	
Haloid	Halobrome	SW & DW	3	1	1 to 4	Commercial, photofinishing

Developers • No matter what the characteristics of a paper may be, the type of developer used, and the time of development, produce definite effects on the contrast, brilliancy range, and tone of the final print. For the serious or advanced worker, these controls are an important part of his technique, and can be accomplished by mixing his own chemicals rather more readily than by buying the prepared formulas. Change of developer composition and dilution are then at his command.

The ingredients of print developers are as follows:

1. *A developing agent.* Metol (other trade names include Elon, Pictol, Veritol) and hydroquinone are the two most universally popular, and are often used together; Amidol; glycin; and others
2. *Sodium sulfite.* A salt, the chief function of which is to preserve the effective life of the developing agent in solution
3. *Sodium carbonate.* A chemical that activates the developing agent by alkalinizing the developer solution. All practical print-developing agents except Amidol need an alkalizer.



1. MAYOR OF PAOLI. Here the wide angle lens gives a sharp depth of field from the newspaper in the foreground to the clock in the background. 35mm Elmar, f/16, 1/20 sec. Photo by Life photographer Peter Stackpole, copyright Time Inc.

4. *A restrainer,* the chief function of which is to minimize fog. Increased amounts of restrainer in the developer will also slightly increase contrast and slow the paper exposure speed. Potassium bromide in a 10 per cent solution is the most common; it will give a warm, often greenish tone to the print. Other antifoggants (benzotriazole, Kodak Antifog, BB compound, and so on) will favor cooler tones in the print.

Now consider a few simple facts about developing agents and their formulas.

1. *Amidol,* full-strength solution, gives brilliant results. It can be diluted up to 15 times its original volume of water, and with prolonged development times will then give a soft print, yet retain good print color. Most print developers in high dilution do not yield good print color. A standard formula is Ansco No. 113 (formula on page 150).
2. *Metol* (Elon) alone, with sulfite, carbonate, and restrainer, gives soft prints with good color. See Ansco 120, or Beers formula (page 151).
3. *The Beers formula* (page 151) admits a wide range of contrast control by altering the contrast of any given grade of paper. There are two separate stock solutions of Metol and hydroquinone, and the table appended to the formula shows how these two solutions can be mixed to gain the desired contrast, the Metol solution giving softer and the hydroquinone harder effects.
4. *The Metol-hydroquinone-glycin formula,* Ansco 130 (page 151) is a brilliant developer with beautiful tonal color and richness. Somewhat softer results can be had by eliminating the hydroquinone. Intermediate contrasts can be obtained by adding varying quantities of straight hydroquinone-sulfite solution, or by using in various dilutions with water.

Determination of Correct Paper Grade · Now assume that you have determined upon a paper of very smooth surface and high-gloss finish because it will reveal nearly everything that is in the negative—although it does tax the craftsmanship of the photographer to produce a miniature negative of the required quality, free from defects. As for making the print, other than using care not to mar the surface, there is no important difference between processing glossy paper and paper of any other surface. Prepare a normal developing solution, and make the tests to determine the most applicable paper grade to use with any given negative. Here is the procedure that I suggest:

Lay a small test strip across the white areas of the scene in which some trace of texture must be retained—that is, across the darkest areas of the projected negative image. Then give exposures of varying times to different sections of this strip by covering them successively with a piece of cardboard or other opaque material. For example, expose the whole strip for

10 seconds, then quickly cover a small section with the cardboard for another 5 seconds, slide the cardboard to cover the strip further for another 5 seconds, and so on, thus creating steps of 10, then 15, 20, and 25 seconds of exposure on this one strip. Develop this test strip for the recommended time. If the high values of the print appear in all the steps as merely blank white, you know that you have not given enough exposure. (Remember this refers to *textured* high values; when you really *want* a pure, blank white you should not tolerate a grayish tone.) Place another test strip in the easel and expose again for 30, 35, 40, 50, and 60 seconds. One of these exposures will presumably be correct. If, on the other hand, even the 10-second exposure in the first test shows too deep a gray for the particular high-value white, then you know that you have given too much exposure. In this case, rather than giving less than 10 seconds' exposure, stop the lens down, chiefly because a too brief exposure will make dodging and accurate timing difficult. The ideal exposure time for most enlarging papers will run between 20 and 30 seconds. Beyond 30 seconds' exposure you may experience "reciprocity departure," which means in practical work that long exposures alter the original scale of the image by increasing its contrast up to a certain point, then decreasing it. Continue to make tests and adjustments until you get the required value in the textured whites assured at from about a 20-second to a 30-second exposure. Suppose your photograph is that of a snowbank, or of white clothing. In your accepted test exposure you should still keep some gradation of white, but there should be no depression of tone beyond that necessary to reveal significant texture. In order to judge the whites properly after the print is developed, stop-bathed and fixed, take the test strip out of the solution and turn a corner of the paper forward without creasing it, matching the pure white back of the paper stock to the lightest-textured high value of the printed image. (The completely white photographic area will always be a little less brilliant than the white back of the paper, because of the gelatin coating of the emulsion overlying the paper surface.) If you have preserved a desired impression of texture while keeping high luminous values, you can safely assume that your exposure is right for the whites of the image.

Then take a larger test strip and cover as great a variety of tones as possible in the negative, from the whites down to the deepest blacks. Give the same exposure obtained for the first test strip, and develop this second strip just as you did the first. Now you will be able to see what range of tones the paper is capable of containing in relation to the negative at hand. Perhaps the first value to look to after the whites is the quality of the intense blacks. A transparent area of the negative should print maximum black. A textureless area printed an obvious gray is extremely unpleasant. Ask yourself, does this test strip show adequate blacks representing completely transparent areas of the negative? If so, you can say that you have a full-scale print, from white all the way down to pure black.

Or you may find that several of the thinner areas of the negative that you wish to preserve as discrete deep tones in the print have all printed a massive black. You know immediately that the paper is of too short an exposure scale for the negative at hand. By using a rather soft developer you might be able to separate those values, but at this point try a softer paper; that is, a paper of longer exposure scale. Proceed to expose for the whites, just as before, to determine the proper exposure to render the whites just as you desire to see them. (A little less exposure may be necessary to achieve the same values in the whites as the first paper gave, because as a rule the softer the paper, the less the exposure necessary to achieve equivalent high values.) Then make the second test to see what happens to the blacks. Suppose the deepest black does come through with the required intensity with a normal developer, and that the close steps of tone above the black toward gray are all retained. You will then know that you have selected the right contrast grade of paper for the negative at hand. (If the blacks are just *slightly* weak, you might use a more active developer while retaining the same paper grade.)

Then make a complete print, exposing for the optimum as the two previous tests have indicated. Develop this print for the same time under the same conditions, and you will then be able to evaluate the image as a whole, and to consider what slight changes of exposure and development, and what dodging and shading, may be required to produce the desired expressive print image.

One of the common defects of miniature-camera enlargements is a harshness of tone best described as a "soot-and-chalk" quality. Extreme cases are obvious, but the subtle differences between a completely smooth and luminous print and one that has slight elements of harshness are so small, and require such taste and perception to recognize and control, that it is quite impossible in a short chapter such as this to describe fully the ways and means of realizing the highest perfections of the print image. Only *awareness* and experience can achieve consistent, subtle results.

The procedures noted above may cause you to ask, "Do I have to go to all that trouble for *every* print?" I would answer, "No." Your experience in judging your negatives will help to eliminate extra testing. More important, once a general exposure-development relationship is established for your *negatives* (adjusted to the desired papers and appropriate to the general mood and quality of your work) you can follow a more or less standard procedure of printing; in other words, there will not be much

deviation from "normal" procedure for the greater number of negatives to be printed. On the other hand, the making of a fine print can never be reduced to a formula; every photograph presents its own particular problem of execution.

Additional Controls · The recommended formulas and development times listed by manufacturers are determined on the basis of efficiency, standard print color and contrast, and economy of solutions. It is too much to expect the manufacturer to make other recommendations, as the variety of personal requirements is enormous. However, (just as in cooking) you must add a "pinch" of this control and one of that control to gain just the right results. Because of the personal nature of print making, suggestions cannot be too definite, but the following ideas may encourage you to experiment on your own. Here are a few additional controls.

1. *Exposure of the print.* Suppose a typical print test indicates a 25-second exposure and a 1½-minute development in a standard developer. The general effect turns out to be slightly harsh. Rather than change the composition of the developer, try increasing the exposure slightly and reducing the time of development. The result will tend toward slightly less contrast, slightly less richness of tone, and probably a warmer print color. However, the combination of excessive increase of exposure and reduced

2. A few unobtrusive lines and a lone figure give strength to this composition by Tosch Matsumoto. 50mm Summar, f/12, 1/200, Super-XX film.

development time produce muddy tones and uneven tonal values. Now suppose the typical test print shows a slight flatness; you can reduce exposure slightly and prolong development. If the exposure is too short, the whites of the image will not be properly revealed, and if the development is too long, fog or stain may be produced. These controls are the simplest, but they do not have very much effect, within reasonable limits, on print color and tonal quality.

2. *Water bath for prints.* This is an effective method or reducing contrast, with the one exception that there is always the possibility of getting weak blacks. Amidol is a good developer for this method, but there is the possibility of stain with it. I personally prefer Metol (Elon) for the water-bath method; if the blacks are not adequate, I immerse the print in a Beers No. 7 solution for a few seconds at the end. (Hydroquinone has a definite penetrating action, while Metol favors the surface values, or light areas, of the print.)

   The method of use is simple. In addition to the tray of developer have a tray of clear water. Develop the print until the deep tones are barely visible, then immerse in the water and allow to stand for a minute or two *without agitation.* Replace in the developer for about 30 seconds and again place in the water. Proceed with this alternate developer-or-water treatment until the desired effect is gained. For prints with large areas of continuous tone, such as clear sky, this method may produce slightly uneven values.

3. *Static development.* For a somewhat limited control—to get softer prints—immerse the print in the developer, agitate until the lightest tones of the image appear, and then allow the print to stand in the developer *without agitation.* The developer that has saturated the more heavily exposed parts of the image will become exhausted quickly, and as it is not replaced through agitation, development of these areas is minimized, while development of the surface areas continues. As with water-bath development, uneven tones *may* appear in continuous-toned areas.

4. *Effects of toning.* The process of toning will be discussed shortly, but it is advisable to mention here that in addition to the change of print color by toning—which produces a psychological effect on the spectator, often creating the illusion of increased brilliancy and contrast—there may be an actual slight increase in print density. I refer to the direct-toning process, such as that with selenium. Exposure and development of the print also modify the final effect of toning.

5. *Presentation.* The mounting of the print, and the viewing light under which it is seen, may profoundly affect the apparent quality of the print.

Prints shown in a relatively dark environment and under a strong illumination appear very brilliant. The same prints shown under diffused light in a relatively light environment may appear discouragingly flat and lifeless. This latter effect is largely due to reflection from the print surface of a general high level of environmental illumination; the deeper tones are definitely veiled. Also, prints shown under plastic will appear less brilliant than those having no covering. Even the clearest glass reduces the brilliancy of the print to a certain extent.

   Thus we see that print values are modified by a variety of interwoven processes and conditions, all of which can be adequately controlled by thought and imaginative facility.

Toning • There are several practical methods of toning; descriptions of them will be found in any standard photographic handbook. My preference is direct selenium toning, chiefly because the resultant tone is, to my mind, vastly superior to the usual egg-yolk brown of ordinary so-called sepia toning. Toning should, to my taste, be very slight—just enough to overcome the blue-green-olive tones of so many contemporary papers.

I prefer to wash prints thoroughly before toning them in the selenium solution. Some workers tone after a short wash, but I have found that insufficient; too much fixing, old fixing baths, and too little washing tend to produce a slight yellow tone in the whites of the image. Kodak directions advise a prebath of 2 per cent Kodalk before immersion in the Kodak selenium toner.

It must be borne in mind that the average concept of a toned print is one of a rather definite color; my personal requirement is a subtle change of print color that can hardly be termed an actual "color." Papers such as DuPont Velour Black will respond to the mild degree of toning I desire; they may not produce a strong color unless toned in the more popular sepia toners.

In any event, after toning in selenium, wash the prints thoroughly in water of the same temperature as the toning solution, or cooler, and dry in the regular fashion. Refer to Book 3, of Basic Photo Series, *The Print,* for further discussion of toning, and see the formulas there. Remember that selenium powder is poisonous! The prepared proprietary toners are entirely satisfactory.

Presentation of Prints • Instructions for finishing and mounting prints can be found in the next chapter, but in the presentation of prints to an audience we have a subject of considerable importance. All we can state here is the need for every photographer to study this problem, not only for the physical protection of his prints, but for the very definite psychological effects involved. A fine photographic print is a rather delicate thing in itself;

it suggests perfection and demands care. When not on display, it should always be protected by a nonabrasive sheet of paper. There are many opportunities for ingenuity in the design of albums and portfolios for fine prints. The lighting under which prints are shown is worthy of considerable study and experiment; it must not be too bright or too dim, and must be placed so as to provide even illumination and so as not to produce glare. Tungsten light makes the prints appear warmer in tone; north daylight yields a rather cold effect. I prefer a good balance of color—standard ("mixed") daylight is about the best. Again the psychological factors are involved; only by experimentation can the proper viewing light for any individual's work be determined.

Spotting · The reasons for care in processing negatives and for keeping equipment clean and free of dust are very apparent when the photographer notes the number of disturbing light specks and streaks in his finished print if he has been careless in this respect. However, even with the greatest care, prints frequently need some spotting in order to remove such obvious defects. Spotting is a corrective measure in which unavoidable spots are matched in tone with the surrounding tones in the print, and it should not be confused with any form of retouching, whose purpose is to alter the image in some fundamental way.

A fine, small brush that comes to a good point is necessary for spotting. There are a number of pigments and dyes that can be delicately applied to the print with the proper bath in order to darken the light areas to the right degree. Rough, semimatte, and semigloss prints can be spotted with the ordinary pigment spotting colors, available in photographic stores everywhere. If these are used on glossy prints, however, the spotted areas show as dull areas, especialy in acute angles of light. Glossy papers are best spotted with dyes, which pentrate the emulsion without altering the reflective quality of the surface. There are glossy spotting inks; the Schmincke Gloss Retouch Color (Brumbacher, New York City) is an excellent material. Refer to Book 3 of the Basic Photo Series, *The Print,* for expanded information on this subject, as well as on the problems of etching the print surface for the removal of black spots, and so on. The subject is far too detailed to present here. There are numerous excellent sources of information on this tricky phase of technique, but the photographer must realize that good spotting and etching takes skill and patience. The good craftsman forestalls such evils by care in processing, but he never fails to correct them when they do appear.

Print Size · This is one of the more important aspects of photography, and is seldom thought about as much as it should be. The salons seem to favor large-size prints without regard for the more subtle factors of appro-

priate scale and rendition of texture. There are no hard-and-fast rules. For a certain viewing distance, the degree of enlargment should be controlled by: a) the mechanical quality of the negative—grain size, optical definition, defects, and so on; b) the texture and design of the image itself; and c) the emotional impact of the subject.

While the miniature-camera photograph cannot, and should not, attempt to equal the definition and the tonal quality of a large contact print, it can nevertheless have, for all practical purposes, a near-perfect definition, and smooth, rich quality of tone. A high standard of miniature-camera work requires that the enlargement shall never be more than optimum. I have made 5 x 7 enlargements from 35mm negatives that are practically indistinguishable from 5 x 7 contact prints in quality, except under the most searching examination. A few of my 8 x 10 enlargements have approached this exacting standard. However, it is always necessary to accept logical compromise, and if the emotional content of the photograph justifies a broader treatment through increased print size, the technical perfections can be relaxed a bit. But careless procedure and sloppy concepts become glaringly apparent in all miniature-camera work.

Print Proportion · Two schools of thought persist in regard to the acceptable proportions of the photographic print. One, represented by photographers like Edward Weston and F. S. Lincoln, adheres closely to standard negative sizes and proportions. They compose directly upon the ground glass and fill the space of the negative, whatever size it may be. Only in rare instances will they deviate from the standard proportions, but under no circumstances do they merely "trim" the print; the proportion is definitely planned at the time of exposure. The other approach is more flexible, but still depends on proportions determined at the time of exposure; prints are not merely "trimmed down to please." Both approaches are valid when working with large cameras in which a ground-glass focusing panel, a wire finder, or a brilliant finder is used. For the miniature camera (except with the finest optical finders) the image as seen in the finder is small, and often somewhat less in scope than the actual field of the negative. Hence it is better to project mentally the desired field of view onto the subject itself, and carry over this concept to the making of the prints.

Thus any arbitrary print proportions in miniature-camera work might well be very inhibiting. Let the picture area be appropriate to the dynamics and the "feeling" of the subject. It will be found that the proportions of the 35mm negative (24 x 36mm) may not always be agreeable, and a concept of a squarer format (say 24 x 30mm) may be more appropriate. The finder can be masked down by the careful application of opaque, and the pictures composed within this more compact area.

While it is desirable to adjust the mount size and proportions to those of the print, the photographer is forced to admit that for practical reasons standard mount sizes are desirable. At least it is practical for him to keep to as few sizes as possible, in order to facilitate storage and display.

My personal recommendations for fine expressive prints, without concern for "carrying power," is as follows: Prints approximately 5 x 7 or 6½ x 9 (not larger than 9 inches in greatest dimension) on 11 x 14 to 14 x 18 mounts. With fine optical equipment and a precise camera, fine-grain film, and appropriate processing of the negative, the quality of prints of this maximum size can be impressive.

PREPARED PRINT DEVELOPERS

Brand	Name	Characteristics
Ansco	Ardol	Warm tones
	Vividol	Cold tones
Du Pont	55-D Standard Paper Developer	Warm tones; normal gradation
Eastman	Dektol	Cold tones; normal gradation; longlasting and high print capacity
	Selectol	Warm tones; normal gradation; longlasting and high print capacity
	Versatol	For film and paper, cold tones, normal gradation with paper
	Kodak Universal MQ	For film and paper, Metol hydroquinone developer
Edwal	Edwal 102	For paper and film, warm tones, with long gradation and developing time with paper
	Edwal One-Eleven	For film and paper, neutral tones with good gradation with paper
Mallinckrodt	Pictone	For film and paper, cold tones, good gradation with paper

FORMULAS

Always mix ingredients in the order listed.

KODAK F-5 FIXING BATH

Water	600.0 cc
Sodium Thiosulfate (hypo)	240.0 grams
Sodium Sulfite, desiccated	15.0 grams
Acetic Acid 28%	48.0 cc
Boric Acid, crystals	7.5 grams
Potassium Alum	15.0 grams
Water to make 1 liter	1000.0 cc

PLAIN HYPO FIXING BATH

Water 125°F.	800.0 cc
Sodium Thiosulfate (hypo)	240.0 grams
Water to make 1 liter	1000.0 cc

ANSCO 113 DEVELOPER

Water 125°F	750.0 cc
Sodium Sulfite, desiccated	44.0 grams
Amidol	6.6 grams
Potassium Bromide, 10%	5.5 cc
Water to make	1000.0 cc

Use at full strength for the most brilliant effects. Dilutions up to 1:20 give progressively softer effects with good tone. Give ample developing time with high dilutions.

ANSCO 120 DEVELOPER

Water 125°F	750.0 cc
Metol	12.3 grams
Sodium Sulfite, desiccated	36.0 grams
Sodium Carbonate, desiccated	30.0 grams
Potassium Bromide, 10%	18.0 cc
Water to make	1000.0 cc

For use, dilute 1:2 or more; it can be used full strength.

ANSCO 130 DEVELOPER

Water 125°F	750.0 cc
Metol	2.2 grams
Sodium Sulfite, dessicated	50.0 grams
Hydroquinone	11.0 grams
Sodium Carbonate, desiccated	67.0 grams
Potassium Bromide, 10%	55.0 cc
Glycin	11.0 grams

Use solution at full strength for maximum contrast. Normal dilution, 1:1. For soft effects dilute 1:2 or more.

KODAK D-72 DEVELOPER

Water	500.0 cc
Metol	3.1 grams
Sodium Sulfite, desiccated	45.0 grams
Hydroquinone	12.0 grams
Sodium Carbonate, desiccated	67.5 grams
Potassium Bromide, 10%	19.0 cc
Water to make	1000.0 cc

A universal paper and negative developer, giving a rather cold, blue-black quality. Dilute from 1:1 to 1:4 for various papers. Further dilution and addition of potassium bromide increase warmth of tone.

BEERS TWO-SOLUTION FORMULA*

SOLUTION A		SOLUTION B	
Water	750.0 cc	Water	750.0 cc
Metol (Elon)	8.0 grams	Hydroquinone	8.0 grams
Sodium Sulfite, desiccated	23.0 grams	Sodium Sulfite, desiccated	23.0 grams
Sodium Carbonate, desiccated	20.0 grams	Sodium Carbonate, desiccated	27.0 grams
or monohydrated	23.4 grams	or monohydrated	31.5 grams
Potassium Bromide, 10%	11.0 cc	Potassium Bromide, 10%	22.0 cc
Water to make	1000.0 cc	Water to make	1000.0 cc

These two stock solutions are mixed in the following proportions to give a progressive range of contrasts. The lower-numbered solutions can be further diluted for very soft effects.

*From Jordan and Wall, *Photographic Facts and Formulas,* courtesy American Photographic Publishing Company, Boston.

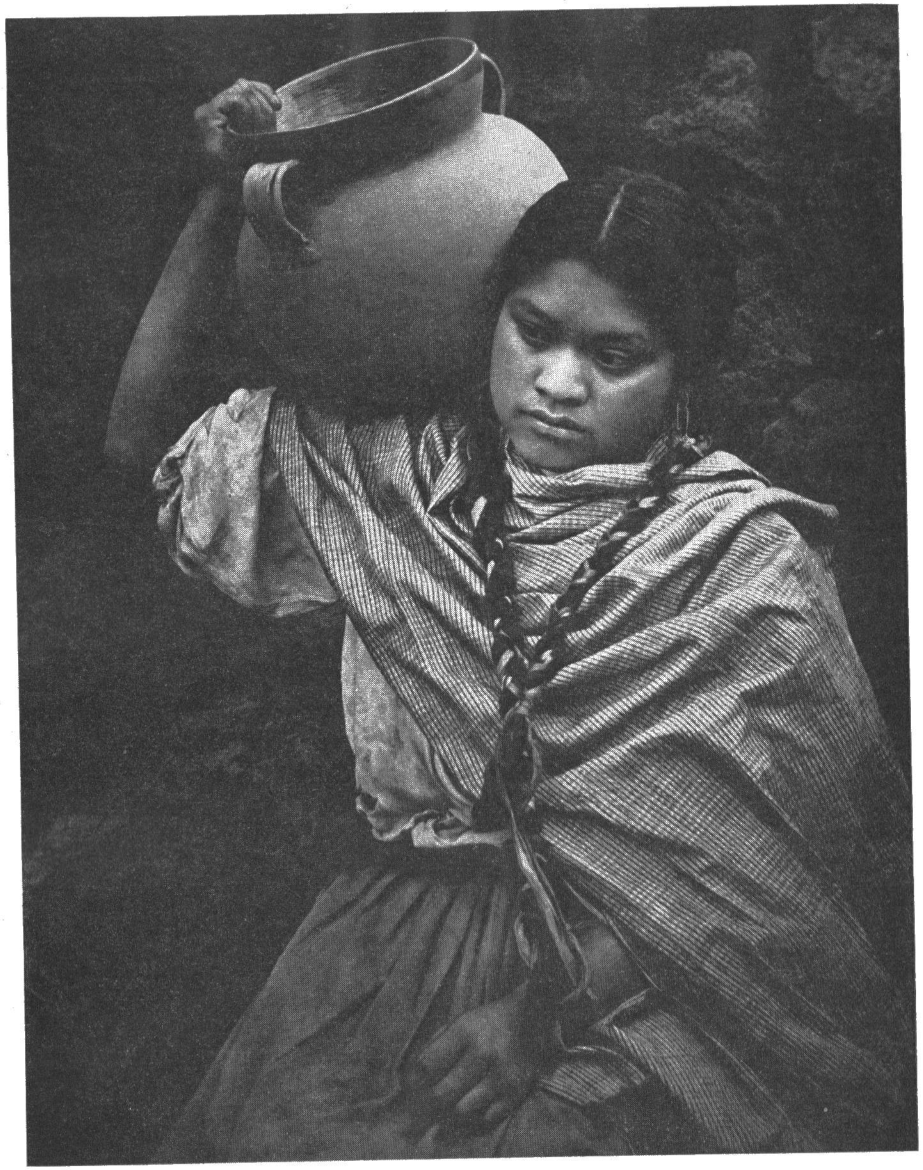
CONTRAST	Low			Normal			High
Solution No.	1	2	3	4	5	6	7
A	8	7	6	5	4	3	2
B	0	1	2	3	4	5	14
Water	8	8	8	8	8	8	0
Total ounces	16	16	16	16	16	16	16

My personal variation of this Beers formula is to mix it without the Potassium bromide then to add the restrainer (potassium bromide or antifoggant) as required for the paper and the effect desired.

TRAY-CLEANER-KODAK TC-1

Water	750.0 cc
Potassium Bichromate	90.0 grams
Sulfuric Acid CP.	96.0 cc

Add the sulfuric acid *slowly* while stirring the solution rapidly. Pour a small amount in tray or container, swish so that all parts are contacted, then pour the solution out and rinse the tray *thoroughly*.



DOMINGA

Helen C. Manzer

A 90mm lens was used to photograph this native of Mexico. 90mm Elmar, f/9, 1/100, Panatomic-X film.

COPYING AND CLOSE-UP PHOTOGRAPHY

WILLARD D. MORGAN

Practically everyone who uses a camera has had occasion to make close-up photographs of objects. Such pictures may have been more or less successful, depending upon the camera and the experience of the operator. The copying possibilities of a camera should really be looked upon as a visual notebook that 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. Anything can be copied that can be illuminated adequately for photographic purposes.

Intense work in photographing the large-object world has been carried on for nearly a century. However, it is only in recent years that small-object or macrophotography has become an essential part of our daily living, mainly because of the important advances in camera design. The eye of the camera is 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 macrophotography of specimens that are invaluable for future reference by the medical and teaching staff. Police departments use the cameras 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 how immense and likewise important the field of small-object photography has become.

The Technique of Copying · Close-up photography of small objects has a field and a technique quite different from those of the usual type of photographic work. When a photograph is taken of a plant, a newspaper clipping, a manuscript, an insect, a medical specimen, or other small objects, special problems arise.

1. The Leica camera requires additional equipment.
2. Focusing becomes more critical as depth of field decreases.

3. Exposure factors change, and are calculated according to the degree of magnification required.
4. Illumination becomes an important factor.
5. Color filters may be required to obtain satisfactory results.
6. Camera and attachments must be mounted on a rigid support, free of vibration.
7. Film must be selected to fit the requirements of the copy material.
8. Specimens to be copied must be mounted or properly arranged to ensure good reproduction on the negative.
9. In copying with color film, specimens and backgrounds should be selected for the most effective combinations and contrasts.
10. Developing of the films to preserve the fine details is of great importance.

Definitions · The terms *microphotography, macrophotography, photomicrography,* and *photocopying* are often interused, misinterpreted, or not understood. These are the accepted definitions:

Microphotography . A reduced-in-size documentary reproduction (usually made on film) of such minute detail that it cannot be read by the unaided eye. *Microfilming* or *microcopying* are terms referring to the technique of microphotography, while the product is called *microphotograph, microfilm,* or *microcopy.*

Macrophotography . The photography of small objects reproduced at natural or larger than natural size without a microscope.

Photomicrography . The technique of making greatly enlarged photographs of extremely small objects by means of a microscope.

Photocopying . A method of photographing exact copies on bromide paper in a camera without the use of a film negative. Often referred to as "photostating."

Attachments for Copying · The Leica user is fortunate in having such a wide choice of accessories for use in all types of copy work. These attachments range from the simple fixed-focus to the more professional Reprovit II outfits. Each copying attachment is individually described here.

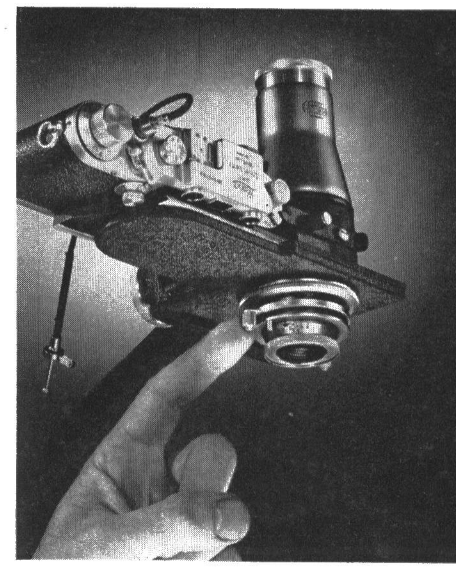
The Focaslide · One of the important accessories for the Leica camera is the Focaslide, formerly known as the Sliding Focusing Copy Attachment. With this revolutionary attachment the Leica is being used in many amateur and professional fields.

The Focaslide consists of two metal plates, one for attaching to the camera and the other for holding the lens and extension tubes. On the sliding part that holds the camera there is a ground glass with a masked-out area equal to the size of the Leica negative, and 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.

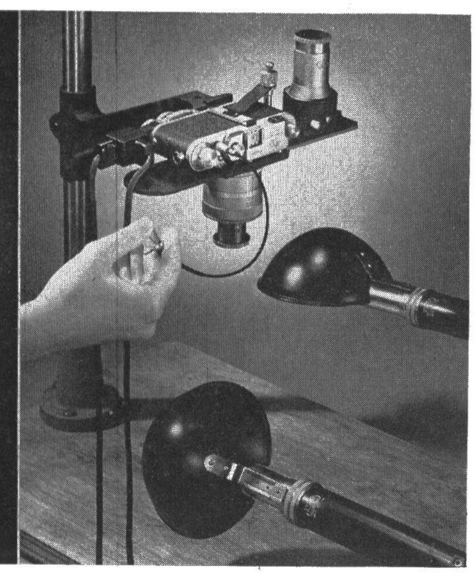
When the extension tubes and the camera are secured in place, the Focaslide can be used in any desired position for photographing horizontally or vertically. A tilting top or a Ball Jointed Tripod Head can be used for securing this attachment to a tripod for indoor or outdoor use. The special Sliding Arm, which attaches to the upright post of the Focomat enlarger, is one of the best supports for the Focaslide. When this outfit is attached to the Sliding Arm, the camera is level and horizontal to the baseboard, thus assuring good allover focus on the negative.

Around the ground-glass focusing plate there is a clip mount for attaching one of the five magnifiers (4x right angle, 5x, 5x widefield, 5x right angle, and 30x). Once the Leica is attached to the Sliding Plate, it can be reloaded without removing it from this plate, or if more convenient, the camera can be easily removed from the attachment. A Wire Cable Release is recommended to avoid any possibility of jarring the camera at the time of exposure.

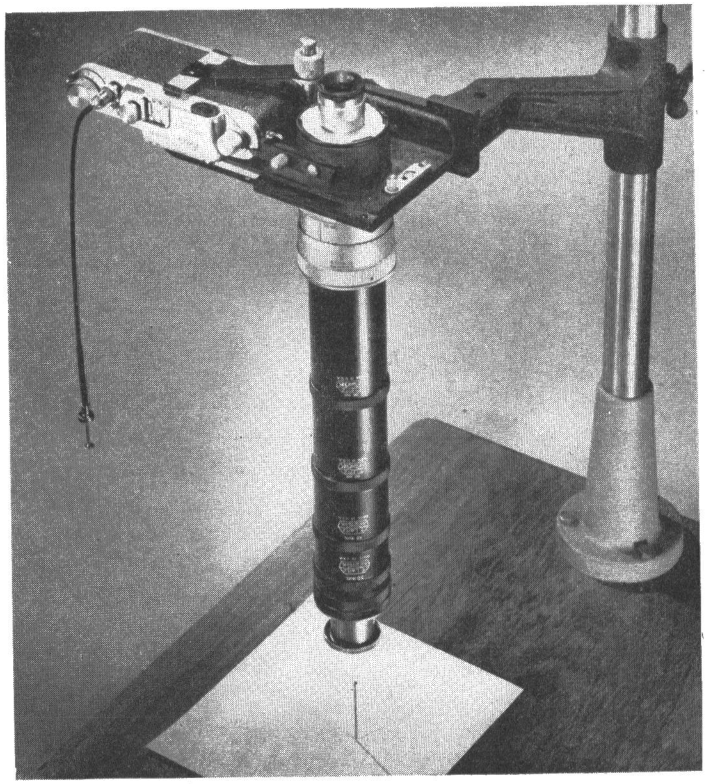
Leica cameras having serial numbers above 400,000 are 1mm wider than earlier models; the Focaslide that accepts the latest Model IIIc Leica is identified by a triangle (△) engraved on the sliding lock. Focaslides accepting earlier-model Leicas are basically similar, with the exception of a slightly thicker sliding lock engraved with a square (□). The sliding locks are interchangeable for use with different models.



1. Focaslide with 5x wide-field magnifier and the Intermediate Focusing Mount with the 50mm Elmar lens attached.



2. Focaslide with 5x magnifier and the Adjustable Micrometer Extension Tube in position. The Leica is set up for flash photography.



3. Focaslide attached to the Sliding Arm and enlarger post. A 30x magnifier is in position over the ground glass. The Adjustable Micrometer Extension Tube is attached to the Focaslide, and also various extension tubes to give great magnification of small objects.

Setting up the Focaslide · After the lens has been unscrewed from the camera, the camera body is mounted on the Sliding Plate and the lens is screwed into the underside of the flange ring of the Fixed Plate. If one or more extension tubes are to be used, they are placed between the Focaslide and the lens. The assembled equipment is attached to the sliding arm mounted on the baseboard of the Leitz enlarger.

Before the setup is complete the subject to be copied must be placed in position and properly illuminated. The object is moved around until it is centered on the ground glass. Rough focusing is obtained by moving the camera close to or away from the object. Fine focusing is secured by using the focusing mount on the lens, the Intermediate Focusing Mount, or the Adjustable Micrometer Extension Tube. When perfect focus has been secured on the ground glass, the camera is slid into position ready for making the exposure.

After the image has been centered and focused on the ground-glass screen, move the locking lever on the Sliding Plate to its intermediate position, so that the plate will be free to move in only one direction. Slide the plate, with the camera attached, in this direction until the setting bar strikes the stop. The camera opening will then be directly over the lens and the exposure can be made. To refocus and check the centering of a new subject, move the Sliding Plate back so that the ground glass is again directly over the lens.

The Intermediate Focusing Mount is another copying accessory. It is attached to the bayonet flanges of the Leica 50mm lenses, thus ensuring a rigid mounting. It also prevents any possible distortion of the image due to the slight lateral displacement of the lens, which may occur when the Leica 50mm lens, attached directly to the Focaslide or the extension tube is focused in its free position. The Intermediate Focusing Mount gives a wide range of picture-taking possibilities. When it is attached directly to the Focaslide and the 50mm Elmar or Summitar lenses, it makes possible the photography of objects at distances from infinity to 15¼ inches, from the back of the camera to the object. A 5x7½-inch area is covered at the closest distance. Still smaller areas are easily covered by inserting any of the extension tubes between the lens and the Focaslide. The Intermediate Focusing Mount gives a variable extension of 7.5mm and can be used as a focusing aid for fine adjustments.

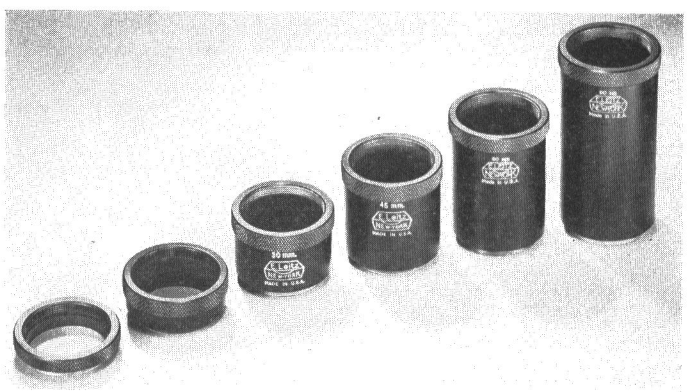
The Infinity Setting Ring · When the Intermediate Focusing Mount is used for normal copy work, the Infinity Setting Ring remains in its usual position at the point of contact between the lens thread of the Focaslide Fixed Plate and the focusing mount. When working outdoors at infinity with the Leica camera on the Focaslide and a tripod, unscrew the Infinity Setting Ring from the Intermediate Focusing Mount in a counterclockwise direction. Attach the mount, without the ring, directly to the lens thread of the Focaslide. Turn Focusing Mount out for sliding clearance then back to proper setting.

The Adjustable Micrometer Extension Tube allows all Leica lenses to be used for copying with the Focaslide. It has a 20mm range of adjustments between a 40mm and a 60mm extension tube. Micrometer indexing of the mount enables accurate settings to be maintained for varying scales of copying work. Adapter Rings are available for all 90mm, 127mm, and 135mm Leica lenses to convert them for use with the Adjustable Micrometer Extension Tube. To make this conversion, the lenses are unscrewed from their regular mounts, the Adapter Ring is screwed onto the threaded flange, and lens and Adapter Ring are screwed into the Adjustable Micrometer Extension Tube.

Extension Tubes · The 50mm lens mounted directly on the Leica camera will focus within 3½ feet of the object. When the Nooky or Nooky-Hesum Optical Short Distance Focusing Devices are placed between the lens mount and the camera body, the distances between the filmplane and object varies from 42 to 16½ inches. But when the Focaslide is used with extension tubes, this lens-to-object-distance can be reduced to less than one inch. The dividing line between reduction and magnification of the object is known as a ratio of 1:1 when the image on the Leica copy negative is the same size as the object area being copied. To obtain this 1:1 ratio, the 45mm extension tube and the 50mm lens are used on the Focaslide. The extension tubes have the same function the bellows has on the view camera. As the distance between film plane and lens increases, the distance between lens and object decreases, with the corresponding decrease in area of the object to be photographed.

The extension tubes available for use with the Focaslide include 7mm, 15mm, 30mm, 45mm, 60mm, 90mm tubes, and the Adjustable Micrometer Extension Tube. These tubes can be used separately or in any combination required by the object to be copied. The Focaslide itself is equivalent to an extension tube of 11.8mm because of the separation between camera and lens mount. The 50mm lens can be collapsed in its mount to give additional variations in focusing. The metal tubes are so light and compact that there is ample working space around the camera when you are photographing small objects.

The table given on page 159 was computed for the 50mm lenses (except the Xenon and Summarit). This table should be consulted for information relating to copy work with the latest-model Focaslide with the engraved triangle mark (△) on the sliding lock. The same table will give approximate information for use with the earlier Focaslide model marked with the square (□) on the sliding lock. For more exact information on the earlier Focaslide, the accompanying formulas can be used for computing ratios and exposure factors. These formulas can also be used for calculating any distances not given in the Focaslide table on page 159.



4. The 7mm, 15mm, 30mm, 45mm, 60mm, and 90mm fixed-focus extension tubes for use with the Focaslide.

Table of Data for Focaslide Used with 50mm Elmar and 50mm Summar

Ratio of Reduction or Magnification	Area Covered in mm.	Distance Back of Camera To Object in mm.	Exposure Factor	Intermediate Focusing Mount and Extension Tubes in mm.	With Intermediate Focusing Mount Calibrations Set at
1:20	460 x700	1138	1.1	Int. F. M.	Zero
1:19	436 x657	1085	1.1	Int. F. M.	Zero
1:18	425 x645	1058	1.1	Int. F. M.	Zero
1:17	392 x594	982	1.1	Int. F. M.	Zero
1:16	368 x555	930	1.1	Int. F. M.	Zero
1:15	345 x522	879	1.1	Int. F. M.	Zero
1:14	320 x485	828	1.2	Int. F. M.	Zero
1:13	300 x450	777	1.2	Int. F. M.	Zero
1:12	275 x420	725	1.2	Int. F. M.	Zero
1:11	250 x380	674	1.2	Int. F. M.	Zero
1:10	227 x345	623	1.2	Int. F. M.	Zero
1:9	203 x310	572	1.2	Int. F. M.	Zero
1:8	182 x275	522	1.3	Int. F. M.	Zero
1:7	160 x244	471	1.3	Int. F. M.	Zero
1:6	137 x206	421	1.4	Int. F. M.	Zero
1:5	125 x185	392	1.4	Int. F. M.	Zero
1:4	70 x105	283	1.8	Int. F. M.+15:	Zero
1:3	48 x 72	242	2.0	Int. F. M.+15:	7.5
1:2.5	38 x 57	223	2.5	Int. F. M.+30:	Zero
1:2	30 x 46	215	2.8	Int. F. M.+30:	7.5
1:15	25 x 40	212	3.5	Int. F. M.+45:	Zero
1:1	24 x 36	208	4.0	Int. F. M.+45:	7.5
1.25x	20 x 30	214	5.0	Int. F. M.+60:	Zero
1:5x	18 x 26	216	6.3	Int. F. M.+60:	7.5
1.75x	13 x 20	232	7.7	Int. F. M.+90:	Zero
1.2x	12 x 18	236	9.0	Int. F. M.+90:	7.5
2.2x	11.5x 17.5	240	10.0	Int. F. M.+90+15:	Zero
2.4x	10.5x 15.5	246	11.0	Int. F. M.+90+15:	7.5
2.5x	10 x 15	253	12.0	Int. F. M.+90+30:	Zero
2.65x	9.5x 14.5	259	13.0	Int. F. M.+90+30:	7.5
2.75x	9 x 13.5	265	14.0	Int. F. M.+90+45:	Zero
2.85x	8.5x 13	272	15.0	Int. F M.+90+45:	7.5
3x	8 x 12	278	16.0	Int. F. M.+90+60:	Zero
3.5x	7.5x 11.5	284	18.0	Int. F. M.+90+60:	7.5
3.8x	7 x 10.5	306	21.0	Int. F. M.+90+60+30:	Zero
4x	6 x 9	312	25.0	Int. F. M.+90+60+30:	7.5
4.5x	5.5x 8	360	29.0	Int. F. M.+90+90+60:	Zero
5x	5 x 7	369	36.0	Int. F. M.+90+90+60:	7.5

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 of magnification distance)

   $\dfrac{O}{I} = \dfrac{F}{D - F}$ = ratio of reduction (as a function of the image or magnification distance)

4. $F^2 = (D - F) \times (B - F)$ = (relation between focal length object and image distance)

   $B = \dfrac{D \times F}{D - F}$ = working distance of object to lens

   $D = \dfrac{B \times F}{B - F}$ = distance of image to lens

5. Depth of field at a given diameter of circle of confusion:

   $A = \dfrac{L \times B \times F}{(L \times F) + C(B - F)}$ = nearest point in focus

   $Z = \dfrac{L \times B \times F}{(L \times F) - C(B - F)}$ = 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 lens diaphragm
D*— Distance of image on film to lens diaphragm
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:

   $$\frac{\text{focal length of lens}}{\text{distance from lens to film plane—minus focal length of lens}} = \frac{F}{D-F} = \frac{O}{I}$$

   Example:

   What is the ratio of magnification obtained when using 60mm and 90mm extension tubes in connection with a 73mm lens (tubes directly on the camera —no Focaslide)?

   $$[60 + 90 + 73 \text{ (lens)}] = D = 223$$

   $$\frac{F}{D-F} = \frac{73}{223-73} = \frac{73}{150} = \frac{1}{2.06} \text{ or } 1 \div 2$$

4. *Distance from lens to object or* (B)
Distance from lens to film plane (D)
(knowing one how to find the other)

Basic forumla: $F = (D—F) \cdot (B—F)$

$$B = \frac{D \times F}{D - F} \qquad D = \frac{B \times F}{B - F}$$

Examples:

What is the distance at which the object is to be placed when a 60mm tube and Focaslide 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 = 11.8mm (Focaslide) + 12mm (tube) + 30 mm (tube)

5. *Depth of field*

The depth of field 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 field 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 field will result in everything being in sharp focus at from 4.75 meters to 5.30 meters.

Lenses for Copying · The 50mm Elmar lens is recommended for use with the Focaslide. However, any of the other Leica lenses, except the 50mm f/1.5, can also be used. The longer focal length lenses such as the 90mm or the 135mm are useful when photographing objects with appreciable thickness, to obtain better perspective. Another advantage in using the longer focal length lenses is that greater working distance between the lens and the subject can be obtained.

Avoiding Vibration · Usually most close-up copy work requires exposures ranging from ½ second up to several minutes. During such exposures vibration of the equipment must be avoided or a blurred image will result. Observe the following points to avoid vibrations:

1. Use a rigid support for the copying equipment.
2. Release the shutter with a Wire Cable Release.
3. When working in a building that transmits the annoying vibrations of passing railroad and subway trains, or trucks, place a sponge-rubber mat under the baseboard of the copying equipment to absorb the motion.
4. When all extension tubes are attached, if necessary, use a support or a 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 fast exposures.

Focusing · All close copy work requires careful focusing to ensure the best results. Most of the Leica copying attachments have ground-glass focusing in combination with magnifiers for critical work. If there is too much stray light falling on the ground glass when one of the magnifiers is not in use, wrap a piece of black paper around the ground-glass housing.

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. Such a stage can be picked up in a secondhand store.

Coarse focusing, to bring the object into fairly accurate focus on the ground glass, you can secure by placing the camera closer to or farther away from the object. To do this, raise or lower the Sliding Arm (to which the camera and copy attachment are secured) on the metal upright bar that supports the equipment. Then make fine adjustments by turning the lens mount, the Adjustable Micrometer Extension Tube, or the rack-and-pinion settings on the bellows copying attachments. Use magnifiers for final checking.

Bellows Focusing Device · This accessory gives a more flexible working range for copying than the extension tubes, although it is not so compact as the Focaslide with extension tubes. Continuous focusing from infinity to 3.5x.

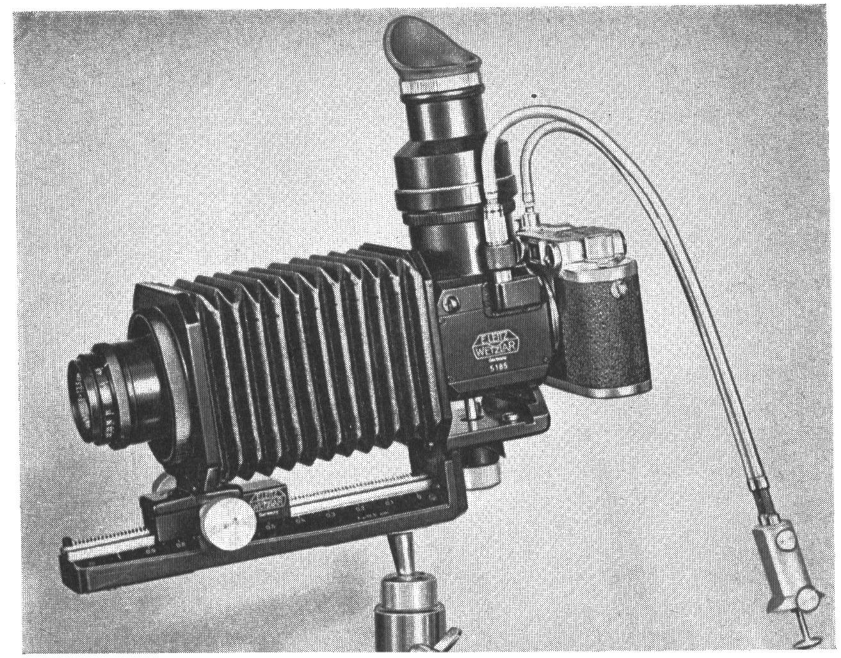
This Bellows attachment is adjusted for use with the 135mm Hektor lens and the Mirror Reflex Housing, and the 50mm Elmar and Summitar with a special Sliding Focusing Copy Attachment. The 135mm combination gives a continuous range from infinity to 1:1 (1x1½ inches), and the 50mm setup is continuous from a ratio of 10:1 (10x15 inches) to a magnification of 2.5x. The reproduction ratio is indicated on the two engraved scales along the base of the attachment. The 35mm Summaron can be used within narrow limits.

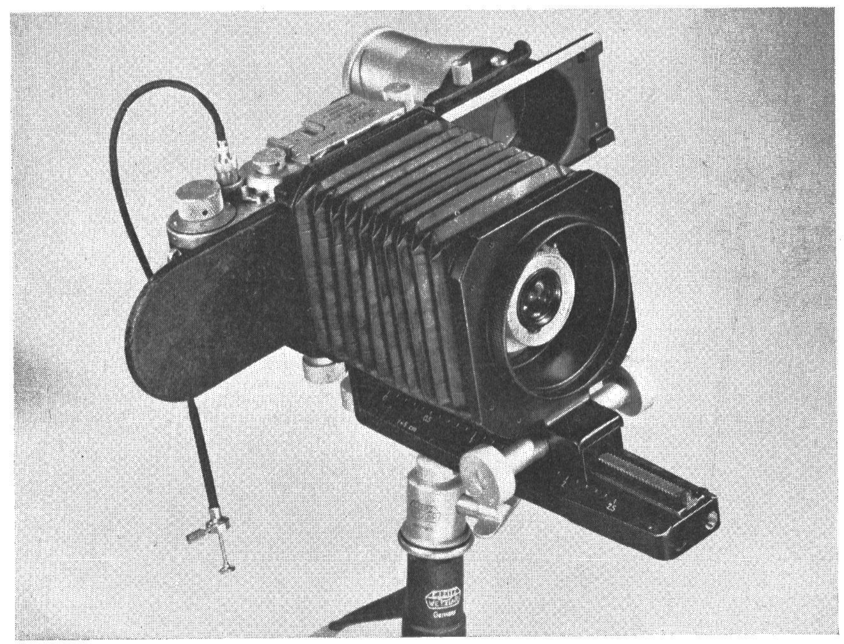
The Mirror Reflex Housing or the Sliding Focusing Copy Attachment is fastened to the bellows by a tripod screw. The camera can be rotated for horizontal or vertical photographs when using this housing. Different adapters are used for each of the lens combinations. The 135mm Hektor is removed from its focusing mount and fitted into its adapter, which screws into the front of the bellows attachment. The 50mm Elmar or Summitar bayonets into its adapters (one for each lens) and this in turn screws into the front of the bellows attachment.

An adjustable bellows-type sunshade is clamped onto the lens and its guide rods fits into the rack-and-pinion base. This shade has a larger opening than the standard shades and can be extended farther from the lens to give greater protection from stray side lights. This bellows-type shade is recommended when photographing against the light and for extreme short-range work when the photographic lights are close to the lens.

BELLOWS FOCUSING DEVICE TABLE

Image size (ratio)	*Area covered mm*	*Depth of field in mm*				*Distance from object to lens in mm*		*Exposure factor*
		f/5.6	f/8	f/11	f/16	*Hektor 135 mm*	*Elmar 50 mm*	
0.1	240x360	41.1	58.7	80.7	117.3	147.3	56.1	1.2x
0.2	120x180	11.2	16.0	22.0	32.0	79.8	30.3	1.4x
0.3	80x120	5.4	7.7	10.6	15.4	57.3	21.7	1.7x
0.4	60x80	3.3	4.7	6.4	9.3	46.0	17.4	2.0x
0.5	48x72	2.2	3.2	4.4	6.4	39.3	14.8	2.3x
0.6	40x60	1.7	2.4	3.3	4.7	34.8	13.1	2.6x
0.7	34.3x51.4	1.3	1.9	2.5	3.7	31.6	11.9	2.9x
0.8	30x45	1.1	1.5	2.1	3.0	29.2	11.0	3.2x
0.9	26.7x40	0.9	1.3	1.7	2.5	27.3	10.3	3.6x
1.0	24x36	0.7	1.1	1.5	2.1	25.8	9.7	4.0x
1.5	16x24	0.4	0.6	0.8	1.2		8.0	6.3x
2.0	12x18	0.3	0.4	0.6	0.8		7.1	9.0x
2.5	9.6x14.4	0.2	0.3	0.4	0.6		6.6	12.0x





5. Bellows Focusing Device. The Mirror Reflex Housing (above) or the Sliding Focusing Copy Attachment *(below)* can be attained as shown in the illustrations.

The Reprovit II Microfilm Equipment · This is designed for more extensive microfilming work with the Leica. It is easy and fast to operate when copying material ranging from 1x1½ to 20x30 inches in size. As noted in the illustration, it consists of baseboard, supporting uprights, sliding copying attachment for holding the Leica, focusing arrangement, illuminating equipment for lighting the copy and focusing, and a special easel for holding the copy flat under glass. The entire outfit can be quickly dismantled for easy transportation.

The 100-watt focusing light, which mounts directly over the ground-glass plate, is an ingenious arrangement for quick focusing and alignment of the copy material. In use, this light projects onto the easel or the baseboard, the rectangular outline of the ground glass and the focusing lines at the center of the plate. This projected-image is brought into sharp focus by raising or lowering the extension arm and adjusting the rack-and-pinion on the front bellows extension. Then all flat copy placed within this projected area will be in sharp focus. The lens is wide-open when making this adjustment. Stop the lens down to a predetermined stop before making the exposure. The operation of the sliding copy attachment on the Reprovit II is similar to that of the Focaslide.

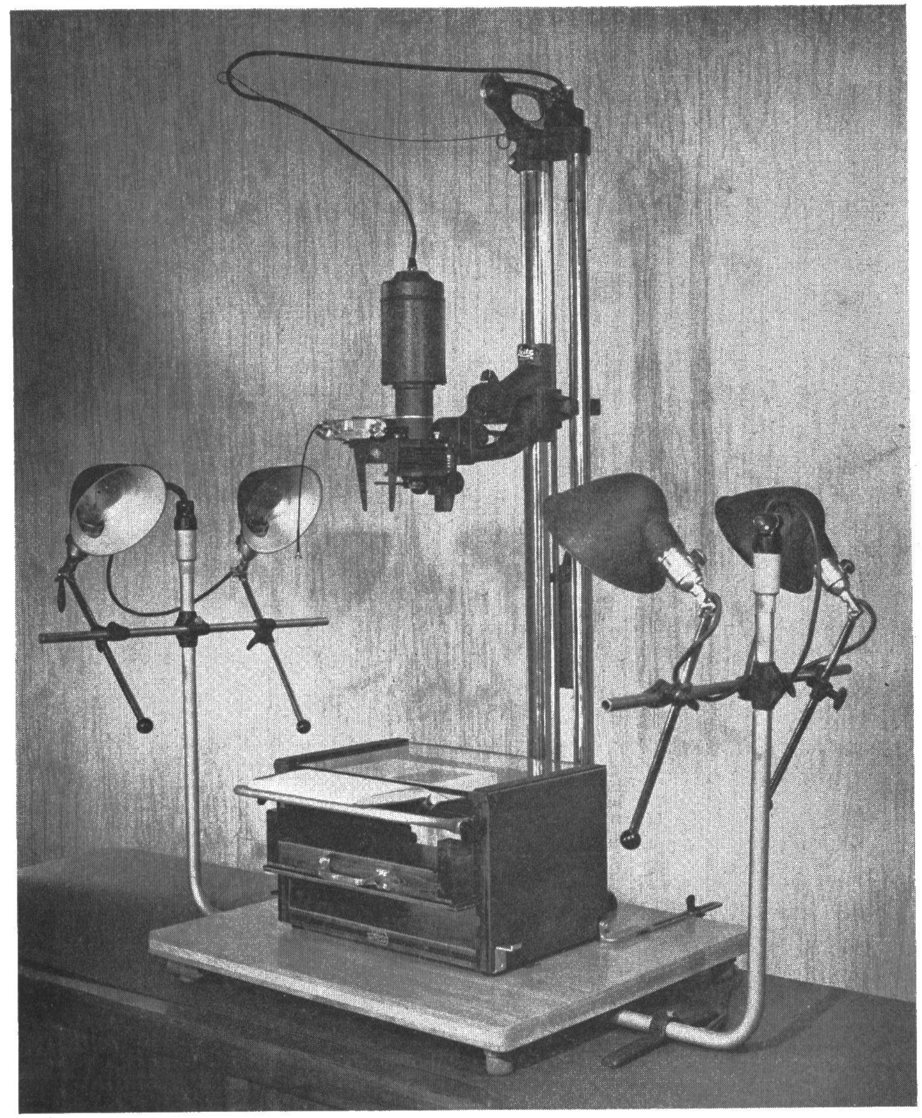
When photographing gross specimens and objects that have greater thickness than sheets of paper make the projected focusing pattern sharp at a point on the object about ⅓ to ½ the distance from the nearest part of the object to the lens. Focus with the lens wide-open and then stop down far enough to bring the entire specimen into sharp focus. If the object is too irregular for you to obtain a sharp focusing pattern, substitute a block of light wood or a white card with cross lines supported at the point desired, and then replace the specimen to be photographed.

A spring-wound steel tape is housed in the Sliding Arm and an engraved index is used for measuring the distance from the object to the camera. This measuring tape is used when making copies at predetermined ratios by referring to the focusing scale attached to the base of the focusing mount. There is a fitting on the Sliding Arm for holding the housing of the focusing light when not in use.

Four copy lights are provided on adjustable side brackets for illuminating the material to be copied. These lights are operated from one master switch, located on the baseboard, and may be adjusted for any angle desired. This switch operates the focusing light in the forward position and the copying lights in the back position. For all average lighting place the lights at a 45° angle to avoid any disturbing reflections on the copy.

The constant level easel will hold flat material up to 10x14 inches. It is an open-box arrangement with heavy glass top, a lower platform sliding in

parallel grooves, an adjustable arm for holding copy that extends over the easel, and a sliding wedge-shaped drawer for adjusting the height of the lower platform. The sliding wedge is operated by a handle and can be placed in any one of 3 grooves to receive books up to 4½-inches in thickness. When



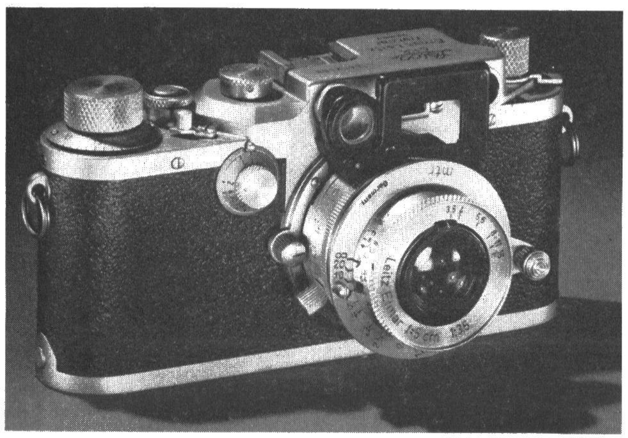
6. The Reprovit II Microfilm Equipment. This copying equipment is useful for quantity production. See text for detailed explanation.

the wedge drawer is pushed in, the lower platform is raised to bring the material against the underside of the glass plate to assure correct placement in the photographic plane.

The Reprovit II can be used for photographing many objects that come within the working limits of the outfit—machine tools, models, minerals, medical specimens, buttons, badges, natural-history objects, and many other materials. For field use the copying head is removed from the clamping arm and the copying attachment placed on a tripod. Focusing is done directly on the ground glass without using the focusing light. For critical results, any of the magnifiers available for the Focaslide can be used.

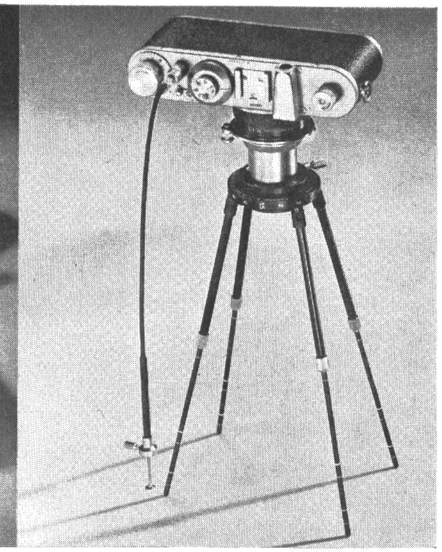
Optical Short Distance Focusing Device • This attachment (code word, Nooky) extends the continuous automatic focusing of the Leica from 3½ feet to within 16½ inches of the object. Distances are measured from the object of the film plane (back) of the camera. One of the Leica 50mm lenses is collapsed in its mount and then the bayonet flanges secured in the receiving flanges of the Nooky. The attachment, with its intermediate focusing arrangement, is then screwed onto the Leica camera ready for use. This attachment has an optical-glass wedge that lies in front of the range-finder window and gives the required deflection of the object rays for close photographic work. The rectangular frame in front of the view finder provides an automatic compensation for parallax and the reduced field of view necessary for close-ups.

The Nooky attachment can be used on Leica Models II, III, IIIa, IIIb, IIc and IIIc. It is intended for use with the 50mm lenses, and two models are available, one for Elmar, and the Nooky-Hesum for the Hektor, Summar, and Summitar lenses. At short distances the depth of field is quite small. Unless very short exposures are called for, it is important to stop down the aperture of the lenses to f/4.5 or f/6.3 to increase the depth of field.



7. Nooky Optical Short Distance Focusing Device. This attachment allows the Leica to be focused between 3½ feet and 16½ inches.

8. The Omifo Reproduction Device with the 90mm Elmar lens operates at a fixed distance from subject.



9. The Behoo Auxiliary Reproduction Device is adjustable for three different fixed-focus areas.

The Omifo reproduction device for the Leitz 90mm lenses operates at a fixed distance of 33 inches to cover a field of 4½x6½ inches. The 90mm lens attached to the Omifo device is left at the infinity setting. Focusing is obtained by moving the camera to or from the subject. The subject is then centered in the view finder.

Auxiliary Reproduction Devices • Leica copying equipment is available for practically every type of work. When compactness and portability are essential, the Auxiliary Reproduction Devices are of special value. These attachments are quickly assembled and set up for fixed-focus copying to cover areas ranging from 1x1½ to approximately 9x12½ inches.

The Auxiliary Reproduction Devices are of two classes, those using intermediate tubes of fixed length between the Leica camera and lens, and those using supplementary lenses mounted in front of the Leica 50mm lens. A detailed instruction booklet is available describing the following Auxiliary Reproduction Devices.

1. *The Belun 1:1 attachment* is used to copy in natural size small objects that come within the 1x1½-inch field of view, such as small coins, stamps, fingerprints, specimens of handwriting, small insects, and portions of larger documents or for clinical uses. The Elmar or Summar 50mm lenses and the Elmar and Summaron 35mm lenses can be used with this attachment. The Belun is not available at present.

2. *The Behoo 1:1.5, 1:2, 1:3 attachment* covers areas from 1½x2¼, 1⅞x2¼, and 2⅞x4¼ inches, with the corresponding ratios of reduction. This device is designed for use with the Elmar 50mm lens. The *Bekur* (not available at present) is a similar attachment for use with Elmar and Summaron 35mm lenses. The Behoo and Bekur devices use three different extension tubes to obtain the three different reductions.

3. *The Beooy attachment* covers areas from 3⅜x5 to 8 7/16x12⅝ inches. This copying device is used with the No. 2 and No. 3 Front Lenses attached to the Elmar, Hektor, and Summar 50mm lenses. The four extension legs and the clamping ring are similar to the Behoo device. The Beooy can be used for photographing flowers, small animals, art objects, and also documents of all kinds. The Bazoo is a Universal Reproduction Device that includes a combination of the Behoo and Beooy devices.

Magnifiers for the Focaslide, Reprovit II, and the Bellows Focusing Device · The following magnifiers are available for image viewing and more accurate focusing on the glass film plane of the Focaslide:

1. *4x Magnifier* · image-erecting and correcting the image from right to left with 90° right angle viewing. Designed for use with Telyt Mirror Reflex Housing but can also be used with Focaslide.

2. *5x Magnifier with Adjustable Collar* · When this is placed in position, draw the eyepiece from the magnifier tube until the hairlines on the clear circular area of the ground glass appear sharp.

3. *5x Large Wide-Field Focusing Magnifier* · This Magnifier allows the entire ground-glass focusing screen to be seen clearly without moving the eye at different angles. To obtain accurate focus, adjust knurled collar of eyepiece until the hairlines on the clear circular area of the ground-glass appear sharp.

4. *5x Magnifier* · with 90° right angle viewing.

5. *30x Focusing Magnifier* · To adjust, pull the eyepiece in or out of the magnifier collar until the hairlines in the clear circular area are critically sharp. This magnifier picks up and magnifies an aerial image, instead of a real image, which appears on ground glass. 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. Therefore the ground-glass image is disregarded when using the 30x magnifier. This magnifier is used only for focusing. When the image is to be properly centered, the 30x magnifier is moved and the image is observed on the ground-glass screen.

Attach the magnifier to be used over the ground-glass screen by inserting and turning in the bayonet catch. It will be noted that the 4 bayonet flanges at the base of the magnifier slip into the corresponding bayonet catches on top of the focusing screen mount. When using the 5x magnifiers, observe the image on the ground-glass portions of the focusing screen.

Leave the lens diaphragm wide-open when focusing, for easier observation of the image, then stop down to f/9 or smaller if necessary. The depth of field is very shallow in close-up photography, but it is increased by stopping down the lens.

Focusing by Measurement · When the Leica is used without the special copying attachments, Nos. 1, 2, and 3 Front Lenses can be used for copying. In this case the Front Lens is screwed over the Elmar 50mm lens and the distance between the object and the film plane of the camera is measured. A booklet of tables is available, giving distances, depth of field, exposure factors, and areas covered. When using the Leica with the Front Lenses, the camera must be attached to the Sliding Arm or to a tripod.

Another method of focusing by measurement is with the various extension tubes placed directly on the camera with one of the 50mm lenses but without the Focaslide. The table on page 159 will give working information for using the extension tubes for this type of copying.

Securing Proper Illumination · The importance of proper illumination of objects to be photographed at close range cannot be overemphasized. 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 that 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 backlights 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 flashbulbs 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 you are 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. Place one or two lights 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 that would ruin the picture, or at least make it fall short of becoming a perfectly illuminated reproduction.

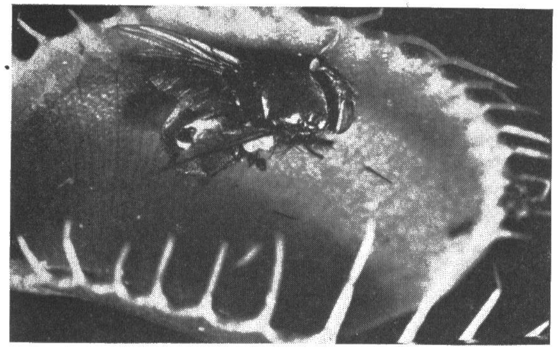
It is also possible to use normal daylight when convenient, although artificial lighting is more constant and easier to control. Sometimes when you are copying in libraries it is not possible to carry in extra equipment such as lights. Here is where it is necessary to use natural daylight. When photographing under such conditions, the full illumination from a window is sufficient. Avoid any cross lighting from other windows that may cast shadows or otherwise cause uneven illumination.

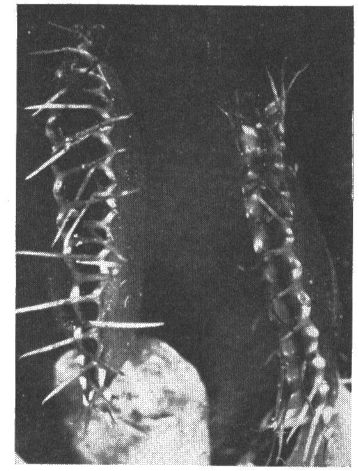
Strong lights are useful when photographing moving subjects where short exposures are required. In some cases the strong lights may cause too much heat or otherwise disturb the subjects. To avoid this, do the focusing with a small light, then when the exposure is to be made snap on the full illumination 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.

VENUS FLY TRAP photographed by Dr. W. M. Harlow with the Focaslide and various extension tubes plus the 50mm Elmar lens. The following description by Dr. Harlow.

In boggy depressions of eastern North Carolina, is found one of the most remarkable insect catching plants known to science — the Venus fly trap. The two lobes of each leaf each act together as a miniature steel trap which closes in less than a second's time when tripped. Along the edge of the leaf at the base of the spines is a "baited" strip that gives off nectar attractive to insects. The amazing mechanism for the closure of the two lobes is activated by three hairs (see picture 4, page 173) on the inner face of each surface. Under ordinary conditions of temperature, it is necessary to "tweak" one of the hairs *twice* within a time limit of about 20 seconds, or any two of the hairs, one after the other! This represents an almost unbelievable complexity of mechanical action to be found in a plant. Furthermore, the trap has two features which make it unlikely that insects less than ¼ inch long will be trapped, or if trapped, retained. The baited strip referred to is so narrow that small insects do not extend from it to the trigger hairs below. Then, when first sprung, the sides of the trap do not close completely (picture 1, page 173) and small insects can escape! However, if the prey is unable to force its way out past the interlocked bars, the sides of the trap (after an hour or more) inexorably flatten and hold the captive closely (picture 2, page 173) while digestive juices consume it.

One morning, I happened into the greenhouse where there were several potted plants of the Venus fly trap, soon after a daddy-long-legs had injudiciously attempted to taste the sweets of the baited strip. Although the sides of the trap had already closed and flattened, his legs were still waving mournfully but futilely in the warm humid atmosphere of the greenhouse!

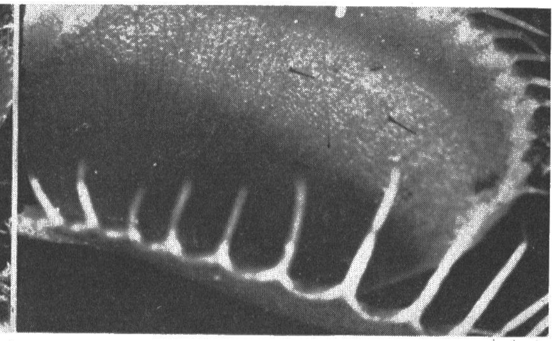


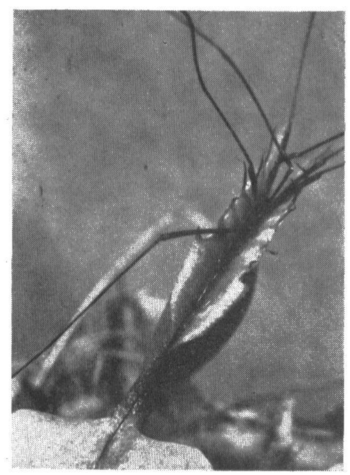


1. *(Above)* A visitor lands and springs the trap.

2. *(Right)* A sprung trap and, far right, several hours later.

3. *(Below)* Venus fly trap growing in natural habit.

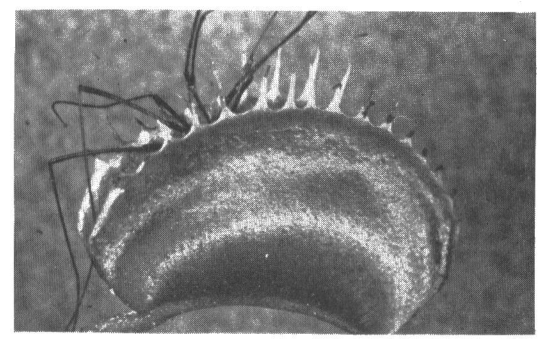




4. *(Above)* The three tripper hairs of the fly trap.

5. *(Left)* Daddy-long-legs caught in trap.

6. *(Below)* Another view showing the Venus fly trap digesting the captive. All photos by Dr. W. M. Harlow.



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 nodal point 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, you can easily determine the exact factors for exposure at different settings by referring to the tables.

The following 6 points must be observed before determining the exact exposure time:

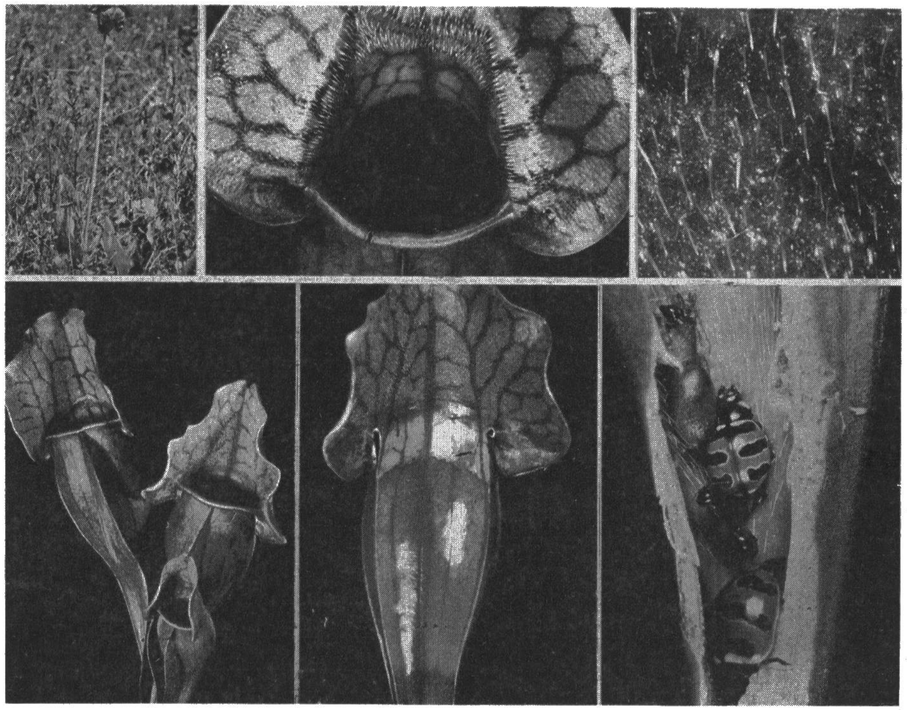
1. Intensity of the light used
2. Diaphragm stop to be used
3. Speed of the film
4. Multiplying factors of any filters used
5. Character of the object to be copied, whether dark or light, rough or smooth
6. The distance between the lens and the film, which determines the exposure factor for reduction or enlargement.

When photographing very small objects it will be found that it is difficult if not impossible to get a reading on the exposure meter that 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 about 5 x 7 or some other material of a brightness or a 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. Place a short length of film in the Leica magazine and expose 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 that 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 4 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 that 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 timesaver and also will help produce perfectly exposed negatives when the good roll of film is used.



II. THE PITCHER PLANT photographed by Dr. W. M. Harlow with the Focaslide. *(Top left)* Pitcher plant growing in bog. *(Top middle)* Mouth of the pitcher. *(Top right)* Enlarged view of the spines on the landing flap. *(Left)* Three of the pitchers. *(Center)* A lengthwise section of a pitcher plant showing the curled edge bearing nectar glands, the landing flap covered with spines, the glass-smooth sides of the pitcher, and the absorbing zone at the bottom. *(Right)* The base of a pitcher, sectioned to show its insect catch.

The pitcher plant is a marvel of design and perfectly adapted for guiding unwary insects to the brink of a glass-smooth precipice, down which they may plunge into the pool of rain-water at the bottom. Along the lip or edge at the top are nectar glands which give off a perfume attractive to insects which land and find themselves upon a surface bristling with small spines all directed toward the abyss! The walking insect finds it easier to go with the pricks instead of against them, and this seals its fate. At the bottom, below the highly polished section, is the "absorbing" zone where it is presumed that the plant may take up minerals or nitrogenous products from the decomposing insects it has caught.

When you are copying, always keep accurate written records of exposures and notes about filters, diaphragm stops, illumination, ratios, and other points. After each roll of film is developed mark the perfect exposures in your record. After a number of rolls have been exposed and recorded make a master exposure table for future reference.

Films Used in Copying • When selecting a film for copying 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 after development the finished negative looked flat without much contrast. 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 4 main classes as follows:

1. Slow positive films
2. Orthochromatic films
3. Slow panchromatic films, such as Microcopy, Panatomic-X, Micro-File
4. Fast panchromatic films
5. Color 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 in copying colored objects when correction filters are to be used. Use Microcopy or Micro-File for this purpose.

Use positive film for copying printed matter such as books, newspapers, charts, maps, line drawings, and objects that 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 that prints black when making an enlargement. 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 Microcopy or Micro-File for copying multicolored printed matter, blueprints, whenever correction filters are to be used for obtaining special effect or more contrasty results. For example, a snappy black-and-white reproduction may be required from an old news-

paper yellowed with age. How can you obtain the proper results? To do this, simply use Microcopy or Micro-File film with a No. II or III yellow filter. If still more contrast is required, use a Wratten G, orange-red, or even a light-red (A) filter.

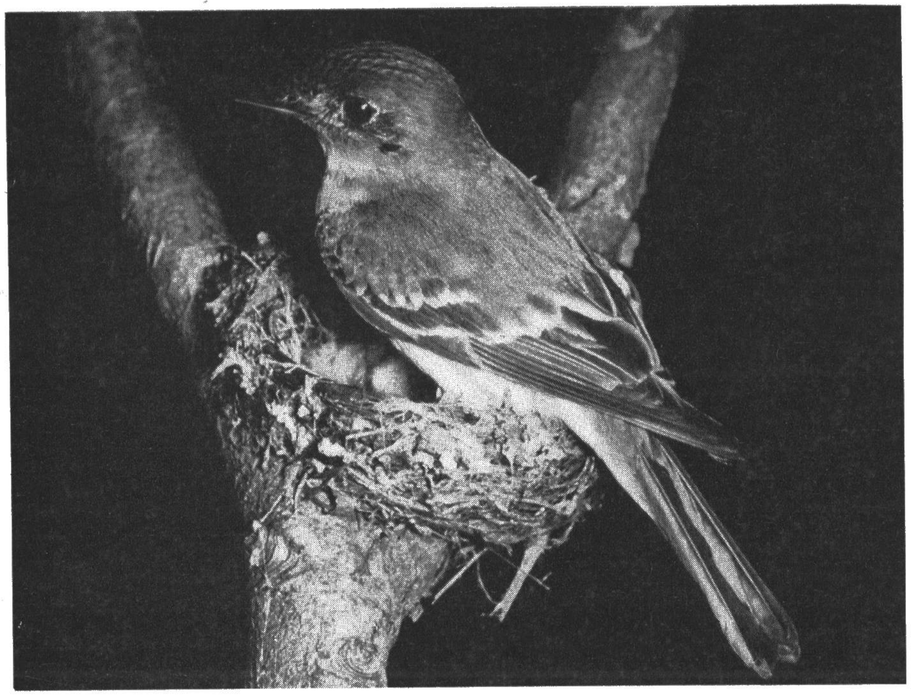
When copying a miscellaneous collection of subjects that may require some color correction along with others which do not require any, Microcopy or Micro-File films are recommended as the most practical films for all-around use. These films can be used without filters for the ordinary black-and-white copying.

Use the medium-fast panchromatic films, such as Panatomic-X or Plus-X for copying paintings, moving objects that 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 that require faithful reproduction of the delicate color gradations.

Use the color films, such as Kodachrome and Ansco Color, for copying originals in natural colors. Such materials can be used very successfully as lantern slides.

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 Microcopy or Micro-File 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 Kodak D-11 solution. Develop the positive film for the full time specified. 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 exposure and complete development. Of course you can watch the development of positive film under a red safelight and slightly underdevelop the film if you see that the exposures were too heavy. However, the finished enlargements from such negatives will not have the snappy quality that can be secured by full development of a perfectly exposed negative.



WOOD PEWEE Edward A. Hill

In still photography of birds remote control is essential 99 per cent of the time. The Leica with Focaslide mounted on a tree clamp or tripod are placed close to the nest to create as large an image as desired. A solenoid is attached to the release button with an extension line for remote control. In a majority of cases it will be advisable to use flash even on sunny days, for birds' nests, other than shore birds, are always located in shaded positions most of the time. Unless flash is used the depth of field desired can seldom be achieved. I use the No. 31 focal plane flashbulb, blue dipped, with daylight Kodachrome, nothing else. The above photograph was made with this set-up, using a 135mm Hektor lens.

MICROPHOTOGRAPHY WITH THE LEICA

BEAUMONT NEWHALL

For the scientific, historical, or literary research worker, the Leica provides a means of quickly making exact and inexpensive records of written or pictorial material. Documents can be photographed in their entirety at distant libraries on field trips and read months later in the scholar's study with perfect assurance that not a word has been misspelled, not an *i* left undotted, not a *t* uncrossed. Every student can possess a picture library for the illustration of his writing. Instead of typewriting sections of books selected for quotation, the researcher with a Leica will insert in the manuscript a facsimile of the printed words. Handwriting on unique documents owned by institutions on both sides of the Atlantic can be compared in needle-sharp enlargements. Notes, drafts, manuscripts laboriously prepared, can be duplicated on film for preservation against loss or destruction. Work in progress can be photographed and mailed for a few cents to colleagues all over the world, for their study and criticism. And besides these specialized uses, the researcher can use his Leica to take photographs of people, foreign places, things of interest—or just for fun.

To get the most out of your equipment, you must bear in mind that your goal is to produce *records,* not *pictures.* Provided the records are readable, they are usable and valuable. By standardizing your working procedure you will find that you will master what may seem a complicated technique.

Most research photography falls into one of three general classes, and each demands a special technique. *Class 1* comprises single pages, individual letters, or short articles that the researcher in the course of his reading would like to record in the quickest way for future reference. With the Leica, these can be photographed at the researcher's desk with no more equipment than a fixed-focus close-up device, such as the Beooy Reproduction Device, which is held in the hand. Provided they are to be used as notes, you can take the negatives by the normal illumination of your worktable or library desk. They are best kept in envelopes in strips of 6 frames.

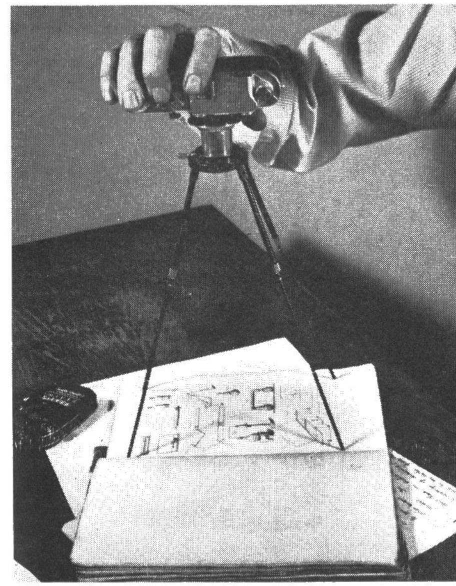
Class 2 includes whole books, large collections of letters, photographs, lengthy manuscripts, and other material requiring the taking of a large number of exposures at one time. This type of microfilming demands a vertical support for the camera. The negatives are best kept on rolls; they may be viewed in a microfilm projector. Prints can be made for filing of any required portions. I recommend the Reprovit II for this type of copying.

Class 3 calls for the making of a facsimile reproductions for the illustration of the researcher's writing. Equipment is needed for ground-glass focusing such as the Focaslide, and for careful lighting of the subject.

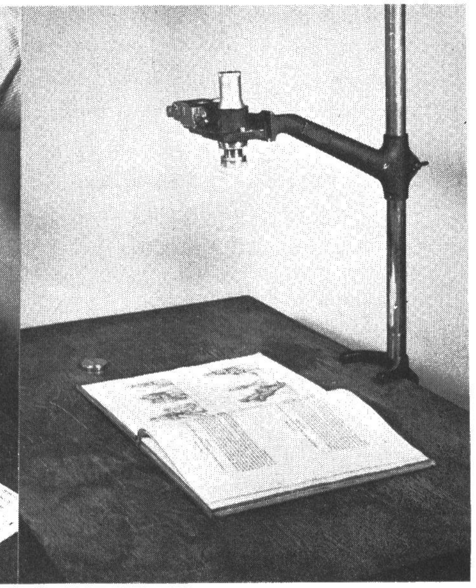
Although these classes overlap, you will find it helpful to keep them in mind. It might seem ideal to make every photograph so good that it could be used for both reproduction and study. This, however, necessitates taking complete equipment everywhere, and adds needlessly to the time consumed in photographing. As will be seen, it is much more difficult to make a facsimile than to make a memorandum record. The difference between Class 3 and the first two classes is the difference between a scholar's final, polished manuscript and his notes, which, though accurate, detailed, and valuable to him, are not intended for publication.

Equipment for Copying • The equipment for hasty notetaking is simple: a Leica (any model), a photoelectric exposure meter, and the spiderlike device known as Beooy in the Leitz catalogue. This consists of an extension tube, a ring to encircle the lens, and four legs of adjustable length that screw into it. When extended, the legs describe a rectangle of about 5 x 7 inches. With the extension tube in place, the tips of the legs mark the exact plane of focus. Anything the legs rest on, therefore, will be rendered needle-sharp in the negative. Leica, Beooy, and exposure meter all slip easily into a brief case. When researching you find something in your reading that you want to record, put the spider legs on the page of the book, press the Leica down firmly with your hand, and squeeze the release button (set to Bulb) for as many seconds as the exposure meter indicates. You do not need to move from your chair; ordinary illumination will give a film record that you can read easily. If the material to be recorded is larger than 5 x 7 inches, make several exposures, each overlapping the other.

The results of this simple photography will not, of course, compare in superficial appearance with work done with more care, but every letter will be distinct and every detail will be visible. With this technique I photographed, in less than an hour, right in the stacks of a Boston library, every reference to daguerreotypists in New England directories from 1840 to 1861. I made prints for my files from the negatives, stapling together those which over-



1. The Leica Beooy is a fixed-focus attachment useful for quick copy work.



2. The Focaslide mounted on the enlarger upright by means of the Sliding Arm.

lapped, just as aerial photographs are made into mosaics. Then I wrote a card for each name to add to a directory of daguerreotypists. The microcopies themselves were filed by towns and automatically formed a geographical index. To have transferred this data by hand would have involved several days' living expenses and doing the copying twice—once for the biographical and once for the geographical file. And photographing with the Leica actually took less time than writing out orders for conventional photo-duplication!

For this type of work, done under almost any kind of lighting, moderate-speed panchromatic film is best. Exposure is less critical than with the slower, high-contrast films recommended for facsimile copying.

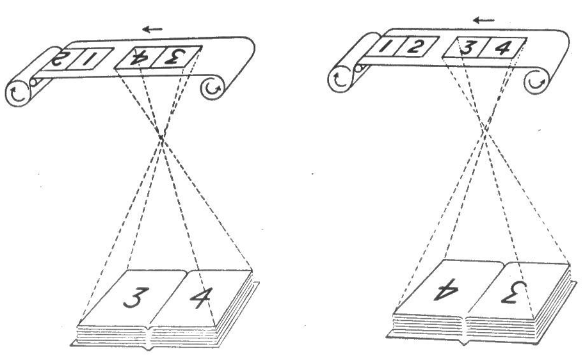
To keep track of exposures, use every sixth frame to record a page in a 3 x 5 inch spiral-bound notebook on which is written the title and the source of each document. After processing, cut the film into strips and file them in glassine envelopes. Give each strip a number, and each frame a letter. Thus MF 56C will refer to frame 3 of strip No. 56. The negatives can be read directly with a high-power magnifier, such as a linen tester, or by projection, if reference to them is too infrequent to warrant making prints.

The most efficient way to photograph entire books, collections of documents and the other material grouped in Class 2 is to support the Leica over them. A sliding arm is supplied to which the Leica can be screwed and which will fit over the upright column of the Valoy or Focomat enlarger. Rule a rectangle approximately 9 x 12 inches on the table, its center at the point of a plumb bob dropped from the center of the lens. Rule the rectangle into 1-inch squares, or fill it with ready-ruled paper. The exact height of the Leica, and the type of supplementary lens or the length of extension tube with the Focaslide needed to bring the rectangle (and what lies within it) into exact focus, can be determined precisely from the data given in chapter on Copying and Close-up Photography.

For the greater part of your work there will be no need to change focus. You will seldom encounter documents larger than 9 x 12 inches. If you do, you can refocus the Leica or you can photograph the document in sections. Documents smaller than 9 x 12 inches, even though they may occupy only a small part of the negative, will be recorded with entirely satisfactory detail. If prints are required of any negative, by setting the enlarger to a magnification of 9 times you can get microcopies of the original size. You will save time in the darkroom by adopting the fixed-focus policy. By maintaining this standard, optimum, degree of reduction, the task of microfilming is greatly simplified. Troublesome calculations of extension factors are eliminated. The focus is always exact, and the work is speeded up.

In photographing objects that have a thickness of more than ¼-inch—the pages of a thick quarto, for example—it will be necessary to change focus. The thickness is measured and subtracted from the standard elevation of the camera. From the tables in the chapter on Copying and Close-up Photography you can calculate the exact distance setting quickly.

If you anticipate much book copying, the newly introduced Reprovit II will speed up the work. Focusing is accomplished by projecting a target on the page of the book, which itself is held in a clamping box. The device is completely self-contained, with its own lighting.

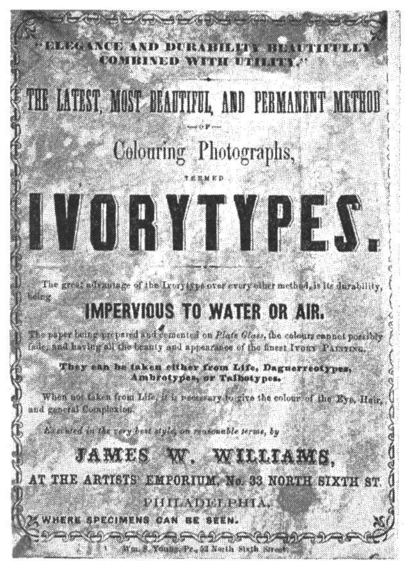


3. Diagrams showing right and wrong methods of copying book pages. Incorrect on the left. See text on page 183 for further information.

Films of Class 2, on which are recorded many exposures of the same or closely related documents, are best kept uncut in rolls. Use one frame for recording an identification number, written on scrap paper with a marking crayon in figures several inches high—big enough to be visible in the negative to the naked eye. It is safest to reserve the first exposure for this purpose. Then you can make exposures until the take-up knob of the Leica will turn no longer.

If bulk film is loaded into the Leica film magazines, the edge numbers of the film may not coincide with the exposure numbers. It is wise, therefore, to allow room in the margin of the exposure record book to insert the actual frame numbers after they have been determined from a study of the developed film. A convenient way of designating any given frame in a roll is to use a fraction, with the numerator the roll number and the denominator the frame number. Thus MF 56/41 indicates the 41st *numbered* frame of roll 56.

Books up to a large octavo size are best photographed two facing pages at a time. Take care to place the book so that the right-hand pages will be recorded in consecutive order. With the top of the Leica facing you, and the take-up knob at the *left,* have the book upside down. Otherwise the film-strip will record the pages in the order 2, 1, 4, 3, 6, 5 . . . as shown in the diagram (Fig. 182).



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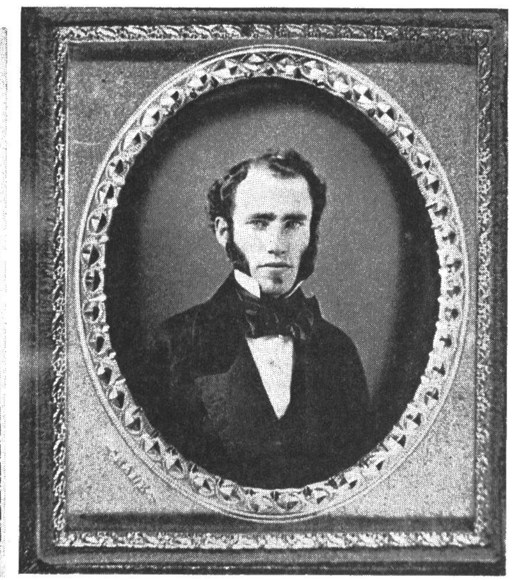
4. Broadside in American Museum of Photography, Philadelphia. Taken in daylight with Beooy close-up attachment.



5. Copy of a daguerreotype originally made by Luther Holman Hale, Boston, about 1850. Taken with two sidelights and Focaslide attachment. Baffle of black velvet around lens to kill reflections.

To support the book while it is being photographed, you will find an assortment of small wooden wedges and thin blocks of wood helpful. (These are not necessary when you are using the Reprovit II outfit.) You can persuade the pages to lie flat by encircling the outer margins and the back of the book with rubber bands, but a more efficient device is to use the weighted tapes with which medieval scribes held parchment in place. To one end of a 2-foot piece of cloth tape, or string, tie a weight, such as a lead fishline sinker. Fasten the other end behind the book page and let the weighted one hang over the edge of the worktable. To turn the page, simply lift the tape.

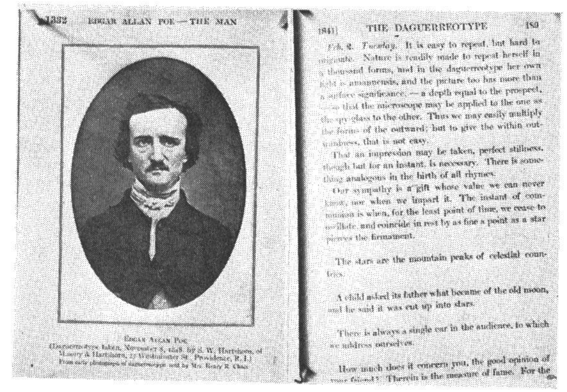
If you are photographing in a well-lighted room, you do not need special illumination for the making of study records. Medium-speed panchromatic film developed about half as long again as the manufacturer recommends for normal photography gives negatives that are ideal for viewing by projection. Prints from them on high-contrast paper, although somewhat gray, are perfectly readable.

However, for illustration purposes, where high fidelity is essential, this technique is not satisfactory. Individual attention must be given to each exposure. For linework, use high-contrast film, such as Kodak Micro-File or Ansco Micropan. These emulsions have the advantage that they yield negatives that are black-and-white, and the disadvantage that the exposure latitude is so short that errors of measurement and judgment will cause failure.

To get the best possible results with this material, you will need a degree of reduction as small as possible. Refocus the Leica for each variation in the size of the original. Although it is possible to do this by calculation, the Focaslide device is so much more efficient that it may be considered indispensable. The original is visible on the ground glass of the Focaslide. Secure exact focus by the aid of a 5x or 30x magnifier. Then slide the camera into the place occupied by the ground glass, and make the exposure.

Special lighting is necessary in order to make the illumination over the entire document even, for any unevenness will be grossly exaggerated by the high-contrast film. Direct at least 2, preferably 4, bowl reflectors on the field. Adjust them until a photoelectric light meter shows the same reading on every area of a neutral-gray card covering the field. The illumination need not be intense however; indeed better results are ofter secured by a long exposure under weak light.

The light meter will give an indication of the correct exposure, but the character of the document must be taken into account. Paper yellowed with time takes a longer exposure than the coated paper of a book published yesterday. Newsprint absorbs light deceptively fast. No factors can be given,



6. Hasty copy of illustration of a daguerreotype of Edgar Allan Poe, from the biography by M. E. Phillips. Taken with Beooy fixed-focus device, hand-held. Note shadow of legs in corners.

because the character of the illumination is another variable. The solution is the old adage: "Trial and error teaches, tells." Collect sample documents of all classes you intend to photograph. Make 5 exposures of each, varying the exposure by half a stop—marking down, of course, each variation. A session with the enlarger will quickly show you which stop is optimum for each class of material.

Documents are often on colored paper, or on paper that has become yellow. To photograph them so they will appear black on white, theoretically, a filter of the same color as the paper should be used. Fortunately, gelatin filters are inexpensive and perfectly satisfactory. Mounting them between cardboard rims, you can fit them into clip-on filter holders of the conventional type.

For continuous-tone material—halftone illustrations in books, lithographs, photographic prints, daguerreotypes, ambrotypes, tintypes—use either positive film or low-speed panchromatic films (Kodak Panatomic, Ansco Finopan). The positive is the cheapest. It is also the slowest, and it is color-blind, so that reproduction of color pictures will be distorted.

Daguerretotypes present no problem if you remember that they are literally pictures on mirrors. The highly polished silver copper base itself forms the shadows; mercury amalgam forms the highlights. When a dark field is reflected by the bare silver, the shadows appear dark. Hide Leica, Focaslide, and shiny metal parts behind a black screen. Cover a piece of stout cardboard about 2 feet square with black velveteen. Cut a hole about 1-inch in diameter in the center of this baffle. During exposure hold the baffle under the lens by a clamp around the upright column that holds the camera. Daguerreotypes are deceptively low in contrast and require 50 per cent increase in developing time, so do not take them on the same film with other material.

Faded photographs that, by exposure to sulfur dioxide in the atmosphere, have become pale-yellow and have lost detail in the highlights, yield excellent copy negatives on the high-contrast film intended for linework only.

Copying Music · An interesting application of microfilming is its use to reproduce complex musical scores from ancient handwritten originals. Dr. Edward E. Lowinsky, the music historian traveling in Italy on a Guggenheim Fellowship, finds that the ability to make microfilms on the spot . . . "has changed opportunities for research beyond the scholar's boldest dreams. In the old days the student of music would have to sit for hours and hours in libraries and archives in order to copy by hand a few musical pieces.

"To be sure, a man of means could employ a professional copyist. But whether he did that or whether he copied the music himself, he was always confronted by the same dilemma: in studying the score . . . how was he to determine whether he had to do with the original design of the composer or the copyist's mistakes?

"Today the easy and fast procedure of microfilming permits the musical scholar not only to make hundredfold use of his time, but it enables him to take a copy of the original with him. Now in the years to come he may study the original manuscript at his leisure and right in his own study.

"There is another even more vital aspect of microfilming of important manuscripts. The serious deterioration of countless numbers of unique musical codices is alarming. In many cases the ink has corroded the paper . . . whole pages have become illegible or have even fallen apart. For many reasons, particularly lack of facilities and economical means, these precious manuscripts cannot be restored. Photography offers the only means of preserving what is still intact. . . .

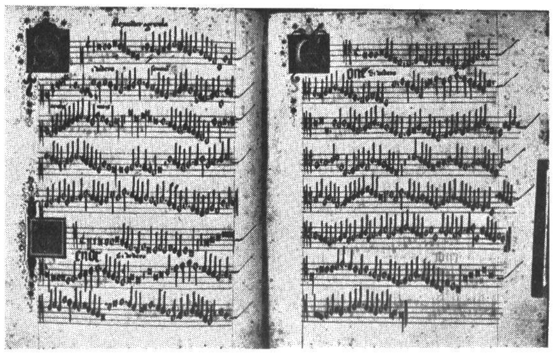
"Portable microfilm apparatus, of the type designed for use with the Leica camera, is bound to revolutionize humanistic, historical and artistic studies to a degree fully comparable with the invention of printing. In earlier times the study of unique and unpublished sources was possible only to the select few among scholars who had either considerable private means or who happened to receive substantial grants. Now, thanks to the microfilm, it will be possible in the foreseeable future for every scholar to gain access to the sources themselves without the expenses of a long trip."

Color · Many researchers, particularly art historians, require records in full color. The Leica is ideal for this purpose, because color transparencies are most economically made on 35mm film. The procedure does not differ from the use of black-and-white film, except that the type of illumination is critical. Details are given in the directions furnished with the 35mm color films available in the United States at the time of writing: Kodachrome and Ansco Color. It should be pointed out that it is impossible to compare a

transparency with a painting; the quality of transmitted light is quite different from that of reflected light. A point-by-point comparison of a color slide and a painted canvas is therefore impossible. Your best approach is to photograph the painting as an object, rather than as an image, lighting it so that the impasto of the paint is visible in relief and including the frame.

In many museums, the Leica has become the indispensable tool of the cataloger. It is often impossible to describe a work of art, a natural-history specimen, or a relic of the past by words alone; photographs mounted on catalog cards provide positive identification. Furthermore, such a pictorial inventory puts on record the condition of the specimens at the time they were received by the museum. For this work it is wise to group the material roughly into categories. Photograph flat objects less than 2 feet in their greatest dimension with the Leica mounted above them, on the sliding arm and upright. Large pictures can be placed on an easel and the Leica on a tripod. Pieces of sculpture, miscellaneous art objects, and other three-dimensional specimens usually appear to advantage with one strong light placed fairly high and at about 45° from the camera axis, with a weaker light to fill in the shadows. Nicety in the placing of the lights is not required for identification photographs. The background should be continuous and undistracting; brown paper pinned to the wall and brought out to the edge of a table in a smooth curve is ideal. It is a good plan to include in the picture a scale marked in inches, centimeters, or both.

While contact prints from the 35mm negatives are adequate to provide identification, slight enlargements are preferable. An illustrated catalog—if the prints are large enough to be studied without a magnifier—saves needless handling of originals. For example, the Museum of Modern Art has a large collection of posters that are stored in cardboard tubes, properly numbered. Without an illustrated catalog, the curator would have to spend hours care-



7. Early handwritten original of a musical composition copied with the Focaslide by Dr. Edward E. Lowinsky. See page 186 for additional information.

fully unrolling each poster to make selections for an exhibition. By referring to the catalog card he can accomplish this task in a matter of minutes.

Theoretically, the negatives of identification prints should themselves be cataloged. Practically, it is less expensive to discard them and to rephotograph the originals on those rare occasions when duplicates are needed. You will quickly discover that photographing is the simplest part of microfilming. The bookkeeping is time-consuming.

Material that is lent by a museum, a library, or a researcher can be photographed with a Leica in less time than a written record can be made. Illustrations submitted with a manuscript, books on loan, entire exhibitions, can be quickly photographed with the Leica set at a fixed focus. Often the negative will serve as a substitute for the material while it is on loan.

The same Leica that is used to make pictorial inventories and microfilms for the researcher's files can be used to produce lantern slides for lecture purposes. Paul Vanderbilt has described (*Journal of Documentary Reproduction,* December 1941) the production of slides at the Philadelphia Museum of Art. By a most ingenious system of standardization and controls, a completely inexperienced cameraman with 3 assistants was able to produce and catalog from 1200 to 1500 slides (2x2) a month, at a cost to the museum of about 16 cents apiece—much less than the cost of slides made by conventional means. The secret of this impressive production lies in the adoption of a uniform exposure for similar types of material, and in the use of a motion-picture printer to produce the positives.

The private collector will find the Leica as valuable as the public institution. No matter what you collect, an illustrated catalog will add to the value of your collection. And with the Leica anybody can become a collector. Most libraries and museums will allow photographs to be taken of objects in their collections and will provide the serious visitor with a place to work. But it is not always necessary to go far afield. Every family has, tucked away in bureau drawers or tied up in bundles in the attic, family photographs of the last hundred years. With the Leica these can be copied to a uniform size and duplicated, so that every member of the family can have a set.

Sixty years ago, P. H. Emerson set down in his *Naturalistic Photography* some of the things that "this cool young goddess, born of science and art" might accomplish. "She twits the librarian," he said, "with the ever increasing deluge of books, and hints laughlingly they must one day come to her, for she will show them how to keep a library in a tea caddy." This prophecy has come true with the development of the 35mm still camera.

COLOR PHOTOGRAPHY

HENRY M. LESTER

Regardless of your present position on the ladder of proficiency in color photography, the pleasures of photography in natural color are entirely yours with a Leica camera. The field of color photography is wide open to you, with a promise of excellent results from the very start. For there is only one condition to be met: Follow the simple, but necessarily inflexible, exposure directions. And these are just that simple:

> *On a bright sunny day, with the sun anywhere behind you, set your camera shutter to 1/60 second and your lens to f/6.3. Point your Leica and focus it on the subject. Take the picture . . . you will get it!*

1. DOUGLAS FIR — Dr. W. M. Harlow

This simple method is good enough to get you started and to prove to you that excellent color pictures are easily made. As you go along you will learn that refinements and elaborations of this procedure will make your pictures better and more pleasing, pictures that will eventually reflect your own conception of what fine color renderings should be. Many Leica owners use color film to photograph members of their families, especially children, to record their holiday activities, and to preserve views of environment—the homes they live in, people they have met, places they have been to. Others have discovered that color transparencies can be an important aid in their business, professional, or vocational pursuits.

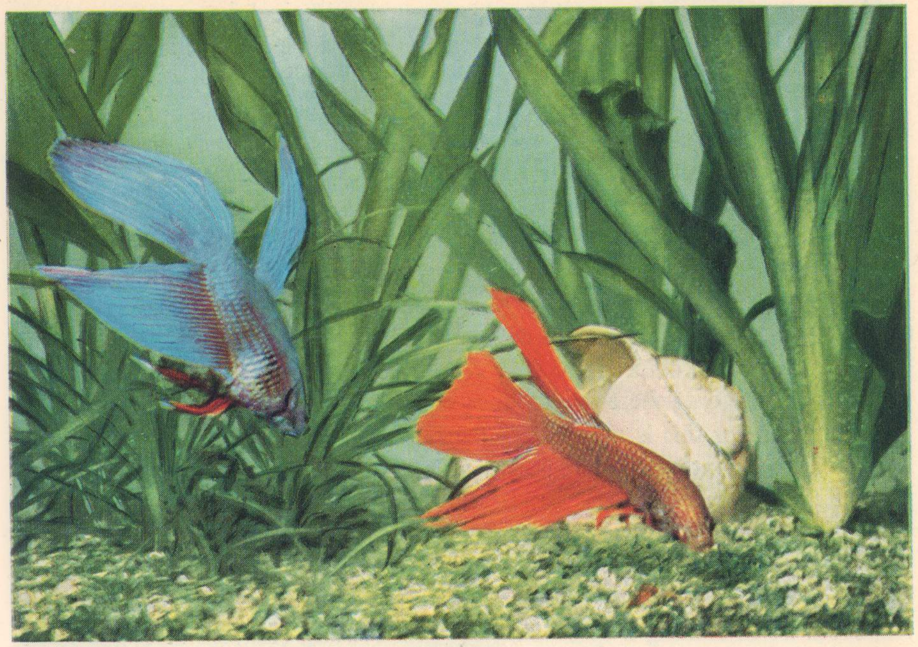
The ease with which color transparencies can be made, their small size, their slight bulk and weight, have added greatly to their wide use. Thus, merchants selling oriental rugs, designers and producers of fashions, art galleries, flower growers, and other business people have found it easier, more economical, and newer and more interesting to have their products reproduced in color transparencies. These pictures are then sent to faraway places where they can be viewed conveniently, leisurely, and be discussed by groups of interested people.

Possibly no other profession has accorded such wholehearted and universal acceptance to natural color transparencies as have medicine and surgery in all of their many branches. Color slides are "just what the doctor ordered," and actually a volume could be written about the various applications. (See the chapter on Medical Photography in this volume.) Other applications include visual teaching, lecturing, industrial and professional demonstrations, and travelogs. Collectors of minerals, flowers and plants, insects, and curios, find color transparencies of their specimens extremely valuable for showing their collections to others.

Color photographers can send their exposed films away for processing or do their own finishing. Ansco Color Films can be ready for viewing in as little as two hours after exposure. Others can do their own color printing by direct enlarging on Ansco Printon, or by the Kodak Dye Transfer method. This latter is somewhat more complicated, but since it allows better control, yields more pleasing prints. And then there are people who like to make exquisite carbro prints in small or heroic sizes—the ultimate in beauty and quality.

Color photography with the Leica camera can be simple. But the knowledge of its principles and some of its more complicated aspects will be found useful for obtaining pictures of subjects that require a special approach either because of their nature or because of adverse or unusual light conditions.

Joseph Nicéphore Niepce, writing in May 1816 to his brother Claude, mentioned that one of the problems he had yet to solve, and to which he intended to apply himself in the future, was the "fixation of the colors." This is probably



2. BETTA FISH. A Focaslide attachment was used for this close-up view, and the exposure made after waiting for the fish to arrange themselves attractively within the field. 90mm Elmar, f/18, 1/40, Press 40 flashlamp in Leitz VIIIa Flash Unit, Kodachrome film. Photograph by Howard E. Foote, FPSA.

the earliest reference in literature to color photography, though Niepce was not destined to achieve any measure of success in his investigations.

This was not because of any ignorance of the fundamentals of color photography. The work of Thomas Young in 1807 had established the fact that all color perception is the result of three color sensations, singly or in combination. That is, every color that can be perceived by the human eye can be visually duplicated by mixing, in the proper proportions, red, green, and blue light. Every successful color process is based upon this principle.

From Schinzel, in 1905 (nearly a hundred years later!) came the proposal of a film coated with three emulsion layers, each sensitive to a single primary color. By that time, advances in emulsion manufacture had resulted in sufficient knowledge of color sensitizing to make such a proposal theoretically capable of fulfillment. Yet it was not until 1935, when Kodachrome film was introduced, that a practical multilayer film was manufactured for general distribution. Since that time, several other films of comparable construction have been made available by other manufacturers, in the United States and abroad.

Monopack Principles • It is not, of course, sufficient merely to coat three differently sensitized layers of emulsion on a film base in order to make a color film. Two basic conditions must be met.

1. Each layer must be sensitive to one primary color and one only. If this is not possible, means must be provided to ensure that only light of a single color reaches any one layer.
2. It must be possible to develop each layer in such a manner that a color image is formed which is complementary to the color to which that layer is sensitive. No mixing or wandering of colors can be permitted.

The first condition is met by the proper choice of emulsions, sensitizers, and the order in which the layers are coated. Figure 3 shows a magnified cross section of a typical color film. It will be noted that four layers are required, though only three of these are composed of light-sensitive emulsions.

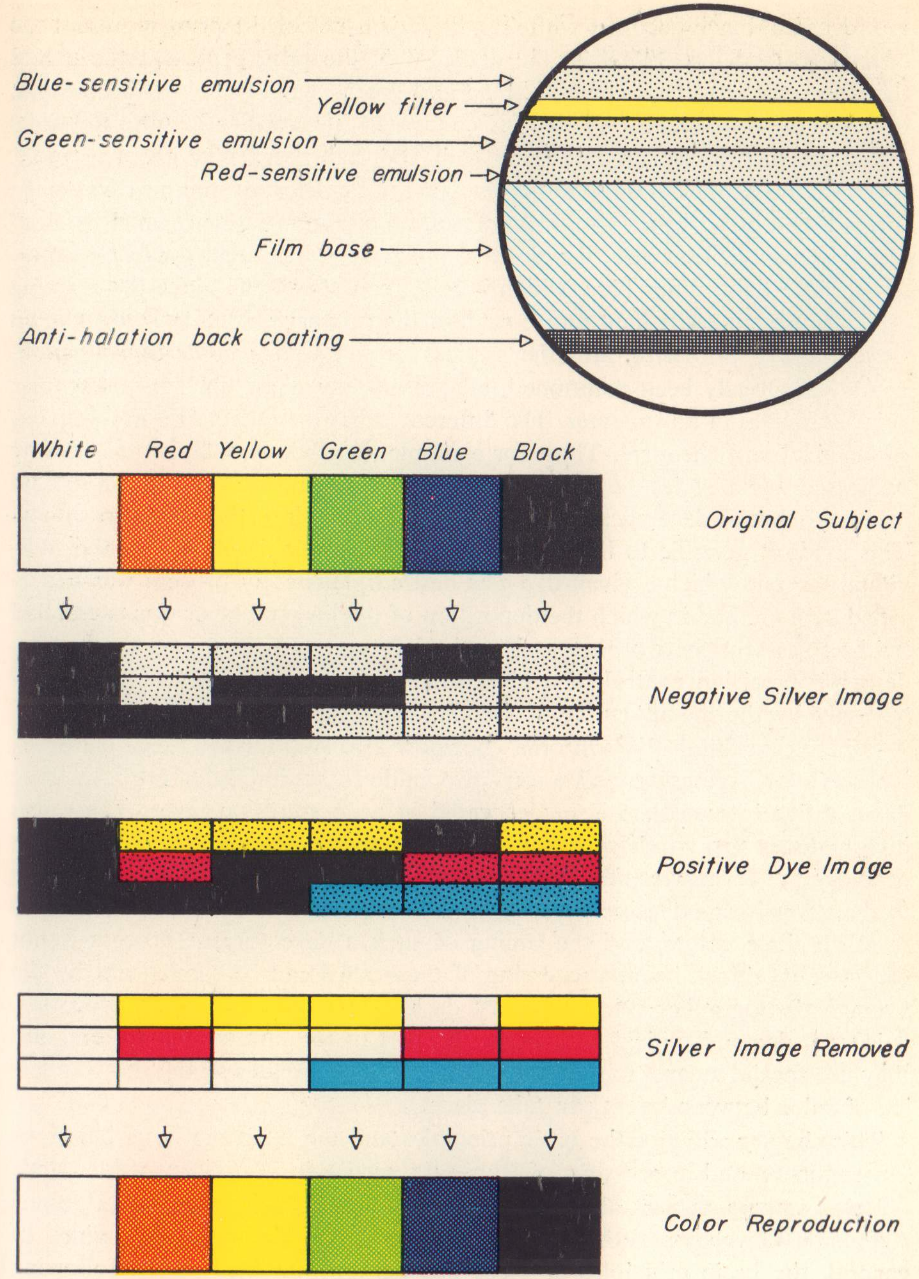
The reason for this is that all photographic emulsions are sensitive to blue light. By treatment with various dyestuffs during manufacture, sensitivity to green light can be *added* (as in the case of orthochromatic films), sensitivity to red light can be added, and by a mixture of red and green sensitizers, a film can be made that is sensitive to all visible colors of light (panchromatic).

But no means exists to *eliminate* the blue sensitivity of a photographic emulsion. So in coating a color film, the first coating (bottom layer) is sensitive to both blue and red light. Over this is coated an orthorchromatic (blue-and-green-sensitive) emulsion. The next layer is clear gelatin containing a yellow dye similar to a Wratten No. 12 (Minus Blue) filter. And finally, as top layer, there is a coat of blue-sensitive or a color-blind emulsion.

Now, when such a film is exposed, the top layer, sensitive only to blue light, will be affected only by the blue rays, red and green passing through it without effect. The filter layer immediately below this emulsion absorbs any blue rays that pass through, but transmits red and green rays freely. So that the next emulsion, sensitive only to blue and green, receives only green and red rays and makes the green record. And the bottom emulsion, sensitive to blue and red, receives only red and green rays and, being insensitive to green, produces the red record. Thus we have satisfied the first condition, and all modern color films are constructed in approximately this manner.

It is in the method of meeting the second condition that various makes of color film differ. It is necessary, whatever the means, to form a yellow dye image in the blue-sensitive layer, a magenta dye image in the green-sensitive layer, and a cyan dye image in the red-sensitive layer.

To understand this, consider for a moment a single negative exposed through a red filter. Since the red filter transmits only a red light, and absorbs blue and green, the densities of silver deposits on the negative represent various quantities of red light. In the print, however, the densities of the negative



3. *(Top)* Magnified cross-section of typical three-layer color film.
(Bottom) Stages in reproduction of a colored original by a three-layer color film processed by reversal.

are reversed, black becomes white, and the densities of the print represent the *absence* of red light. That is, the densities of the print represent the colors that the filter absorbed—namely, blue and green. Thus as far as the bottom, or red-sensitive, layer of the film is concerned, its positive image represents the effect of white light minus that of red light, or: blue-green (cyan).

The same applies to the other two layers; in its densities, the positive image formed by a green-light exposure represents white minus green, which is blue-red or magenta. Likewise, the positive image of a blue-light exposure represents white light minus blue, which is red-green or yellow. Since the printing colors represent white light minus each of the primary colors, they are known as *subtractive primaries,* and the process as *subtractive color reproduction.*

As has already been mentioned, all present-day color films produce their colored images in this manner. The differences between them are, in the main, mechanical and chemical. Thus, for example, Kodachrome film was formerly processed by a series of separate color-development stages, controlled by means of special developers that penetrated the depth of the emulsion slowly. This made it possible to limit the action of the color developers to the individual layer in which a given dye was desired. This early process was superseded by a method in which the deposition of dye in each layer was controlled by the color sensitivity of the emulsion in that layer. In either case the process demands precision control of a high order of sensitivity, and can be carried out only by the manufacturer of the film.

Other color films—Ektachrome (not now available for the Leica camera), Ansco Color, Agfacolor, and so on—are made somewhat differently. In these films, a dye intermediate is incorporated in each emulsion layer. These dye intermediates are so chosen that they react with a properly designed color developer to form dyestuffs of the correct color in each layer, in proportion to the silver-image densities. Only one color-development stage is required to form all three colors, and the timing of such a development process is not excessively critical, hence processing of these films can be carried out by the average photographer using ordinary darkroom equipment. Such processes, it is true, demand critical control on the part of the film manufacturers, and they use special means to immobilize the dye intermediates so that no wandering of color between layers can take place.

This chapter will give the basic principles and the latest working directions for exposure and processing of currently available American color films.

Leica camera owners abroad may find available such color emulsions as Agfacolor, Gevacolor, Ilford Color, Dufaycolor, and Ferrania Color films. In general, the basic principles of color photography outlined in the following pages apply to such processes as well. However, since these films will probably differ in speed, color sensitivity, recommended filters, and processing, the

4. BRIGHT EYES — G. E. Herbert

135mm Hektor, f/6.3, 1/60, G-E No. 31 flashlamp, Leitz VIIIa Flash Unit, Kodachrome, Type A film.

photographer must follow the instructions packed with each roll of film. It cannot be emphasized too strongly that specific recommendations can be made only for a specific type of color film; that the processing recommended for Ansco Color will not, in all likelihood, produce anything but failure if attempted with Agfacolor, in spite of its apparent similarity.

Light Sources • There is an old proverb that all cats are black in the dark. This, in a way, is a restatement of a fact fundamental to all photography, that objects are seen only by virtue of the light they reflect.* In color photography the operator is concerned not only with the amount of light reflected, but also with the color of the reflected light, since it is this colored light which forms the photograph.

A red object is red because it reflects red light and absorbs the remaining colors. A white object appears white because it reflects all visible colors of light. But if a white object is illuminated by red light, it appears just as red as a red object illuminated with white light. In either case, in a color photograph the object will appear red, since the film has received only red light and there is no way of knowing whether the remaining colors were absorbed by the subject or were originally absent from the light source.

The color of the light source has a very strong influence on color rendition in photography. For example, daylight contains more blue and less red than tungsten light. A white object photographed in daylight will appear bluish and in tungsten light will appear reddish, unless compensation is made for the color content of the light source.

This is done by the film manufacturer, who balances the sensitivities of the three emulsion layers in such a way that a white object appears white when photographed under the specified light source. However, this is usually done for only two types of light—daylight and some type of tungsten illumination.

This does not specify the balance completely. Daylight at noon is very different in color content from daylight near sunset. Likewise, there are many types of tungsten lamps, each with a color distribution of its own. Rather than supply many different types of color-film emulsions for all possible cases, it is wise to use the two principal types, daylight and tungsten, and make the necessary smaller adjustments within each group by means of filters.

However, there must be some means of specifying the color of a light source in order to make intelligent application of filters and other control methods. For many years, the concept of *equivalent color temperature* has been used, based on the temperature of a glowing body emitting light of a given color. We know, for example, that if we heat an iron bar, it will glow, first at "red heat," then, as the temperature increases, yellow, white, and bluish—though the iron bar will usually melt before this last color is attained. Color balance

* Excepting, of course, self-luminous objects—light sources, flames, or fireflies!

5. BUTTON BUSH. 90mm Elmar lens and extension tube on Focaslide used to give sharp detail against background. Edward A. Hill, APSA.

6. EUCALYPTUS FICIFOLIA. Focaslide attachment used to compose close-up view in a natural setting with sunlight exposure. Photo by R. V. Moran.

of an illuminant could, then, be specified by the temperature of an iron or a tungsten bar glowing at the same color. But since these materials also tend to reflect some light, the match would be in error; hence a theoretical *black body* having no reflective power whatever is considered as the source of light; its temperature is expressed in degrees on the *absolute scale.**

Unfortunately, this method of expressing the color of "white" light is applicable only to sources having continuous spectra, with energy distribution similar to the theoretical black body. It has already been noted that any color—including white— may be *visually* matched by a proper mixture of three colors: red, green, and blue. Obviously, there are many such mixtures that will appear white to the eye, all having markedly different effects on color film. This is the case specifically with fluorescent light, and it must be emphasized that a fluorescent light cannot be expressed in terms of color temperature ex-

*The absolute scale starts from theoretical absolute zero, or 273° below zero on the Celsius thermometer scale. The degrees are the same size as Celsius degrees, hence 0°C is equal to 273° on the absolute scale, 100°C equals 373° absolute, etc. Absolute degrees are specified as °K or degrees Kelvin—the term "Kelvin" specifying only the thermometer scale and having nothing to do with the concept of color temperature as such.

cept for a *visual* match. Incandescent lamps, on the other hand, follow the black-body radiation curves fairly well, and their color temperature can be specified with reasonable accuracy. Daylight, being a mixture of sunlight and partially scattered skylight, cannot be expressed accurately in terms of equivalent color temperature, and such statements as "Daylight is 5600°K" (or 6500°K, or any other figure) are practically meaningless.

The term "color temperature" as it applies to the color balance of various films implies only a ratio between the red and blue sensitivities, with green held constant. Thus, while it is possible to specify a daylight-type color film having a balance suitable for light of 5600°K, it is not correct to assume that therefore daylight has a color temperature of 5600°K. All it means in this case is that the film is balanced to correspond with the energy distribution of a light source having such a color temperature, and that, by test, it has been found to give satisfactory rendition in normal daylight.

The fundamental objection to the expression of color balance in terms of equivalent color temperature lies in the fact that equal visual color differences are not represented by the same number of degrees at different points on the scale. For example, in the vicinity of 3200°K the smallest change that will

7. HAY HAY. Ralph G. Morrissey.

Leica IIIc, 50mm Elmar, f/8, 1/60, No. 2A (blue) flashlamp, Leitz VIIIa Flash Unit, Kodachrome film.

8. MARQUESA MORN Charles Allmon

35mm Elmar, f/6.3, 1/30, Kodachrome film. Leitz Polarizing filter was used to cut tropical glare, accentuate colors, and to deepen the blue sky.

be noticeable to the eye or to a color film is about 50°. At 6000°K, the smallest visible color difference requires a change of nearly 200°. And the same filter will make the just barely visible difference in each case.

Thus a filter that will raise the color temperature of a light source from 3200° to 3250° will raise a 6000° source to 6200°. This difficulty would be overcome if the color-temperature scale were expressed not in degrees K but in *mireds,* or micro-reciprocal degrees; in the use of this system, the just barely visible color difference is approximately constant at any point of the scale. A proposal to this effect has recently been made, and another unit, as yet unnamed but based on a constant factor multiplied by the logarithm of the color difference in mireds, has been suggested. Much work remains to be done before this system comes into general use, and the concept of equivalent color temperatures, while admittedly faulty, will continue to be used in this book.

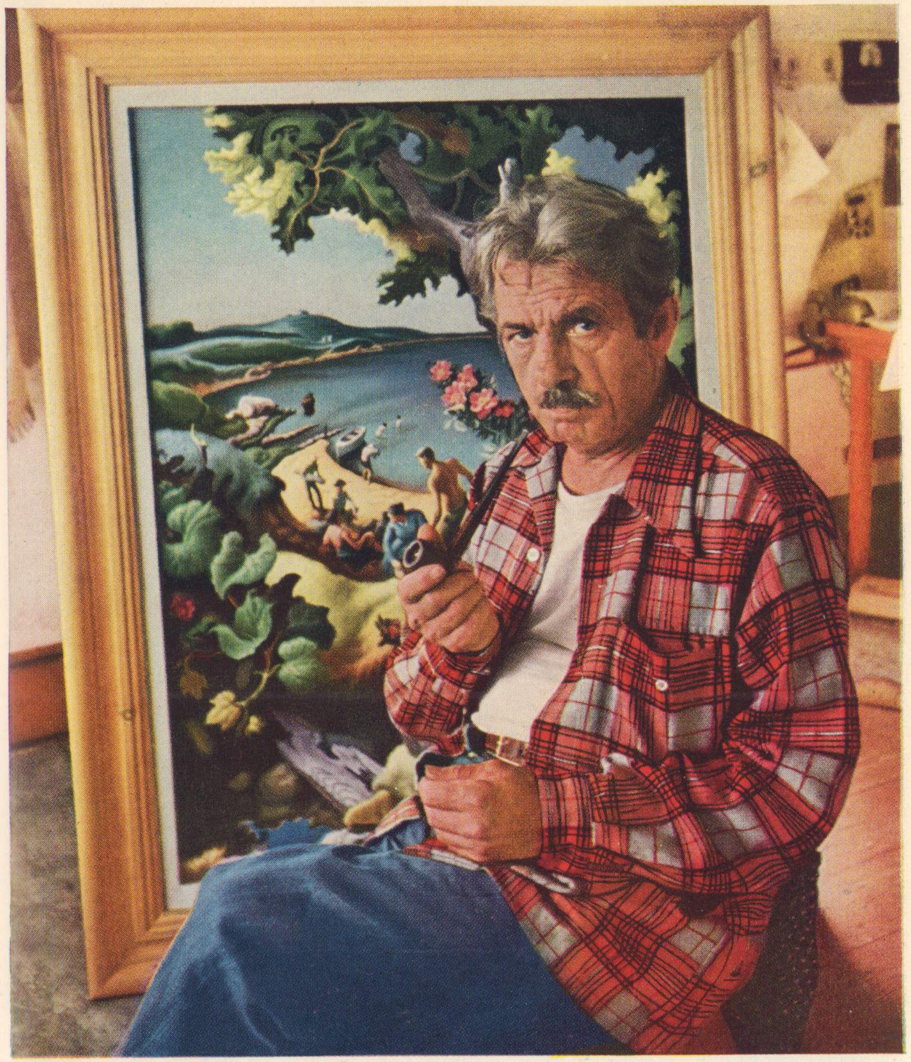
To the photographer, therefore, the essential fact to remember is that certain incandescent sources may have their color balance specified in terms of equivalent color temperature; that color films are balanced to *light sources,* not to theoretical black-body radiators, and that filters are available to correct the color balance *of the film* to approximately correct rendition with other sources. Such filters are designed to have certain absorptions in each of the three layers; thus it is possible to secure filters that will produce adequate results even with illuminants, such as fluorescent light, which do not follow the distribution curves of a black-body radiator.

Since such filters are matched to the sensitivities of the three emulsion layers, they will work correctly only with the make and type of film for which they are designed—the Ansco UV-15 and the Kodak 81A, while designed for use with films balanced to 3200°K and illumination at 3400°K, are not alike in appearance, nor are they interchangeable in use. Each must be used with the film of its corresponding manufacturer.

Likewise, neither filter can be said to have a 200°K correction factor, except in the vicinity of 3200°K and in connection with the film for which each was designed. Nor can photometric filters designed for visual correction of color temperature be used for photographic purposes (except possibly empirically and as the result of photographic tests).

Outdoor Color Photography • In the case of outdoor color photography, the principal light source is, of course, daylight, usually a mixture of sunlight and skylight. For normal subjects at fairly close range, daylight-type color films will produce optimum results without filters of any kind.

In the case of distant subjects, however, the proportion of skylight to sunlight is greater, and bluish results are usually obtained. Correction filters such as the Leica Chrome Filter, the Ansco UV-15 and the Kodak Skylight are generally recommended for such cases; the combined effect of distance and



9. THOMAS BENTON — Alfred Eisenstaedt

haze may in some cases call for the use of stronger filters.

Supplementary illumination can sometimes be obtained by means of reflectors. "Soft" reflectors, used principally to open up shadow areas, usually consist simply of large sheets of white cardboard. "Hard" reflectors, simulating spotlight effects in some cases, are made of large sheets of wallboard covered with tinfoil or other material producing specular reflection.

10. FLICKER *(Male)*. 135mm Hektor lens with camera and Focaslide relatively close to bird to fill frame. Photo by Edward A. Hill, APSA.

11. GREAT HORNED OWLS. 135mm Hektor lens and Focaslide. A remarkable example of a natural habitat photo by Edward A. Hill, APSA.

Auxiliary illumination in outdoor photography can also be obtained from synchronized flashlamps. Since daylight-type film is in use, such lamps must of course be of the blue-coated or "daylight" type. The "long-peak" or focal-plane type of lamp is not generally supplied with blue coating, but these and the small focal-plane lamps such as the G-E No. 6 or the Sylvania FP-26 can be colored by the user with a commercial blue dye, such as Jen-Dip.

A method for calculating the correct shutter speed and aperture for correct balance between sunlight and flash will be found under Flashlamp Exposures.

Artificial Light Sources • The two principal types of 35mm color film available for the Leica, Kodachrome Film, Type A and Ansco Color Film, Tungsten Type, are balanced for light sources of somewhat different characteristics. Kodachrome Film, Type A is balanced for illumination having an equivalent color temperature of 3400°K, corresponding very closely to the light emitted by photoflood lamps. Ansco Color Film, Tungsten Type, is balanced to 3200°K, and a number of different lamps emitting light of this color quality are available. If necessary, Ansco Color Film, Tungsten Type, can be exposed under photoflood illumination with an Ansco UV-15 filter to lower the apparent color temperature of the light source to the level of 3200°K.

12. ABOVE THE DESERT — Julius Huisgen

50mm Elmar, f/5.6, 1/60, Leitz Polarizing filter, Kodachrome film. Camera hand-held in cabin of plane.

13. MACBETH. Photo by Louise S. Smith.

Leica IIIc, 50mm Summitar, f/2, 2 seconds, available stage lighting, Kodachrome, Type A film.

Likewise, Kodachrome Film, Type A can be exposed to 3200°K illumination with the use of the Kodak Light Balancing filter 82A. Other filters are available for use with photoflash illumination (equivalent color temperature 3800° to 4000°K) and recommendations for this and other special cases will be found in the film-data pages that follow.

Electronic flashtube illumination is becoming increasingly popular for color photography, but special attention must be given to its characteristics if satisfactory color rendition is to be obtained. The equivalent color temperature of flashtube illumination is about 7000°K, and satisfactory results are obtainable on Kodachrome Film, *Daylight Type* without any filter at all; if slightly warmer results are desired, a Kodak Light Balancing filter 81B may be used.

With Ansco Color Film, Daylight Type, the Ansco Color Compensating filters Yellow 23 and Cyan 44 must be used in combination. However, an excessive loss in speed occurs in this case, and the manufacturer recommends the use of Ansco Color Film, Tungsten Type with the Ansco Conversion filter 12.

Lighting Techniques • In general, lighting for color photography should be soft, with a range from highlight to shadow illumination of not more than

1:3. Within this limitation, however, any lighting plan that is satisfactory for black-and-white will be equally effective in color, if not more so.

Soft lighting does not mean flat lighting! It is popularly believed that back lighting should not be used in color photography. This belief has arisen from the poor results obtained when back lighting is used with insufficient fill light in shadow areas. Actually, if back lighting is so arranged that no part of the subject receives less than 1/3 as much light as the brightest part, back lighting is exceedingly effective in color.

The rule of thumb calling for a 1:3 light ratio applies to all parts of a scene. For example, if background colors are not to be lost, the background must be separately illuminated, and care must be taken to balance its light level with the remainder of the scene. If a dark or a subdued background is desired, it should be lighted to a level of not less than 1/3 the highlight brightness in the scene. Where, on the other hand, the background is equally as important as the subject, it should be lighted to the same level as the average subject illumination. In general, the background should not be brighter than the subject.

The same rule applies to all parts of the scene. It is poor color photography to permit any part of the area to be underexposed; what would be effective shadow rendition in black-and-white will simply be off-color or completely black if under-lit in a color photograph. Only where a black is wanted and deliberately planned for should any part of the scene remain unlit.

Exposure of Color Films • The simplest means of determining correct outdoor exposure for color film is the data sheet packed with each roll of film. If this information is followed carefully, a remarkably large number of accurately exposed transparencies will result.

Equally simple and somewhat more convenient are the dial-guide calculators offered by the film manufacturers and available from all dealers. These contain the pertinent information concerning subject, light condition, and angle of illumination, correctly correlated to shutter speed and lens aperture, and will be found of considerable assistance under most outdoor conditions.

The photoelectric exposure meter can be invaluable when used intelligently; while seldom necessary in outdoor work except under unusual conditions, it is almost essential indoors with artificial light.

Check any exposure meter to be used with color film carefully by making a few trial exposures at the indicated meter reading, and about 50 per cent over and under. From the results of such a test, you can determine the accuracy not only of the meter reading, but of shutter speeds and lens settings. If you find consistent errors, the simplest method of compensation is to alter the film-speed setting. Thus, for example, if you should obtain underexposure, take a lower film-speed rating; if you should obtain overexposure, set a higher film speed on the meter. Once determined, these altered settings should remain practically constant for a given meter and camera combination.

In using a meter outdoors, take special care to avoid errors in readings due to the inclusion of too much of the sky area in the field of view. Most meters should be pointed somewhat downward when used outdoors.

In the case of Kodachrome, and probably with other color films as well, ignore any meter reading on outdoor subjects in full sunlight that indicates exposures of less than 1/60 second at f/8. Exposure at smaller apertures or faster shutter speeds at this aperture will almost certainly result in under-exposure, regardless of the meter reading.

In general, the color sensitivity of the photoelectric meter is not the same as that of the color film, and many errors in exposure when meters are used on bright-colored subjects can be traced to this cause. It is therefore preferable, especially indoors with artificial light, to take the exposure reading on a gray card held at the subject position. Such a gray card should have about 18 per cent reflectance (the gray side of Kodak Neutral Test Card is a satisfactory standard), and readings made in this manner will usually produce good results, though you may have to make some adjustment for exceptionally dark or light subjects. Adjustments of this type seldom exceed 1/2 stop, plus or minus.

Flashlamp Exposures • Guide numbers from which the recommended exposure for use with photoflash lamps can be calculated will be found in the film-data pages of this chapter. In all cases these guide numbers are used in the following manner: Divide the guide number applicable to a given lamp and shutter speed by the lamp-to-subject distance in feet. The result is the recommended lens aperture for use with that lamp and shutter speed. For example, if the guide number for a given flashlamp at 1/200 second is 45 and the lamp-to-subject distance is 10 feet, the aperture is $45 \div 10 = f/4.5$.

Since the color temperature of flashlamp illumination is about 4000°K, a filter must be used with tungsten-type color films to avoid excessive blueness. An Ansco UV-16 is best with Ansco Color Film, Tungsten Type, while a Kodak Light Balancing filter 81C is best for Kodachrome Film, Type A.

In emergencies, daylight-type color films can be exposed indoors with blue flashlamps as the sole source of illumination. Color rendition is not completely satisfactory in such cases, however, flesh tones having a tendency to be too yellow.

Blue photoflash lamps may be used outdoors as a source of fill light to illuminate dark shadow areas in a sunlit picture. A simple procedure is available to secure a balance between the daylight and the flash illumination; it is as follows: First determine the correct exposure for the scene as illuminated by daylight alone. Then divide the guide number for the lamp to be used by the

f-stop just determined. The result will be the correct lamp-to-subject distance for the normal balance.

For example, the normal sunlight exposure for Kodachrome Film, Daylight Type would be 1/100 second at f/4.5. Now if the blue flashlamp to be used has a guide number of 45 for a shutter speed of 1/100 second, divide 45 by 4.5. The result is 10, hence the flashlamp should be 10 feet away from the subject for correct balance between sunlight and flash illumination.

Prints from Color Transparencies • Prints from color transparencies are offered by the same film manufacturers, and also by many commercial photofinishers. It is likewise possible, using Ansco Printon, for the photographer to make his own color prints with a Leica enlarger and ordinary darkroom equipment. Directions for making such prints will be found in this chapter.

It is also possible to make color-separation negatives from color transparencies, and from these, in turn, to produce enlarged color prints by the Kodak Dye Transfer process, the Trichrome Carbro process, and others. These processes are too involved to be explained here; full working directions for these will be found in the PHOTO-LAB-INDEX.

Kodachrome Prints are available from the Eastman Kodak Company from 35mm transparencies in the following enlarged sizes:

2x = about 2¼x3¼, unmounted
3x = about 3x4⅜, unmounted
5x = about 5x7½, mounted in folders
8x = about 8x11, mounted in folders

Special-size prints up to 11x14 are also obtainable; image cropping will be done when indicated by a paper mask attached on the transparency. All Kodachrome Prints must be ordered through Kodak dealers. Color prints on Ansco Printon are made by various photofinishers, and may be ordered through camera dealers.

Transparencies for printing must be softly illuminated, correctly exposed, and critically sharp. Transparencies should be judged first by projection, for sharpness and deatil. Examining the transparency over a sheet of white paper will show whether the exposure is correct. A transparency that looks like a good print when so viewed is overexposed. A correctly exposed transparency viewed over a piece of white paper appears rather too dark. Color rendition is always slightly degraded in printing, hence originals should be rich and full in color; muddy originals will look worse when printed.

It is also possible to make excellent black-and-white prints from color transparencies. To do this, first make an intermediate negative on a good panchromatic black-and-white negative film, such as Kodak Panatomic-X. If you desire contact prints, you can make an enlarged negative by projecting the transparency onto a sheet of Panatomic-X sheet film with a Leica enlarger. Expose the copy negative fully and develop it rather softly.

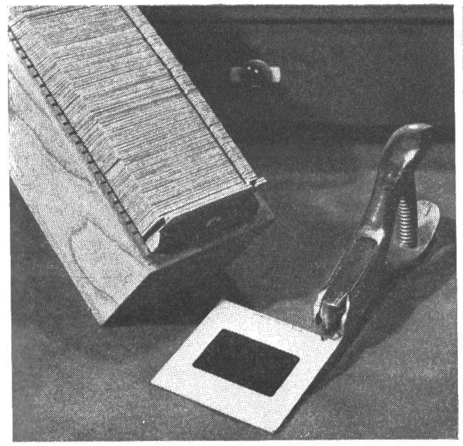
The most practical and efficient method of securing excellent black-and-white negatives from 35mm color transparencies consists of using the Leitz Belun 1:1 reproduction device. It will work equally well with transparencies in cardboard mounts, glass slides or on unmounted film. The transparencies are simply placed upon the opal glass surface of a viewing box, such as the Kodak Kodachrome Illuminator, the Belun device, attached to a Leica using the 50mm Elmar lens, is placed over the transparency so that the entire picture area appears within the mask and the exposure is made. A long-scale, soft gradation panchromatic film, such as Ansco Supreme or Kodak Plus-X will yield best results. Correct exposures are easily determined with an exposure meter placed directly over the picture area. It should be remembered that since the reproduction is made on a 1:1 basis, the exposure shown by the exposure meter should be increased by a factor of 4. To obtain correctly oriented prints the emulsion side of the original Kodachrome or Ansco color must face the light source, not the emulsion of the copying film.

Care and Storage of Color Films · Underexposed color films should preferably be stored at low temperature and low humidity, say 60°F at 40 per cent relative humidity. However, where temperature and humidity cannot both be controlled, it is better to choose storage conditions where the humidity is low; for example, a refrigerator in which the internal temperature is 40° and the relative humidity 80 per cent is *not* a good place to store color film.

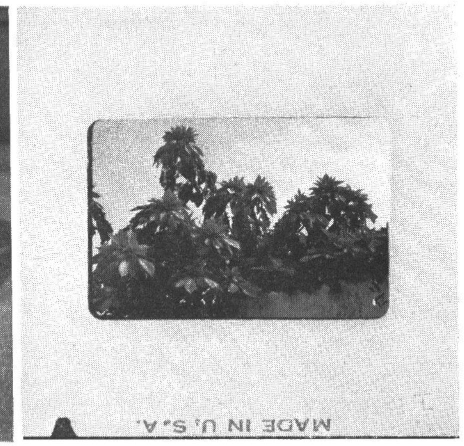
After exposure, the films may be kept in the unsealed package until processed, if temperature and humidity are not excessive. They must not be sealed in their containers, especially in tropical climates, unless they are first dried out thoroughly. One Davison Silica Gel Air Drier,* 2 ounces of silica gel, or 1 pound of dried rice or tea leaves will dry ten 36-exposure rolls of 35mm film. Processed films should likewise be kept cool and dry, preferably below 70°F and 50 per cent relative humidity. Color films should NEVER be kept in humidor containers.

Projection of color transparencies and binding them between glass plates is described elsewhere in this volume. A practical hint is offered here to simplify handling a great many cardboard mounted color transparencies in projection and viewing. The traditional "thumb-spot" so essential and easily applied to glass-mounted slides is not very practical on cardboard mounts. A far better method, more permanent and "indelible" consists of notching each cardboard mount as shown in Figures 14 and 15. The "V-2 Notcher" is obtainable

*Obtainable from Davison Chemical Corp., Baltimore 3, Md. An alternative and equally satisfactory material is S/V Sovabead, obtainable from the Socony-Vacuum Oil Co., Industrial Products Division, 26 Broadway, New York 4, N. Y.



14. Notching punch for cardboard mounts. Notches form neat groove in file box, indicating that slides are properly arranged for projection.



15. Cardboard slide mount notched in lower left corner for direct viewing. Notch is turned to upper right corner for projection "by touch."

from the Neumade Products Corp., 330 West 42 Street, New York 18, N. Y. One of its sides is easily lined up with the edge of the cardboard mount, ensuring that *each* notch will always appear in the same position. The notch should be made in the *lower left corner,* when the transparency is viewed with the image erect and correctly oriented for its right and left emulsion side away from the observer.

For projection, the cardboard mount is held with the notch at the upper right edge where it can be conveniently felt with the index finger. This is a fool proof indication that the slide is correctly oriented for projection. The notching of all slides, as soon as they are received from processing is most helpful in filing them for projection "by touch" instead of individual inspection: the notches form a neat groove, indicating that all slides are correctly oriented. If a single slide is not correctly filed—the broken continuity of the groove will show it up immediately.

Kodachrome Film, Daylight Type · This is a color film designed for use in 35mm miniature still cameras and balanced for exposure in sunlight.

Exposure index:	Daylight 10	Tungsten 4*

These values are those recommended as settings for meters using the American Standard Exposure Indexes. For meters calibrated for Weston ratings and for early G-E meters, the following settings are suggested:

Weston	Daylight 8	Tungsten 3*
G-E	Daylight 12	Tungsten 5*

* For emergency only; with Kodachrome Filter for Photoflood.

KODACHROME DAYLIGHT EXPOSURE TABLE

(Lens apertures for shutter speed of 1/60 second)

Lighting	*Aperture for average subjects*	*Light-colored subjects*	*Dark-colored subjects*	*Side-lighted subjects*	*Back-lighted subjects*
Bright, direct sunlight	between f/5.6 and f/8	f/8	f/5.6	between f/5.6 and f/8	f/4.5*
Weak, hazy, sun, no distinct shadows cast	f/4.5	f/5.6	f/4	*Assuming shadow areas unimportant. With close-ups having important shadow areas, use one full lens opening larger.	
Cloudy but bright	f/3.5	f/4	f/2.8		
Open shade on bright day	between f/2 and f/2.8	f/2.8	f/2		

Light sources · The best color rendering is obtained in bright or hazy sunlight. The light sources listed in the following table can also be used, but in general they do not give as good results even with the recommended filters.

Light Source	Filter	Remarks
Photoflood lamps	Kodachrome Filter for Photoflood	For best results and shorter exposures with photoflood lamps, use Kodachrome Film, Type A without a filter.
Bluish daylight conditions	Kodak Skylight filter (No. 1A)	This filter reduces bluishness in distant scenes, and in pictures taken on overcast days or in shade under a clear blue sky.
Daylight fluorescent lamps	Kodak CC-20B	For warmer results than are obtained without filter.
White-flame carbon-arc lamps	Kodak CC-40Y	Same as the last.
3200°K lamps	Kodak 80 plus 82A	For better results and shorter exposures use Kodachrome Film, Type A and No. 82A filter.
Flashtube FT-403, etc.	Kodak 81 or 81B	See instructions with film.

Flashlamp exposure guide numbers · For the use of blue flashlamps indoors independent of daylight, in average flash reflectors. Divide the proper guide number by the distance in feet from lamp to subject. The answer is the recommended lens opening for average subjects.

BLUE FLASHLAMP EXPOSURE GUIDE NUMBERS

Lamps		Guide Number
G-E 22B	open flash	50
	1/100 sec	40
	1/200	25
G-E 5B	open flash	45
*G-E 6, *Sylvania FP-26	1/100 sec	30
	1/200	21
*Sylvania 40	1/100	38
	1/200	28

*Blue-dyed by the user

Kodachrome Film, Type A · This color film for miniature cameras is balanced for exposure with photoflood lamps. Processed by the Eastman Kodak Company, it yields full-color transparencies for projection. Kodachrome Prints and Kodachrome Duplicate Transparencies are available through Kodak dealers.

Exposure index: Tungsten 16 Daylight 10*

These values are recommended as settings for meters using American Standard Exposure Indexes. For meters calibrated in Weston ratings, and for early G-E meters, the following meter settings are suggested:

Weston	Tungsten 12	Daylight 8*
G-E	Tungsten 20	Daylight 12*

* With Kodachrome Type A Filter for Daylight (Kodak Wratten No. 85). In daylight the meter should be pointed somewhat downward to minimize the effect from the sky if the manufacturer recommends this practice.

For copying, take the reading from a white card and divide by 5. If the camera lens is extended for focusing on a subject less than 8 focal lengths from the lens, allow for the decrease in effective aperture. An Effective Aperture Kodaguide will facilitate this calculation.

PHOTOFLOOD EXPOSURE TABLE

(For Kodachrome Film, Type A with No. 2 or RFL2 Reflector Photofloods

Shutter speed	*Number of lamps*	*Lamp-to-subject distance with No. 2 or RFL2 lamps*					
		f/2	f/2.8	f/3.5	f/4	f/4.5	f/5.6
1/25 or 1/20	1	5 ft	3¾ ft	3 ft			
	2	7½	5½	4¼	3½ ft	3¼ ft	
	3	9	6½	5	4½	4	3¼ ft
1/5 or 1/4	1	12	8½	6½	6	5½	4
	2	17	12	9½	8½	7½	6
	3	21	15	12	10	9½	7½

NOTE: Do not use more than three No. 2 or RFL2 Photofloods on a single fused circuit.

Light sources. In general, the best color rendering is obtained with photoflood lamps. Satisfactory color rendering can be obtained with the light source and filter combinations listed below.

LIGHT SOURCE	FILTER
Daylight	Kodachrome Type A Filter for Daylight (85)
Photoflash lamps Nos. 5, 6, 11, 22, 31, 50	Kodak 81C
Flashlamps Nos. 25, 40, 2, 26, and 2A	Kodak 81D
SF Flashlamp	Kodak 81A
SM Photoflash lamp	Kodak CC-10Y, for warmer results than are obtained without filter
3200°K lamps	Kodak 82A
3500°K white fluorescent lamps	Kodak CC-10Y plus CC-20M
4500°K white fluorescent lamps	Kodak CC-40Y plus CC-30M

Flash Guide Numbers. For use with G-E and Sylvania flashlamps in average reflectors. Divide the proper guide number by the lamp-to-subject distance in feet. The answer is the recommended lens aperture for average subjects in rooms with light-colored walls and ceilings.

SHUTTER TIME	FOCAL-PLANE SHUTTER *G-E 6* * / *Sylvania FP-26* †	*G-E 31* * / *Sylvania 2A* †
1/100 sec	45 ‡	50 #
1/200 sec	30 ‡	35 #
1/400 sec	22 ‡	25 #

* With Kodak filter 81C.
† With Kodak filter 81D.
‡ Concentrating reflector for midget lamps.
\# 6- to 7-inch polished reflector.

Daylight exposures. Kodachrome Film, Type A may be used in daylight with the Kodachrome Type A Filter for Daylight (Wratten 85). The exposure table given for Kodachrome Film, Daylight Type may be used to estimate exposure outdoors for Kodachrome Film, Type A with the recommended filter.

Ansco Color Film • Ansco Color film produces color transparencies by exposure in any standard camera, followed by development with chemicals

supplied in an Ansco Color Developing Outfit. Processing can be carried out in any normally equipped darkroom, or the film may be returned to Ansco, Binghamton, N. Y., for processing. The cost of processing is *not* included in the price of the film.

Exposure Indexes. The following exposure indexes are intended for use with exposure meters using American Standard Exposure Indexes:

	Daylight	*Tungsten*
Ansco Color Film, Daylight Type	12	—
Ansco Color Film, Tungsten Type	—	12

Daylight exposure. The following table provides approximately correct exposures for Ansco Color Film, Daylight Type when used outdoors. In winter, use the next larger stop; with brilliantly lighted summer scenes, such as beach, seascape, and high-altitude mountain shots, use the next smaller aperture.

DAYLIGHT EXPOSURE

	Shutter speed	*Front-lighted*	*Side-lighted*	*Back-lighted or open shade*
Bright sunlight	1/100 sec	f/4.5	f/3.5	f/2.5
	1/50	f/6.3	f/4.5	f/3.5
	1/25	f/9	f/6.3	f/4.5
Hazy, soft shadows	1/100	f/3.5		
	1/50	f/4.5		
	1/25	f/6.3		
Bright overcast, no shadows	1/100	f/2.5		
	1/50	f/3.5		
	1/25	f/4.5		
Dull overcast	1/100	f/2		
	1/50	f/2.8		
	1/25	f/3.5		

When using Ansco Color Film, Tungsten Type with Ansco Conversion filter 11, use 1/2 stop larger in each case.

Haze-correction filters UV-15 and UV-16 require no additional exposure.

Filters for Ansco Color films

UV-15	Light color-correction filter for use indoors with Ansco Color Film, Tungsten Type and photoflood lamps. Also useful as a light haze-correction filter with Ansco Color Film, Daylight Type.
UV-16	Light color-correction filter for use with Ansco Color Film, Daylight Type, for general haze correction. Also use with Ansco Color Film, Tungsten Type with photoflash lamps.
UV-17	Heaviest haze-correction filter for use with Ansco Color Film, Daylight Type. No increase in exposure is necessary.

Conversion filter 10	Bluish filter used when Ansco Color Film, Daylight Type is exposed by tungsten light of the 3200°K type.
Conversion filter 11	Orange filter for use with Ansco Color Film, Tungsten Type when exposed in daylight. Exposure should be 1.5 times that required for Ansco Color Film, Daylight Type exposed under the same light conditions.
Conversion filter 12	Special conversion filter for use with Ansco Color Film, Tungsten Type, and electronic flashtubes.

Indoor exposure. The table below is based on exposures for average subjects in light-colored surroundings. A dark-colored subject will require 1/2 stop or more increase in lens aperture, whereas light subjects will require 1/2 stop less.

INDOOR EXPOSURE GUIDE
(Two 500-Watt 3200°K lamps in reflectors)

		Lamp-to-subject distance in feet				
Key light		3	4	5	6	8
Fill light		5	6	7½	9	12
	Seconds	*f-numbers*				
	1	11	9	8	7	5.6
Shutter speed	1/2	8	6.3	5.6	4.5	4
	1/4	5.6	4.5	4	3.5	2.8

The exposures given in the above table are applicable when No. 2 Photofloods or RFL2 Reflector Photofloods are substituted for the 3200°K 500-watt lamps. With either of the Photoflood types, an Ansco Color Film UV-15 filter should be used over the camera lens.

Guide numbers for electronic flash

Ansco Color Film. Daylight Type, with Ansco Color Compensating filters Yellow 23 and Cyan 44 used in combination. Guide number for studio-type lamp with 225-watt second input, 24.

Ansco Color Film, Tungsten Type, with Ansco Color Conversion filter 12. Guide number of studio-type lamp with 225 watt-second input, 40.

For electronic flash units having power loading other than 225 watt-seconds, the following correction may be applied to the guide numbers on page 215:

When watt-second input is	MULTIPLY 225 WATT-SECOND GUIDE NUMBER BY
25	0.3
50	0.45
100	0.6
225	1.0
400	1.2
900	2.0

Flash Guide Numbers for Ansco Color film. Flash guide numbers given herewith are for "open-flash" or Time, Bulb, and 1/25-second settings on flash synchronizers, with lamps in metal reflectors of good quality. Dark-colored subjects will require 1/2 stop more exposure, light-colored subjects 1/2 stop less.

To find exposure, divide the guide number by the lamp-to-subject distance in feet; the result is the lens aperture to be used.

FOR USE WITH ANSCO COLOR FILM, DAYLIGHT TYPE		FOR USE WITH ANSCO COLOR FILM, TUNGSTEN TYPE	
Flashlamp	*Guide number*	*Use UV-16 filter with flashlamp*	*Guide number*
G-E 5B	50	G-E "SM"	40 *
G-E 22B	65	G-E 5	75
Sylvania 25B	50	G-E 11	95
Sylvania 2B	95	G-E 22	135
Sylvania 3B	135	Sylvania Press 25	75
		Sylvania Press 40	95
		Sylvania 2	135
		Sylvania "SF"	35 *

* NOT RECOMMENDED—if used, omit the UV-16 filter, but the results will be reddish.

Processing Ansco Color Film • The processing of Ansco Color film differs from black-and-white processing, and instructions must be followed exactly. While the processing is not difficult, variations that might be permissible in black and white can only lead to inferior quality in color. The temperature of all solutions must be within the limits specified. Directions for mixing and storage of chemicals must be followed carefully if disappointment is to be avoided.

After exposure, develop Ansco Color film in a "first developer" to produce a black-and-white negative image. Follow this by stop bath and hardener. Then rinse the film and expose it to white light to make the remaining silver developable. Follow with development in a color-forming developer that produces a silver positive image, accompanied by a dye positive.

The film at this stage is entirely black, containing a silver negative image, a silver positive image, and a positive dye image. Follow with a treatment in a silver bleach, which will leave only the positive dye image visible as a highly transparent finished picture in color. Fix, wash, and dry.

Developing tanks and reels should be of photographically inert materials. Glass, enamel, and plastic are suitable, and stainless-steel tanks and trays may be used if solutions are not permitted to remain in them for any considerable. time.

Reels in which the film is wound between solid side walls are unsatisfactory because they prevent proper re-exposure of film to light after the first development. If you use such equipment, remove the film from the reel after the first development for re-exposure. Reinsertion of the film in the reel for the remaining steps is best done under water.

Reels of the drum or cage type around which the film is wound and then dipped in a shallow tray of solution are undesirable because of aerial oxidation of solutions during use. Submerge film completely during processing, with neither film nor solution exposed to air any more than necessary.

Ansco Color Developing Outfits are available in units of 3½ gallons, 1 gallon, ½ gallon and 1 quart, sufficient to process 84, 24, 12 and 6 rolls respectively of 20-exposure 35mm film.

Processing procedure · The following procedure is for use with the latest type of Ansco Color Developing Outfit, containing the new non-irritating color-developing agent. Since changes in these recommendations occur at intervals, always follow the directions found on the instruction sheet in each kit; use the instructions below only as a general guide.

1. *First development.* Develop film in the first developer for 17 minutes at 68°F (20°C). Agitate once each minute, turning the tank completely upside down or removing the reel and replacing it after a 5-second draining.
2. *Stop bath.* At the end of development, drain the film quickly and immerse it in the stop bath for 1 minute at 68°F (20°C), with constant agitation.
3. *Hardener.* Transfer the film to the hardener for 4 minutes at 60° to 75°F (15° to 24°C). Agitate continuously and vigorously.
4. *Wash.* Wash the film for 3 minutes in running water not over 80°F (27°C). Now you may turn on white light, or open the developing tank.
5. *Re-exposure.* Expose the film to the light from a No. 2 Photoflood for at least 3 minutes; expose each side for 1½ minutes. It is absolutely necessary that the entire surface of the emulsion be evenly exposed, otherwise the finished film will show streaks or weak colors. Have the lamp above or to one side of the film, to avoid subjecting the wet emulsion to the heat of the lamp.
6. *Color development.* After the second exposure, develop the film in the color developer for 16 minutes at 68°F (20°C).
7. *Stop bath.* Immerse the film in the stop bath for 1 minute with continuous agitation; temperature 68°F (20°C).
8. *Hardener.* Harden the film for 4 minutes at 60° to 75°F (15° to 24°C). Agitate constantly for the first minute, then at intervals for the next 3 minutes.
9. *Wash.* Wash the film in running water (not over 80°F or 27°C) for 3 minutes. Thorough washing is important, to avoid stains.
10. *Bleach.* Place the film in the bleach bath at 68°F (20°C) and agitate until the brown color in back of the film is completely removed and you see a blue-green image. All brown spots must be completely gone; allow at least an equal time in addition to be sure of complete bleaching. 6 minutes.

11. *Wash.* Wash the film for 3 minutes in running water, until most of the yellow color of the bleach bath is gone. Insufficient washing will not harm the film at this point, but will shorten the useful life of the fixing bath that follows.
12. *Fix.* Place the film in a fixing bath (68°F or 20°C), and agitate an equal time again for assurance of complete fixing. Total time, about 5 minutes. At this stage you can see the finished color transparency.
13. *Wash.* Wash the film for 10 minutes. For maximum permanence, the wash may be increased to 15 minutes, but only if the water is below 60°F.
14. *Dry.* Wipe the film surface *very gently* with a clean, soft chamois or a viscose sponge, and hang to dry in a cool place as free from dust as possible. You can use a wetting agent instead of wiping if you desire, and it will minimize any chance of scratches or damage to the delicate film emulsion.

Making Color Prints with Ansco Printon · Ansco Printon is a three-layer emulsion similar to Ansco Color film, coated on an opaque white plastic base. Since it is to be viewed by reflection, the coatings are somewhat thinner than those on Ansco Color film; as it is intended for printing, the sensitivity balance of the three layers has been shifted to match the dominant absorptions of the dyes used in the original transparency.

Any Leica enlarger can be used with Printon film merely by inserting an Ansco Heat Absorbing Glass in the optical system, and adding certain Ansco Color Compensating filters. The basic adjustment of the enlarger is one Ansco Heat Absorbing Glass and one UV-16 filter. In addition, one or more of the following Ansco Color Compensating filters may have to be added to correct minor variations in the color balance of the particular Printon emulsion batch.

Yellow 23	Magenta 33	Cyan 43
Yellow 24	Magenta 34	Cyan 44
Yellow 25	Magenta 35	Cyan 45
	Magenta 36	

Use as a starting point the recommended filter combination given on the label of the Printon package. After you have made and developed test exposures, you may find it necessary to add or remove certain filters to secure optimum balance. If you find, for example, that it requires not only the recommended filters but an additional Magenta 34 for correct rendition, then the Magenta 34 may be considered a part of the permanent enlarger setup, and other batches of film can be used by adding their recommended filters to the Ansco Heat Absorbing Glass, UV-16, and Magenta combination.

The filters listed are so graded that any filter number ending in 4 is twice as dense as one ending in 3; likewise one ending in 5 is twice as deep as one ending in 4. Thus one Yellow 24 equals two Yellow 23s, and one Yellow 25 equals two Yellow 24s or four Yellow 23s. In addition, they have been so balanced that equal numbers of all three colors produce a neutral gray. Therefore you should never find it necessary to have filters of all three colors in the system, and such a combination as

Yellow 24	Magenta 35	Cyan 43

is the same as

Yellow 23	Magenta 33	Cyan 43
Yellow 23	Magenta 33	
	Magenta 34	

And since the three filters in the top row neutralize one another, they may be removed, leaving the combination:

Yellow 23	Magenta 33
	Magenta 34

After you have made a test print, you can easily determine the corrections needed by viewing the print itself through the various filters until you find one that is of the missing color. Hold the filter near the eye; do not lay it on the print.

Make the test exposures of a colorful transparency, and preferably of a small size, to conserve material. Strips of Printon are provided in each package for such tests. Exposure is not more critical than that required to make a really excellent black-and-white print. The speed of Printon is approximately half that of a paper such as Ansco Brovira, but tests cannot well be made on a black-and-white paper, since Printon is a reversible material. However, it has been found that a grease-spot photometer, carefully used, produces a very high proportion of excellent prints.

Handle the enlarger in total darkness, of course, since Printon is sensitive to light of all colors. Carry out first-development and stop-bath stages of processing likewise in total darknes. Beyond that point, you can carry on the process in full room light, but *not in daylight, which might cause stains.*

Processing of Printon film is similar to that of Ansco Color film. Small prints can be handled in a tank with hangers; larger ones are easily done in trays, and as many as six 8x10 prints have been developed in a tray by the "shuffling" technique. While the new Printon Color Developer is substantially non-irritating, it is best to wear rubber gloves while carrying out the color development and bleaching, to avoid any possibility of irritation, and to minimize staining of the skin.

In color, as in black and white, some areas of the image, particularly with very contrasty transparencies, may require dodging. This you can do exactly as in black-and-white enlarging, remembering, however, that since Printon is a reversible material, additional exposure makes a given area *lighter,* while shading will make it *darker*. For example, if a corner of the print is to be darkened, you must hold it back or shade it. If a deep shadow is to be lightened, you must "burn it in" or give additional exposure. The photometer can also

be of considerable assistance in determining the amount of increase or decrease in exposure required for various parts of the image.

Processing Ansco Printon • The Ansco Printon Developing Outfit, 1-gallon size, contains chemicals for processing about 1600 square inches of Printon film. This corresponds to 40 prints 5x7, 20 prints 8x10, or 10 prints 11x14 per gallon. Use the prepared solutions within two weeks after they have been made up, and store them in well-stoppered bottles.

In tray processing, it is well to use just enough of each solution for the number of prints to be handled in that batch. You can then discard chemicals at the end of each step, and process each group of prints in fresh developer. For example, according to the above figures, 5 prints 8x10 can be processed in 1 quart of solution. If 5 prints are to be handled at once in a tray with the "shuffling" technique, use 1 quart of each bath and discard it at the end of the step. Actually, since all prints start simultaneously in fresh developer under these circumstances, it is quite safe to process 6 films 8x10 in 1 quart of solution in trays.

As is the case with Ansco Color film, strict adherence to time and temperature recommendations is essential if optimum results are to be obtained. There is far less tolerance in this respect than with black-and-white printing.

After exposure, treat the Printon films as follows:

1. *Development.* Develop exposed Printon in the first developer for 12 minutes at 68°F (20°C). Equally good results are obtainable at other temperatures provided the development time is adjusted to correct for this, as follows:

65°F	(18°C)	14 min.	71°F		10 min.
66°		13½	72°	(22°C)	9½
67°		12½	73°		9
68°	(20°C)	12	74°		8½
69°		11½	75°	(24°C)	8
70°	(21°C)	10½			

2. *Stop bath.* Immerse film in the stop bath for 2 minutes at 60° to 75°F (15° to 24°C). After the print has been in the stop bath for 1 minute, you can turn on room lights. However, do not expose the wet film to strong daylight at any time during processing.

3. *Wash.* Wash the film in running water for 2 minutes at 50° to 75°F (10° to 24°C).

4. *Second exposure.* Expose the print for 2 minutes to the light of a No. 1 Photoflood or its equivalent at a distance of 3 feet. Turn the prints over so that for at least 1/4 of the total exposure time the light reaches the back of the prints. There is less danger of overexposure than of underexposure, therefore give ample time.

5. *Color development.* Develop the prints in the Printon Color Developer for 20 minutes at 68°F (20°C). Equally good results are obtainable at other temperatures provided the recommended times below are followed:

65°F	(18°C)	23 min.	69°F		19 min.	73°F		15 min.
66°		22	70°	(21°C)	18	74°		14½
67°		21	71°		17	75°	(24°C)	14
68°	(20°C)	20	72°	(22°C)	16			

6. *Stop bath.* Immerse the print in the stop bath at 60° to 75°F (16° to 24°C) for 1 minute. Use the same solution as after the first developer.

7. *Hardener.* Treat the print in the hardening bath for 4 minutes at 60° to 75°F (16° to 24°C).

8. *Wash.* Wash for 5 minutes in running water at 60° to 75°F (16° to 24°C). If the water is colder than 60°F, increase the washing to at least 10 minutes. This wash must be thorough, otherwise an irremovable pink stain will result in the bleach.

9. *Bleach.* Bleach the print for 10 minutes at 68°F (20°C). Equally good results can be obtained at the other temperatures listed below provided the corresponding times are followed:

65°F	11 min.	69°F	10 min.	73°F	9 min.
66°	11	70°	10	74°	8
67°	10	71°	9	75°	8
68°	10	72°	9		

10. *Wash.* Wash the prints for 3 minutes in running water at 50° to 75°F (10° to 24°C). Insufficient washing here may result in blue or yellow stains.

11. *Fix.* Treat the films in the fixing bath for 4 minutes at 60° to 75°F (16° to 24°C).

12. *Wash.* Wash for 10 minutes in running water at 50° to 75° (10° to 24°C).

Dry. Prints may be dried on a rack, or suspended by clips from a line. You can avoid stains occurring due to long, slow drying in humid weather by treating the well-washed films for 1 minute in a 1 per cent solution of formaldehyde. Then hang the print to dry without further rinsing. Hang in a clean, well-ventilated room away from strong light and chemical fumes. Do not attempt to ferrotype Printon. In general, any drying method suitable for negatives will work with Printon. Rapid drying, by means of a fan and mild heat, helps maintain clean whites.

THE LEICA IN PHOTO-JOURNALISM

ARTHUR ROTHSTEIN

Newspapers and magazines publish news and feature photographs as well as picture stories. These are the three basic types of pictures made by the photo-journalist, and each has certain characteristics.

A news photograph is essentially a single picture taken under the pressure of events, isolating a significant action, presenting a well-known personality, or recording an incident of interest to the community. It is direct, straightforward, and factual. The photo-journalist specializing in news pictures is fighting against time. He seeks the essence of the story, photographs it, and rushes the exposed film back for quick processing.

A feature photograph is a single picture of an event that is of continuing interest, creating a mood, presenting information, recording a timely subject rather than spot news. It often embodies elaborate technical effects and unusual compositions, but may also be extremely simple. The photo-journalist who produces feature pictures works carefully, has time to evaluate, and to consider his approach.

The picture story is a planned and organized combination of news and feature photographs presenting in narrative form a complete and detailed account of an interesting and significant event, personality, or aspect of contemporary life. Sometimes called a photo essay, it represents the most complicated type of work done by the photo-journalist, and requires the knowledge and use of the greatest variety of techniques, the ability to direct people and their actions, the application of diplomacy, tact, and persuasion, and a considerable amount of physical energy.

Every picture story starts with an idea, and these ideas come from a variety of sources. They may originate from an editor or a photographer on the staff of a publication; they may come from the inventive brain of a press agent, a free-lance writer or photographer, a faithful reader, or an interested citizen.

At *Look* magazine, the idea is carefully considered by the executive and managing editors. If approved, it is turned over to a writer and a photographer

1. UP AND OVER. A motorcycle climb offers quick action for top shutter speeds. 35mm Elmar, f/4.5, 1/1000. Photo by Chris Butler, from *Leica Photography*.

for production. This team usually conducts some preliminary research on the subject and writes out a tentative shooting script. Then they go out on location and start making pictures. Here the shooting script serves only as a guide, and often, when working on the scene, major departures are made from it.

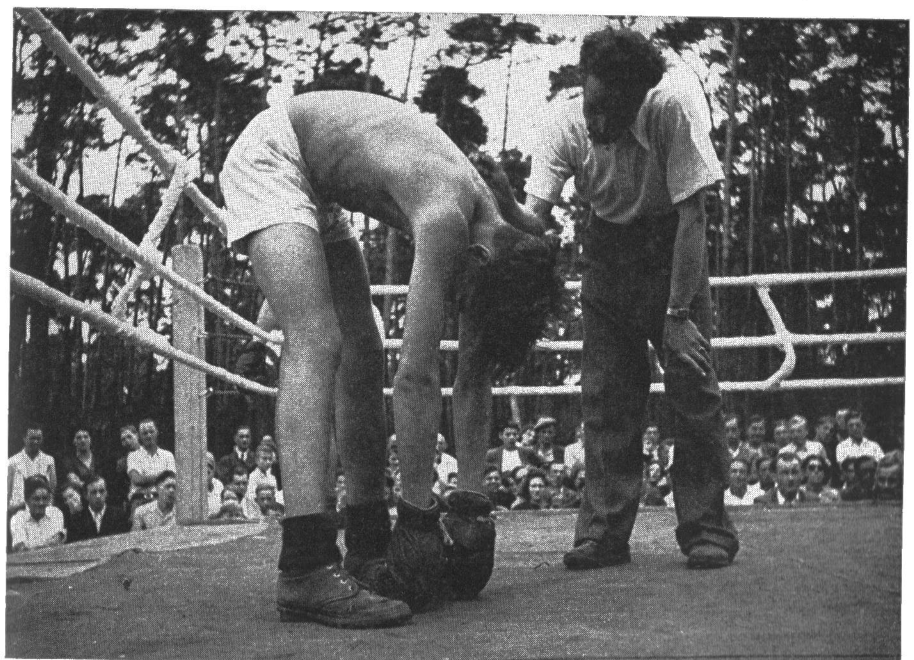
In shooting a picture story the photographer has to keep several points in mind. He strives for a lead picture that combines as many elements of the basic idea as can be used in one dramatic, storytelling, well-composed photograph. He tries to have a beginning and an end to his picture series, so that the photographs will start at a given point and flow smoothly from one to another to a logical conclusion. He attempts as complete coverage as possible. This means shooting many more pictures than are required for the final layout. In some cases the photographer may compose a shot in both horizontal and vertical arrangements as well as for possible use on a left or a right page. On an average picture-story assignment, a *Look* photographer will shoot 10 pictures for every one that is published.

The selection of the pictures to publish is the next step, and this is usually made by the editors and the art director after the writer and the photographer return from location and the photographs are processed. The editor determines the amount of space for the story and selects the pictures. The art

director employs his knowledge of visual techniques and typography to crop the pictures and design the layout. The writer fills in the text blocks, and the picture story is finally ready for the printer.

For those who would produce picture stories there are certain basic rules:

1. Do as much preliminary research as possible. Know your subject thoroughly before starting a shooting script.
2. Make your shooting script detailed and complete. Try to think of every picture possibility, and write it down.
3. While shooting, cover the story completely. When in doubt as to whether or not to make a picture, always shoot it.
4. Get close-up as well as long shots on the same scene. Also try both vertical and horizontal composition.
5. Use sunlight or natural light whenever possible, but avoid strong contrast and fill in shadows with flash if necessary.
6. Strive for a lead picture.
7. Make your pictures flow smoothly in story form.
8. Those with whom you work should find you patient, relaxed, reasonable, and courteous.



2. OUT ON HIS FEET. German youth knocked out at Pfungstadt, Germany. 35mm Elmar, f/3.5, 1/1000. Copyright Saturday Evening Post. Photo by Chris Butler.

The Leica is an extremely valuable camera to the photo-journalist. It is useful in every phase of news and feature photography and in the picture story. The Leica is in the hands of the news photographer who works for a local daily newspaper, as well as in those of the one who works for the big, nationally distributed picture magazine. In the course of their work, these photo-journalists have turned to the Leica for the features that make it a better camera for their purposes, and have also developed certain ways of using the Leica to achieve the particular effects they require.

In covering certain types of assignments, the fact that the Leica is compact, easy to carry, inconspicuous, and simple in operation make it very desirable. Where the photographer has to work quickly, unobtrusively, and without attracting too much attention, the Leica is invaluable. On such jobs it is advisable to remove the camera from its case, attach it to a neck strap, and keep it partially or completely hidden under a coat. Don't bother with changing lenses. Use the camera in its simplest form. Extra film cartridges can be carried in a pocket.

One of my first assignments involved a picture series on the people living in the Blue Ridge Mountains who were to be resettled as a result of the creation of the Shenandoah National Park. These people had lived in isolation, preserving customs and habits dating to Elizabethan times. They were shy, unfriendly to strangers, and they disliked having their pictures taken. I spent a week visiting them with a Leica around my neck, but did not take any pictures. After they had become used to me, I quietly tried a few shots, and for a few weeks continued to make pictures whenever possible. Toward the end I met with considerable co-operation and interest in my photographic project. Not only did the Leica seem less formidable than other cameras, but it was easy to carry over the mountain trails. Since most of my work was outdoors, I used panatomic film and the Elmar f/3.5 lens.

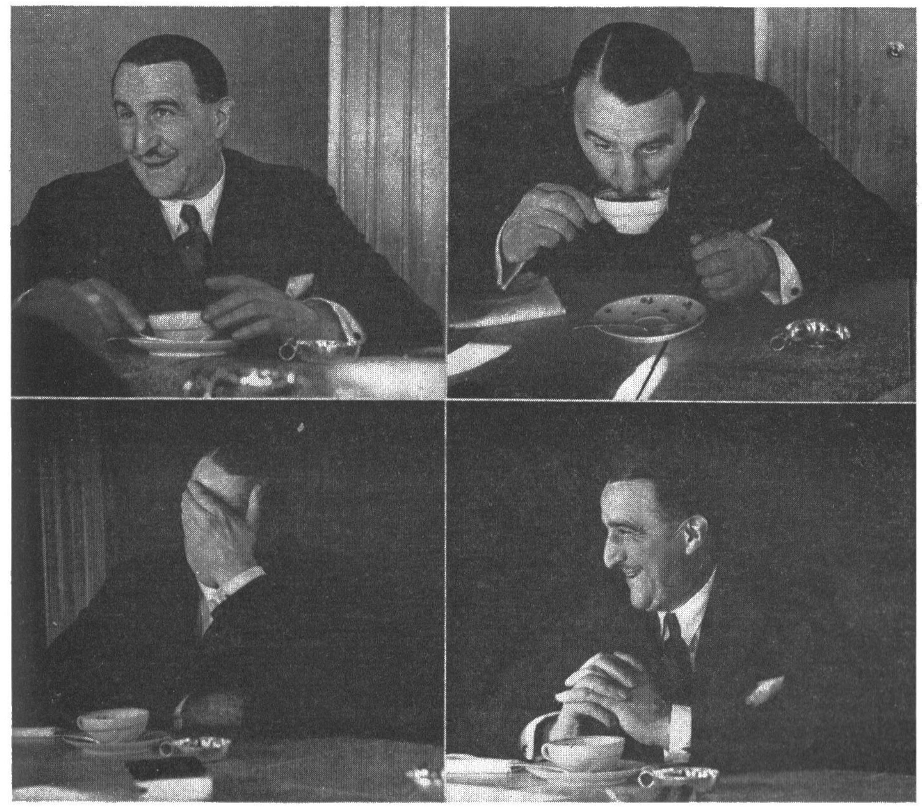
One of the most useful features of the Leica is the fact that it has 36 exposures on a roll of film that can be clicked off as fast as the camera can be wound with the sweep of an index finger. This means that the news photographer who misses a significant bit of action has many other chances to get it. It also means that a series of photographs leading up to a climax can be taken, and carried through beyond that point to produce a picture sequence. Extremely valuable in sports coverage, such sequences show a spill in a steeplechase, or a football play, but also are valuable for capturing the real characteristics of a personality because he is not forced into stilted poses.

I used this technique when I was assigned to photograph J. Arthur Rank, the British film magnate. I sat opposite him in a dining car as he traveled from New York to Los Angeles. Using a Leica with rapid winder and f/2 Summitar lens, I shot every gesture and every expression, so that when I got

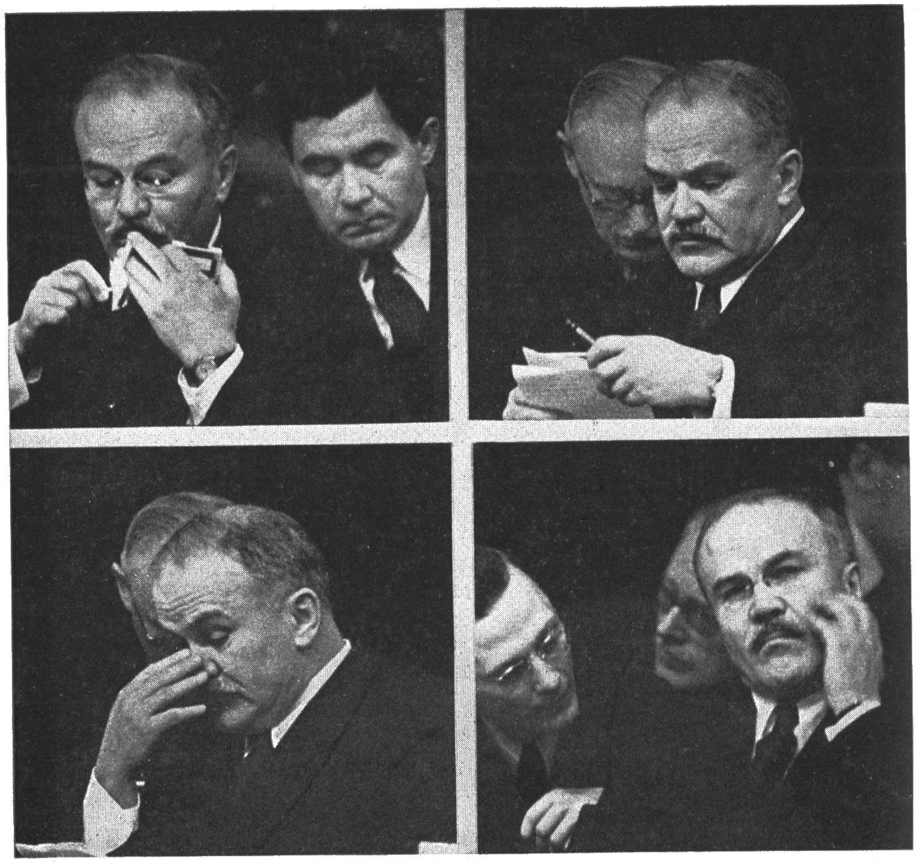
off the train at Albany I had 250 pictures, from which our editors were able to make an effective layout.

To the photo-journalist faced with the necessity of covering thoroughly an event that is moving fast over a wide area, the depth of field of the Leica's shorter focal-length lenses is very valuable. In good light, with the 35mm lens, it is practically unnecessary to change focus. With the wider angle of view, the subject is rapidly located, and little time is lost in getting the picture. The 35mm lens is also used to good effect in obtaining the type of picture that has an object very close and large in the foreground and a related group or scene in the background. By presenting an individual dramatically against his environment like this, a fine, storytelling photograph can be produced.

Any photograph involving action will of course require the use of the higher shutter speeds on the Leica. However, in good light, with the resulting additional depth of field, the speed of 1/200 or 1/500 second may be



3. Photos of J. Arthur Rank made with rapid winder for Look magazine by Arthur Rothstein. 50mm Summitar, f/4.5, 1/60, natural light, Super-XX film.



4. MOLOTOV OFF-GUARD. Conventions and public meetings often require the use of long-focus lenses. 200mm Telyt, f/4.5, ¼ second, Super-XX film. Photo for Look magazine by Arthur Rothstein.

used for normal work to ensure complete sharpness by lessening any chance for camera movement. As used by the photo-journalist, the Leica is mainly a hand-held camera, and in this respect it is worth practicing with the shutter speeds of 1/5 or 1/10 second to see whether the camera can be held firmly. It will help to press the camera against a firm support like a tree or post, or to tighten the neck strap around the wrist. When the longer lenses are to be used at slow speeds, a tripod and a cable release are necessities.

The Leica long-focus lenses are used to good advantage by the photo-journalist for many purposes. The fast-aperture long-focus lenses are fine for stage photography, animals at the zoo, sports from the sidelines, or close-ups of personalities. The longer and relatively slower telephotos are used with reflex housing, and make it possible to cover events from unusual distances and to clarify obscure details. Some remarkable results have been obtained with 200mm lenses at large conventions and meetings, showing the facial

expressions of individuals under the stress and excitement of delivering or listening to oratory.

This is exactly what happened when Soviet Foreign Minister Molotov was speaking once at the United Nations. Flashbulbs were forbidden, and the photographers were stationed in glass-enclosed booths at the rear of the hall about a hundred and fifty feet from the principal speakers. I used a Telyt 200mm f/4.5 with reflex housing, on a tripod, and exposed on Super-XX film at ¼ second wide-open. The resulting photographs were an unusual series on an interesting personality.

The variety of lenses of varying focal lengths available for the Leica makes it possible to fill the negative with the desired composition, thus decreasing the need for unusual degrees of enlargement to make the print. This is important to the photo-journalist, who tends to use the faster and conse-

5. SUBWAY RIDERS. A slow shutter speed requires a steady camera when photographing under natural light conditions. 50mm Summar, f/2.8, 1/8 second. Photo by Look photographer Stanley Kubrick.

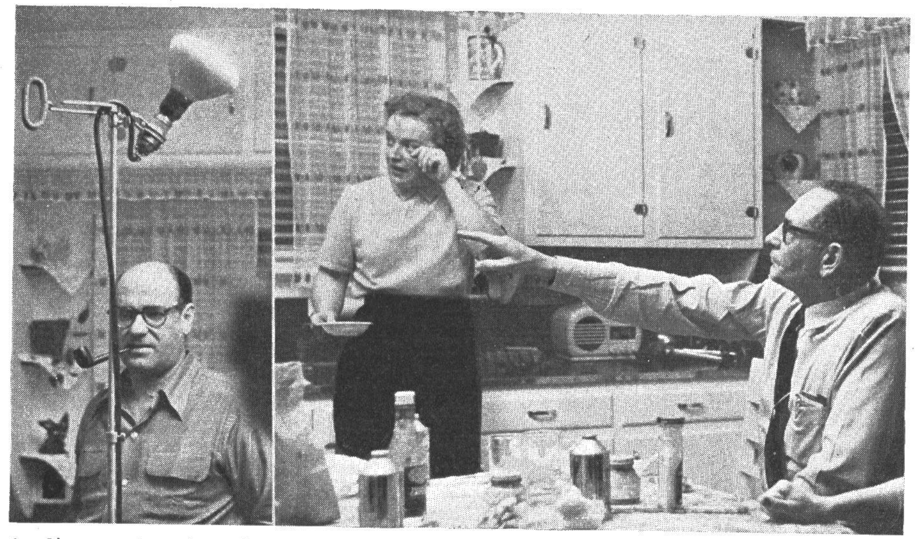
quently grainier emulsions. It is a great help also to understand the changes in perspective, and to be able to control the distortion and the emphasis resulting from the use of different focal-length lenses. Depending on the effect desired, the photographer can range from a picture in which foreground and background are sharp, and receding markedly from each other, to a picture in which only the isolated subject is sharp and the background flattens out completely.

Every photographer who produces pictures for publication is faced with the problem of working under bad lighting conditions. Here is where the Leica, hand-held at 1/10 or 1/20 second, equipped with a coated Summarit f/1.5 lens and using a fast panchromatic film, has often been used to get the picture when nothing else would succeed. Under such conditions, too, it is important to remember that proper development of the film may do much to improve the final picture. Since most fine-grain developers imply a certain loss of emulsion speed, a roll of film that is known to be underexposed should be processed in a more vigorous developer, even though the grain may be increased. Some photographers find it advisable to use three developers—DK-20 for normal negative, D-76 for slightly underexposed negatives, and D-76 with ten times the normal amount of borax for badly underexposed negatives. It is certainly better to have a good 5 x 7 print that will make excellent copy for reproduction than to have a flat, underexposed 11 x 14 print.

Photographers working for newspapers or magazines prefer the most natural and realistic lighting effects when using the Leica. In most cases it is possible to photograph with the existing light, adjusting shutter and diaphragm accordingly. This, of course, has been done since the early beginnings of photography. If the photographer has the time and the ability to recognize ways of bettering the quality of his photographs, he can sometimes make improvements in the available light without upsetting the balance.

A trick that magazine photographers use is to raise the level of illumination in an indoor scene without disturbing the seemingly natural and realistic effect. This is done by placing photoflood bulbs so that they enhance the light given off by existing light fixtures. Care must be taken not to use the photofloods in ordinary household lamps for long periods, as the intense heat will damage the fixtures. Also, avoid placing more than two photofloods on one household circuit.

There are certain unusual advantages in the use of photoflash bulbs with the Leica. The news photographer covering a society ball wanders through the crowds with a 36-exposure roll in the camera and a pocketful of midget bulbs working quickly and surely. The feature photographer avoids the harsh glaring effects of direct flash by bouncing his light off the ceiling.



6. Photograph at the right was made with photofloods directed toward the ceiling to increase the natural lighting effect. 50mm Summitar, f/5.6, 1/30, Super-XX film. Photo by Look photographer Phil Harrington.

A single bulb directed at the ceiling of an ordinary room will provide enough reflected soft light to make a synchronized flash photograph at 1/30 second at f/6.3, using fast pan film. Full information about using the Leitz Synchronized Flash Unit is given in the Flash chapter.

The Leica also may be easily synchronized for use with electronic discharge lamps or strobe lights. A special baseplate is available for zero delay. Here the light itself creates the exposure, of extremely short duration. Besides the ease with which motion is stopped in using this type of light, a softness and a clarity can be obtained similar to the effects of a diffused skylight. Careful attention must be given to development, and it is best to use the slower pan films with a D-76 developer and increase the time of development by 50 per cent.

The photo-journalist thinks of the Leica as an instrument with which to photograph what is happening, but often he finds it necessary to create the event. Sometimes he will see a bit of action that would look better in front of a different background. This calls for what is known as controlled action. Using this technique, the photographer, as a director, asks the individuals to be photographed to enact a little scene while the pictures are taken. This has the advantage of giving the people something to do that may bring out a characteristic gesture, and invariably results in pictures that are expressive and natural-looking. The Leica is ideal for following such controlled action, catching the climax and the most effective phases of the action.

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~~COWLES MAGAZINES, Inc~~. RELEASE

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We, being the parents or guardian of the minor named on this release, hereby approve this agreement and waive all rights we may have in the premises.

Date..................................
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Witness...............................

In consideration of ....receipt of which is hereby acknowledged, I hereby give my consent to ~~Cowles Magazines, Inc~~. and to anyone else whom ~~Cowles Magazines, Inc~~. may authorize, to photograph me and to use any photographs of me, as well as my name, for any purpose, including advertising and purposes of trade, without any limitations as to the date of such use.

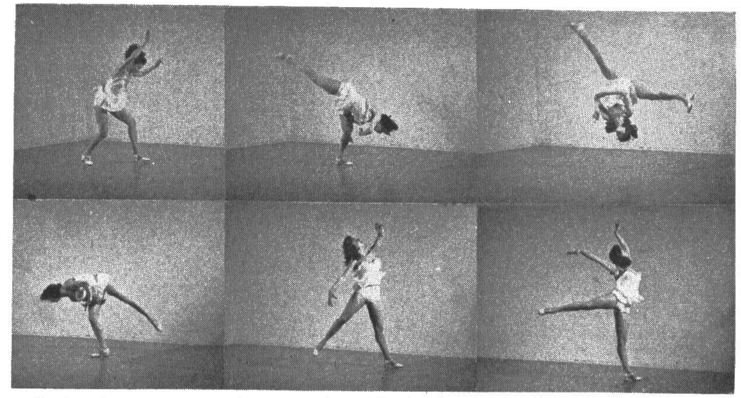
Signed......................................
Address.....................................
City......................State.............
Witness.....................................
Telephone...................................

7. Sample model release to be obtained from all subjects in your pictures when required.

All these special methods and approaches in the use of the Leica by newspaper and magazine photographers have resulted from the need of overcoming the many pictorial problems faced in professional work of this sort. They may be applied just as well by the amateur photographer who makes pictures for a high-school paper, a college yearbook, or a company house organ. It is an interesting fact that a very large proportion of professional newspaper and magazine photographers started as amateurs. An early interest in photography, a talent for expressing oneself in visual terms, and a great deal of self-education combine to produce many of the photographers who work in that most difficult of specialties, photo-journalism. The field is open for others who wish to work in it. Much can be learned from study and analysis of photographs in the nation's better periodicals. Best of all, take pictures, submit them to editors, and obtain criticism. Technical excellence is a prerequisite, but even more important is the ability to understand people and their ways of life, and to interpret all this with the camera.

The following points are worth remembering when making photographs for publication:

1. Take news photographs quickly, process them rapidly, and rush them to the newspaper. Some papers prefer to process exposed film in their own darkrooms.
2. Keep your equipment as simple and compact as possible, considering the job to be done.
3. Cover your story thoroughly, with variations in composition and lighting. Use natural light.
4. Tell a story with your pictures.
5. An 8 x 10 print is usually adequate.
6. Get model releases from your subjects.
7. Be sure to identify your prints properly when they are sent out.



8. Acrobat sequence photos made with the Leica Motor. 50mm Summar, f/2, 1/200, Super-XX film. Photo by Look photographer Arthur Rothstein.

In all cases, the attitude of the photographer should be that the picture is being made for publication. This means that the selection of material to be pictured must be of interest to as many readers as possible, not to the photographer alone. This universal appeal must be carried out in the technical execution of the photograph as well. The picture has to be self-evident, and never obscure, in its statements. The Leica is admirably suited for this type of natural, realistic, straightforward, and honest picture reporting.

9. Motion picture scene from "The Great Sinner." 50mm Summitar, f/3.5, 1/20, Super-XX film. Photo for Life by Peter Stackpole, copyright Time Inc.

NEW YORK TRAFFIC William Vandivert

This photograph was taken to illustrate a point being made in an advertising brochure for the Bituminous Coal Institute. Only the 135mm Hektor lens could have captured the perspective required for the layout.

THE PICTURE STORY IN INDUSTRIAL AND PUBLIC RELATIONS

WILLIAM VANDIVERT

Expanding beyond the picture-magazine field today, application of the picture story—in one or many photographs—is spreading to public relations and advertising. Industry in its new era of public responsibility is learning to use photographs. The modern photographic story is a new language. Like all languages, it is superbly used by some and badly abused by others. At its height it possesses freshness and truth, naturalness, and even a lyrical quality.

The photographic story has turned once again toward the eye glimpse of the miniature camera, but this time on a basis of broader technical perfection. This technical perfection is not that of processing nor that of improvements in film, but rather the intermittent use of the techniques of the "posed candid," artificial illumination, flash, highspeed strobe, or other devices developed during the past dozen years of experimentation.

From the synthesis of each individual's knowledge and particular experiences come the polished styles you see in today's picture magazines. It is these magazines which have led the way and developed this new language to an art. It is significant that the most striking styles today are those based on naturalness of light and action.

Taking a page from the picture magazines, business is turning more and more to the impact of photographs to tell its own story. Good business public relations is good performance—publicly appreciated. More easily than any other method, the picture story can honestly and dramatically show good performance by management, or by labor, in industrial enterprise and development.

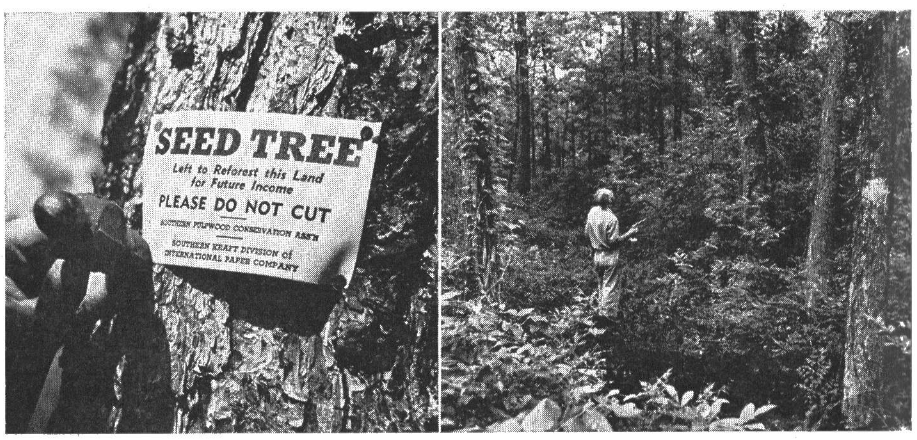
Annual reports, brochures, filmstrips, motion pictures, photographic books, and picture files open to all—these are the forms most photographic public relations take. Most of this work is the province of the still photographer. And it has been my experience that the naturalness of Leica pictures and the versatility of the miniature camera are extremely valuable in presenting the public-relations story.

How to Cover a Picture Assignment • One recent assignment of mine in the South may serve to illustrate the development of a public-relations picture story. A vice-president of one of the most progressive public-relations firms telephoned one May morning asking me to sit in on a conference in his office that afternoon to discuss an urgent photographic problem.

In the conference the story outline was swiftly developed. The client, the largest paper company in the country, was preparing to circulate widely a photographic brochure on its work in forest conservation. The story was to cover the activities of a company conservation engineer assigned to the State of Mississippi. I was to photograph, broadly and dramatically, a week's schedule in his actual territory. The theme was to point up the company's very real public service in the conservation of our forests. This was the skeleton of the story. It was my job to clothe the bare bones of the outline with the pictures that would bring it to life.

Three days later I flew to Mobile, Alabama, with a light, diversified camera outfit consisting of my battery of Leicas, a Rolleiflex, and a light view camera. At the airport, I met my subject, the conservation engineer, and the manager of the company's local paper mills. In a 2-hour conference that night we arranged a schedule of places, subjects, and times, leaving it flexible enough to accommodate bad weather. At dawn next day I put my cameras into the engineer's car and we took off on a grueling 6-day trip of 3000 miles, during which I photographed 60 different scenes.

Making the Key Pictures • For these 6 days we ate, drank, worked, and slept our story. Pulling a picture series together in the field involves far more than just making the necessary number of pictures. Each picture must bear a relation to all the others. You must establish your locale and subject quickly in *a lead picture* that attracts and holds the reader. If there is a



1. The closeup of the Seed Tree sign turned out to be the lead picture in a conservation story for the Southern Kraft Company. At the right a forester marks trees for cutting in an experimental hardwood pulp cutting area.

2. Pulpwood stacked in a Mississippi pine forest, being cut according to good conservation practices. Seed trees are left scattered at regular intervals. At right, a conservation engineer and "Posey" Howell, father of modern tree plantations in Mississippi, stand in a plantation of pine that Howell planted thirty years ago.

climactic point of interest, you must dramatize this in one telling picture. And you must *close your story gracefully* with a single picture.

On this assignment our lead picture became our cover picture, a close-up of a sign being tacked to a tree that the conservation engineer had selected as a seed tree left to reforest land now being cut. Since in this story there was no great climax in the running thread of interest, we hunted for a climactic theme picture that would sum up the feelings we meant to convey in this booklet. And our closing picture became a final inspection of a carload of cut pulpwood on its way to the mill. This was re-emphasized on the rear cover in a picture of a hand pointing out the wide growth rings on the ends of a stack of pulp logs, to show the rapidity and the richness of forest growth in the South.

The lead, the climax, and the close are the key pictures that form a solid structure to support the bulk of your story. From the lead picture to the end, the running series of your picture story must possess a logical, easy progression. To assemble a dynamic story at top speed in the field takes concentration, and skill in storytelling that only experience can perfect.

3. Closeup of hand and growth rings of pine pulpwood, showing richness of growth. This was used as the rear cover of the advertising brochure. Emphasis is obtained by making important closeup photographs.

For 4 days our theme picture eluded us. We were fortunate in making the dates and the separate pictures scheduled, but the single shot that told our story of forest conservation was still missing. Suddenly it came. We were in the woods under a fine stand of pine when my conservation engineer leaned over and brushed away the needles to reveal a tiny seedling.

"This," he said, "is what I continually tell them to save. These seedlings, if brought to maturity, spell a great prosperity for the South. They have a

4. The theme picture taken for the paper company booklet showed extreme closeup of hand and seedling tree which pointed up the whole conservation idea.

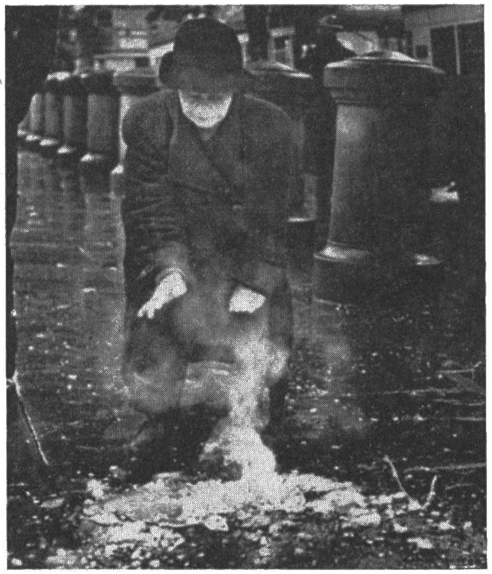
custom of burning over the woodlands here each spring to help grass grow so that they can graze their cattle. This little fellow, if protected, can mean more money for the owner of this land than any cattle he could graze on it." His hand cupped the plant protectively.

"There is our picture," I said.

We spent an hour photographing variations on this theme, one a close-up of the frail seedling and the protective hand. The best of these shots became our lead, and it has since become the hallmark of the company's conservation policy.

In the course of our 6-days' work, I used all the cameras I had brought with me. Picture subjects had run the gamut from scenes in the deep woods to a barbecue for logging crews, from women's clubs to posters and cards tacked on trees. But, as always, the Leicas played a special part in pointing up my story. Leica photographs of men in the depths of a tree plantation had a quality that impressed all those who saw the pictures.

Value of Practical Experiences • Many of my World War II experiences helped point up my own photographic techniques. In Britain in 1940, after the defeat of France and the evacuation from Dunkirk, we momentarily



5. It is still necessary to be always alert for the incident that happens suddenly in front of you and can never be re-enacted. These chance shot are the key pictures that bring reportages to life, as in this scene showing the London woman warming her hands over an incendiary bomb after an air raid. Taken for *Life* by William Vandivert, (c) *Time* Inc.

expected an invasion attempt by the German Army. The country had been stripped of arms to stem the tide of conquest on the Continent, and those arms were now lost. Whole regiments were virtually unarmed. To replace these staggering losses, munitions factories were all working at a prodigious rate around the clock. Assigned to photograph this effort in a quick trip, I carried only my Leicas, a tripod, some flashbulbs, and a couple of extension lamps.

Where natural light was insufficient, I used a short time exposure, filling in the dark foreground areas with an open flash. Any more complicated setup would have been out of the question, because nothing was allowed to delay production. The results were superb. When occasion demands, I still use this technique, with consistently good results.

Even though much of photographic storytelling today is done within the confines of predetermined outlines, it is still necessary to be always alert for the incident that happens suddenly in front of you and can never be re-enacted. These chance shots are the key pictures that bring reportages to life. Sometimes they are so compelling that they even change the final form of your outlined story.

Early in the bombing of London, I was driving through Trafalgar Square one chilly morning, on my way to photograph bomb damage done the night before, when a lone German bomber dived out of low clouds and scattered incendiary bombs across the square. No one was hit. There was no time even to get out of my car before it was all over. Then through a break

6. A wide angle lens, with its extreme depth of field, made this picture possible in the 1944 Burma campaign of the Wingate column. A doctor supervises loading wounded aboard the light plane to be ferried across Japanese-held territory. Taken for *Life* by William Vandivert (c) *Time* Inc.

in traffic I spotted an old flower woman warming her hands over one of the glowing bombs. I abandoned my car and dived through the railings to snap one of my best pictures of the war on civilians. This single picture sparkled the whole story of the bombing of London in the following week's *Life* magazine, and later hung in a Museum of Modern Art show of my pictures of Britain at war.

Careful Research Pays Off • Fanatical attention to research and a never-ending curiosity as to what lies off the beaten track are the lessons I learned during a trip into Chinese Turkestan in 1943, the only photographic reportage of this little-known territory ever allowed by the Chinese Government to any journalist at any time. Theodore White, of *Time-Life,* and I spent 2 months traveling by plane, car, truck, horse, and even wagon to cover the ground we were interested in.

The climax of our trip was a 1000-mile ride from Urumchi, the capital, to Kashgar far to the Southwest. Over caravan tracks by truck we laboriously followed the fabled Northern Silk Route across the desert from oasis to oasis. Our research on the archaeological past of Turkestan had been sketchily done, because the volumes of Sir Aurel Stein's works on his finds in innermost

Turkestan some 30 years before, which we needed for reference, were not available in Chungking or the cities of the East we had passed through. By sheer good fortune we found them and other invaluable reference works in the spacious library of the British Consulate in Kashgar, at the end of our 1000-mile journey. Our research showed us what we had missed. Our return trip did not hold to the beaten track, and was a rich harvest of archaeological treasures—ruined cities, Buddhist caves, and signal towers used 2000 years ago for flashing messages across the thousands of miles to Peking. These photographs supplied the missing element in our story, the historical setting against which our pictures of today were given perspective in time.

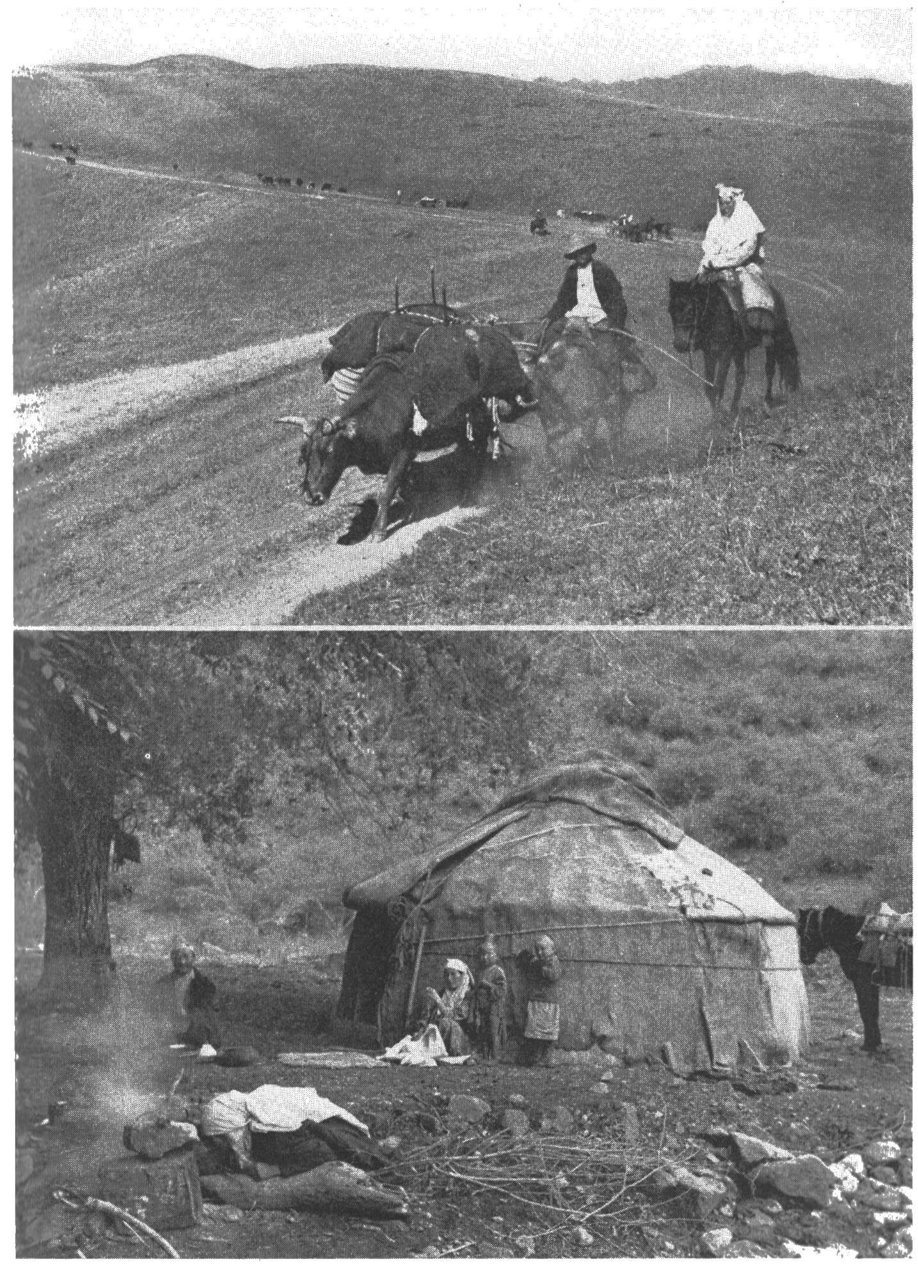
The Problem, Form, and Story Line · Each picture story has an individuality and form of its own. The space it is to occupy dictates it in part, but the subject carries its own mandate.

In photographing the public-relations and advertising stories, you invariably find another conditioning influence—a client with a problem. This problem is seldom simple, but is usually a part of a larger problem. The basic research task is first to understand the client's business, then his problem, and the people to whom he wishes to present his story. The form and photographic technique develop from a logic of the situation that you discover in the course of investigation and discussion. Fortunately, a good public-relations counsel or advertising agency usually simplifies this task for you.

The end form in which your photographic work finds itself can range from brochures to bound books, from travel folder to magazines published by the larger corporations, from annual reports to advertisements. Your subject matter can range from peanuts to steam rollers, from coal mining to fashions, or from furniture to servomechanisms for the Atomic Age.

Having selected a *form* and a *story line,* never for a moment forget the art director, who does the final layout. Give him flexibility and choice, so that he can best fit your pictures in the space available. A conference with him before shooting is invaluable. Again, never forget your reader. It is his eye that you must capture, and his attention that you must hold. Continually seek that aspect of your subject which will be as visually fresh as possible.

Industrial photography often calls for the dramatization of a single outstanding detail in the midst of a crowded scene. I find the most valuable lens for industrial work in my Leica outfit is the 35mm wide angle. Indoors I always use the camera on a tripod, while outdoors it is usually hand-held. Its depth of field, speed, and perspective enable me to catch natural light drama in what otherwise might be a fairly stereotyped scene. Or, I will use the 135mm Hektor f/4.5 long focus lens for a well-lit close-up. Vibration



7. Chinese Turkestan. *(Above)* A Kazak family moving to new grazing area. *(Below)* Kazak yurt and family. The mother is sewing, father and son sit waiting for food while another old woman blows up the fire. Such photographs are packed with information but not over crowded. (c) *Time* Inc.

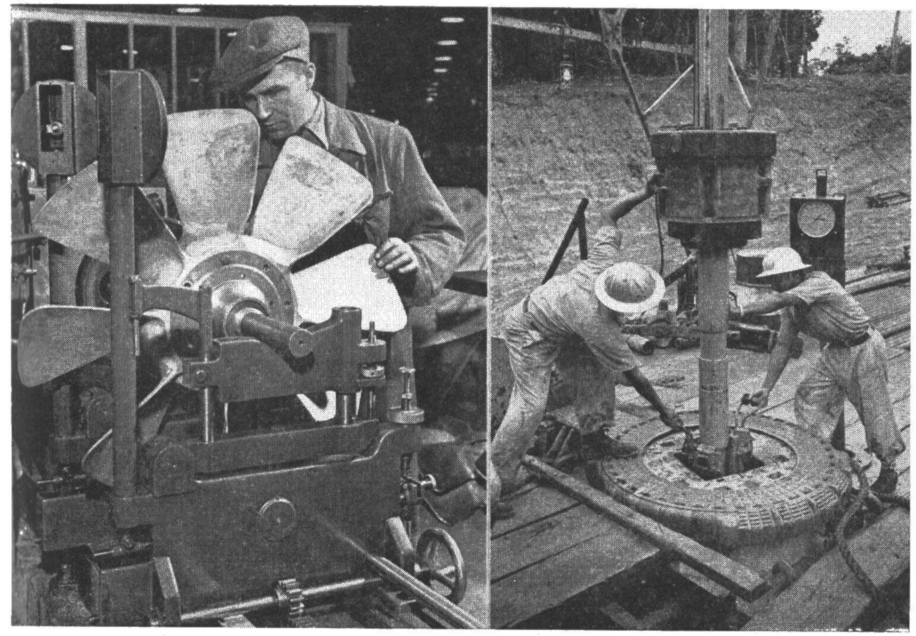
is a trouble in factories that can sometimes be overcome by a steadying hand on the tripod, or even a long hand-held exposure.

For most of my Leica work I use Super-XX film exposed normally and developed in DK-20. However, where I want extreme film speed and no greater grain, I use Plus-X film exposed at a speed rating of ASA 320 and developed in a variation of D-76 in which Kodalk has replaced the Borax tenfold. With care the results are as good.

Cameras are a matter of habit and utility. My present camera outfit ranges from Leicas with a battery of lenses to Rolleiflexes, to 3¼x4¼ and 4x5 Linhofs with a battery of lenses, to a 8x10 camera that I use almost exclusively for color. Each camera has its merits for certain types of work. The Leica is always in my kit for its special contribution.

Lighting is a matter of individual taste. Mine, I realize, is dramatic, but always based on naturalness and credibility. Anything obviously artificial may easily jar the reader into rejecting the story you wish him to believe. My lighting equipment runs from flash synchronization with many extensions to portable strobe units, 12,000 watts of color-temperature controlled floods, and spots for use on location.

8. Sheet hemming section of a great textile factory in Maine. The Leica with wide angle lens gave a depth of field and a natural quality that would have been impossible with a larger camera.



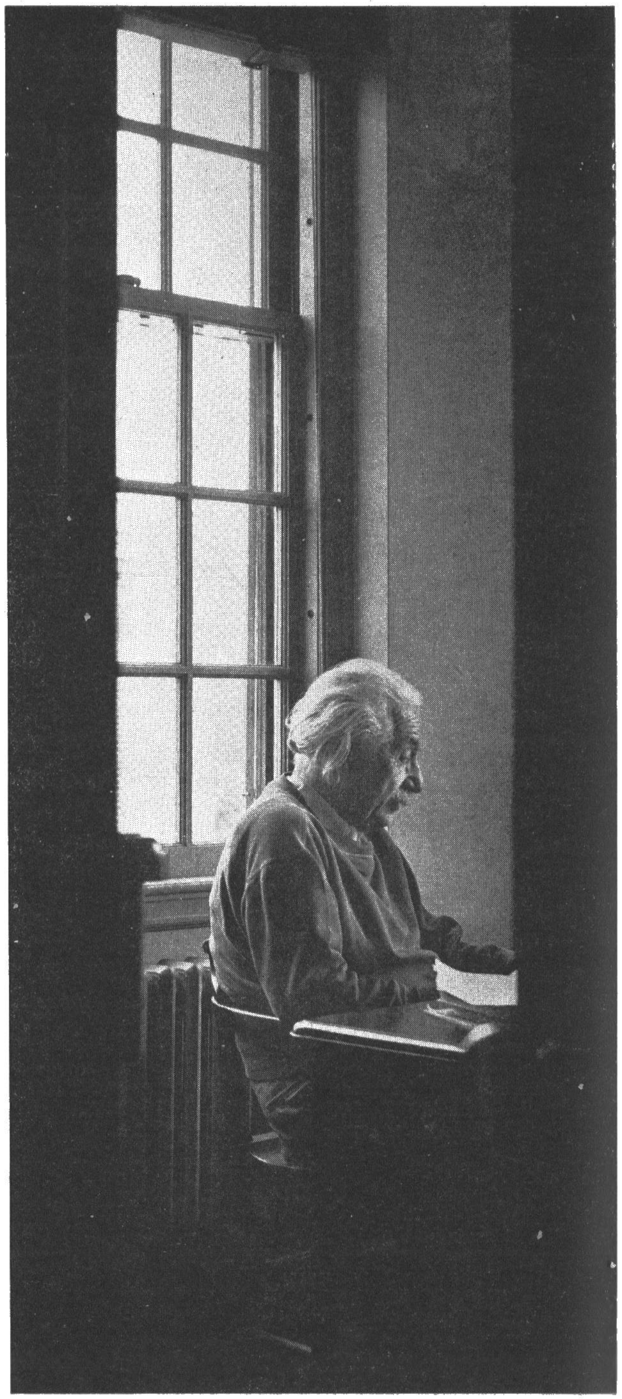
9. *(Left)* Worker testing balance of medium tank motor fan. Open flash with 50mm Summitar lens. *(Right)* Two Venezuelan drilling rig hands on the platform of a rotary drilling rig. Creole Petroleum Company's program for education and use of local labor has brought big rewards in good will and sound industrial relations.

Many a shot that would take a staggering amount of lights with a larger camera can be captured simply with the Leica. This was my experience in an industrial scene in the packaging section of a textile factory not long ago. A number of unobtrusive exposures with my Leica resulted in a general view that I could never have obtained otherwise, even with all the lighting equipment I had at hand.

But all matters of techniques are subordinate to your purpose. Tell your story directly. Catch your reader's eye with a superb lead or theme picture. Don't miss the climax or end pictures. These are the structural steel of your story edifice.

Remember that you are granted only a few seconds to catch your reader's whole attention. Seize it immediately with a powerful lead. Then carry it through a varied but logical sequence to a satisfying conclusion.

And remember, too, that self-interest or self-identification is the greatest lure of reader interest. Show him vividly how your story affects him personally. Enlist his personal interests. That is the key to the successful public-relations Leica photographic story.



1. Of Albert Einstein, Eisenstaedt says: "He is a wonderful man, quiet, soft-spoken. He always got nervous when he saw the camera pointed at him." This picture was made as part of a story on "The Thinkers," the members of the Institute for Advanced Study in Princeton, New Jersey.

MY WAY WITH THE LEICA

ALFRED EISENSTAEDT

I like people, and I like to photograph them the candid way—the way *they* like to be photographed, with the least possible fuss and formality. When people are pushed around, they are not themselves and the pictures reveal it. I like to photograph people and things as much as possible the way I find them, choosing for my pictures their most expressive attitudes. This calls for watchful observation coordinated with the immediate availability of my camera. My Leica has become so much a part of me—virtually an extension of my hands—that the camera and I work as a unit. My reactions are instantly relayed to the shutter, almost always enabling me to get a picture very like my mental vision of what I want to capture on film.

My way in photography demands that mechanically, at least, there shall be as few obstacles as possible between me and my subjects, so that I may achieve natural, meaningful pictures. For many years I have made my living taking pictures, and I have used all types and sizes of cameras. But I am most attached, yes devoted, to my Leica cameras because they help me to produce the kind of pictures that best express what I see and feel in the subjects I photograph.

Although some of my assignments involve a prepared shooting script, my most exciting pictures are rarely in the script. They are spontaneous and cannot be planned ahead. Once briefed on the theme or slant of the story preferred by the editors, I know the scene of the actual event will unfold pictures which could not be anticipated in advance.

As I was leaving to do a picture story of a football game at Notre Dame, the editor simply sent me off with a plea to bring back a few shots that would be "different." That was not easy. Football stories have been photographed for years, and rarely is it possible to find a slant that has not been used before. The night before the game, I learned that all the players would assemble at dawn in the chapel to attend Mass. I was in the chapel long before anyone

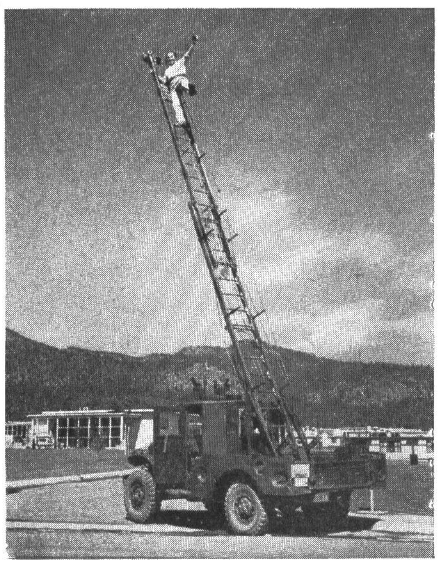
All photographs by Alfred Eisenstaedt, (c) Time Inc., are reproduced here by permission of Life Magazine, on whose staff he has been since it started publication.

else got there. And I was richly rewarded by some shots that proved to be quite "different" and not at all of the football "type."

To me, first impressions are quite important. That's why I like to start taking pictures as soon as possible after reaching the location. I take general views, close-ups, background, and all sorts of things that might escape my attention later. Early attention to such things often leads to a better undertsanding of the story. It is like learning a language—you pick up a word here, a word there, and it is not long before they fall into their proper places and convey a thought.

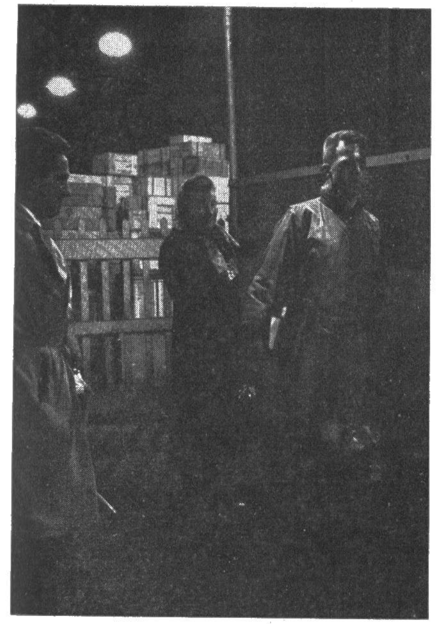
For about 95 per cent of my pictures I use a 35mm Elmar lens. When the light is good I can usually stop it down to f/6.3 or even f/9, at which setting it can be used as a fixed-focus lens, with its depth of field adding a desirable feature to my pictures. I usually have with me two Leica cameras, one equipped with the wide-angle lens, the other with the 50mm Summitar. Of course I have the necessary lens shades, view finders, lenses of longer focal lengths and an exposure meter. However, I rarely use the meter, and never outdoors, where I prefer to rely on my experience. I use only one kind of film—always Kodak Super-XX. And, of course, Kodachrome for color.

I like to feel that my equipment is as forthright as my approach to my work. On assignment I usually carry every piece of equipment I own. I get a feeling of security from the knowledge that I have with me more than I am likely to



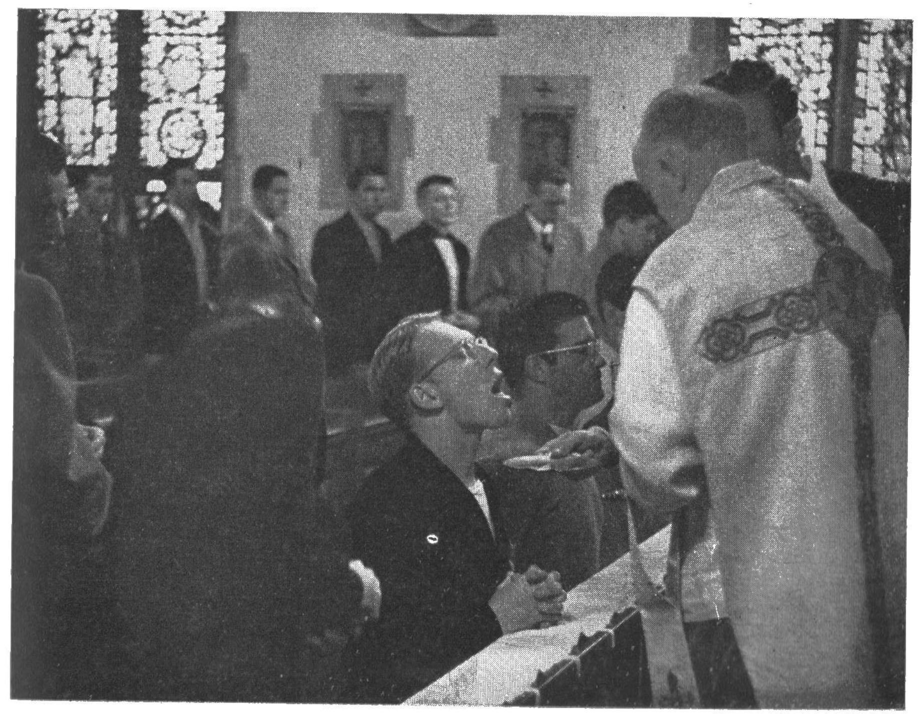
2. Photographer Eisenstaedt waves from ladder. "You often have to take pictures from an elevation, particularly to establish the scene of the story," he says.

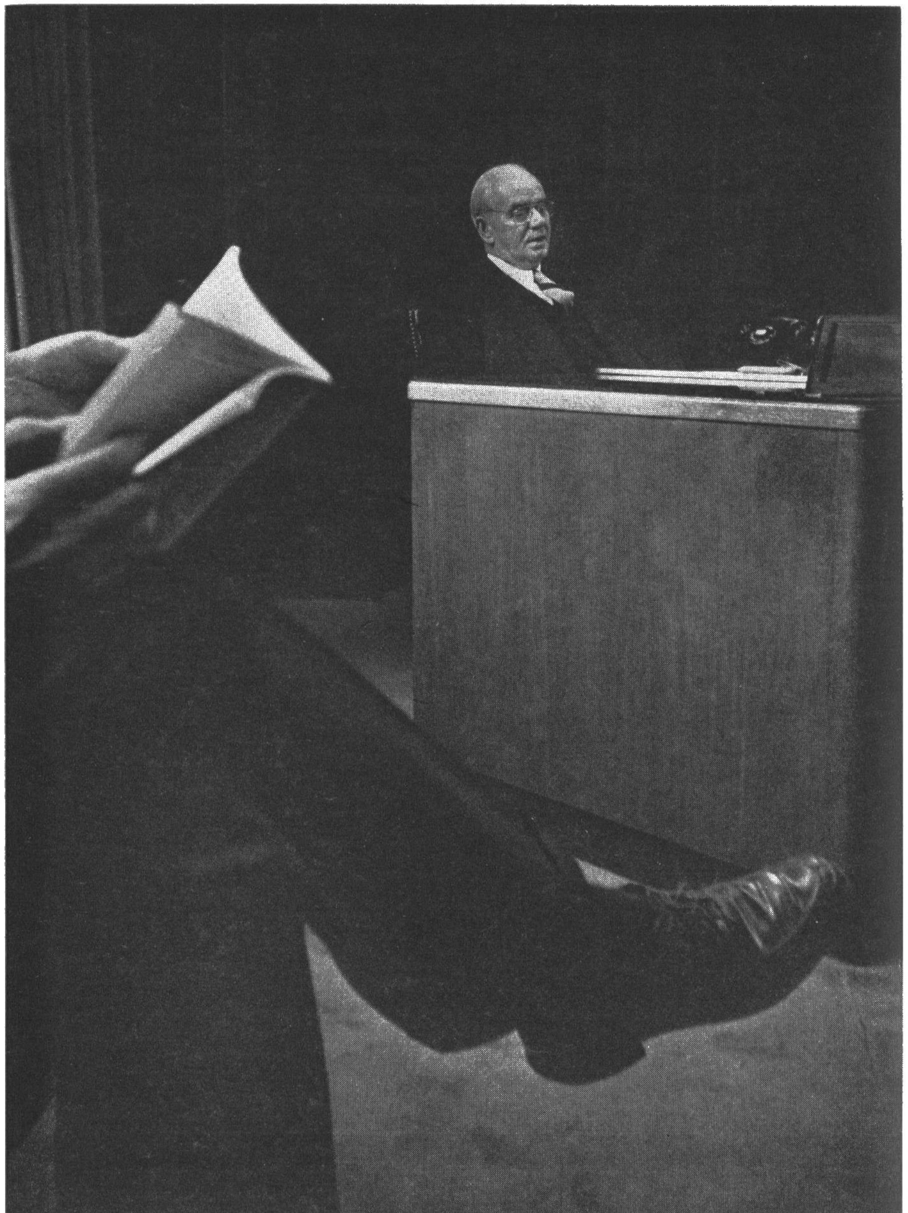
3. On the "Roosevelt Hospital Nurses" assignment, the editor's wishes were that the story should carry the atmosphere of a college rather than that of a hospital.



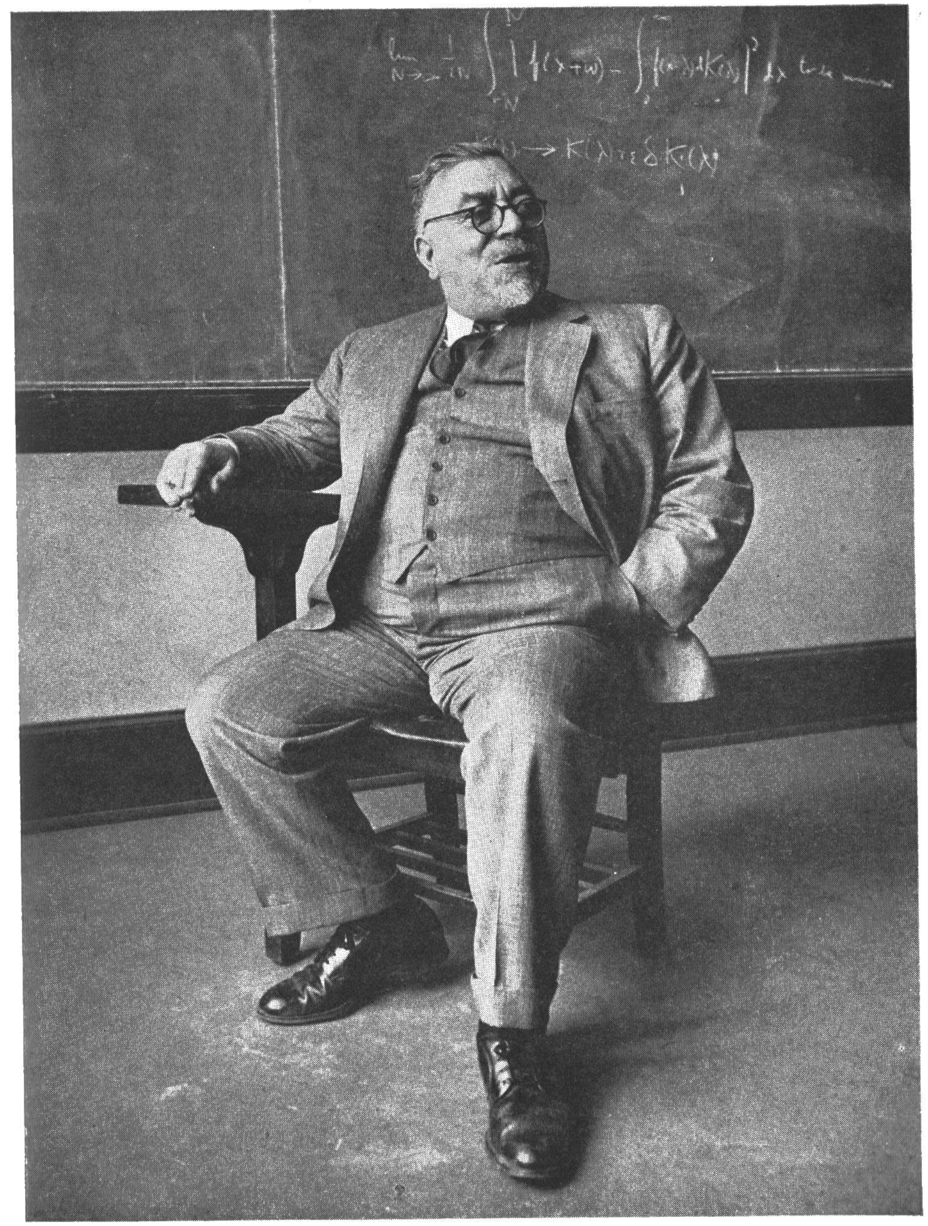
4. Gary Davis's refusal to pose for photographers delighted Eisenstaedt, who was able to do an entirely candid story on the American expatriate's arrival home from Europe. "I took this picture without a flash at ½ second — stopped breathing, pressed my body against the fence."

5. This chapel scene of a pre-game communion mass, used as the lead picture in *Life's* Notre Dame football story, was Eisenstaedt's answer to the editor's insistence that the story be "different."





6. Philip Murray, president of the CIO, sat almost motionless while being interviewed about a coal miners' strike. To give the picture meaningful emphasis, Eisenstaedt shifted to include someone's leg in the foreground of the camera field.



7. Mathematician Norbert Wiener might prove a "grumpy" subject, Eisenstaedt was forewarned. Having apparently won his confidence, the photographer was rewarded by Wiener's warm and jovial friendliness.

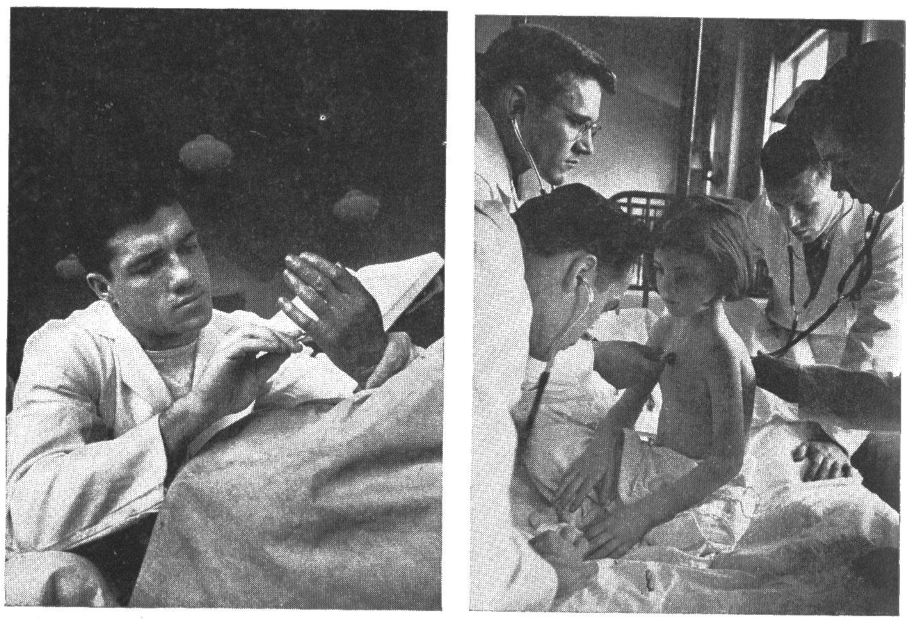
need. The reverse would be fatal. My carrying cases are equipped with small casters—a great comfort when there are no porters around. I always have a tripod with me, though I do not use it now as often as I did in the past. These days I prefer a neckpod, a fine item: a leather neck strap with a "pocket" supporting a wooden stick, screw threaded to fit the camera baseplate. The neck strap fits in my pocket, and the stick is carried in my sock!

When hard pressed for time or maneuverability, I rely entirely upon my steady hand for camera support, but try to brace myself firmly, or to lean against something or someone. Thus I have trained myself to take unmoved pictures at exposures of ¼ second without any support, and up to ½ second when braced against something.

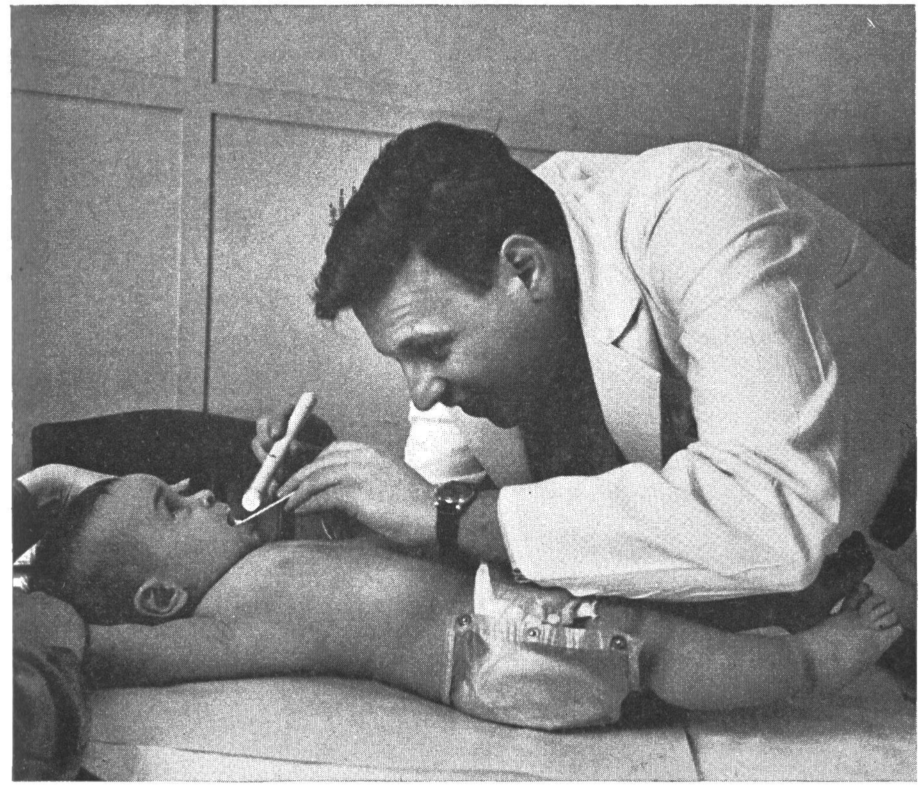
For extremely difficult lighting conditions I carry flash equipment. It is helpful sometimes on news or political stories, although there often is no time to reflect the light off ceiling or walls, as I prefer to do.

I also have one very personal requirement. It probably is a funny thing. Whenever I go on a job, I always wire ahead to have a ladder ready. Without a ladder I do not feel happy on a job.

Sometimes pictures taken under prevailing conditions do not convey graphically a situation that a person at the scene comprehends not only by what his



8. The "University of Michigan" assignment was to be a photo essay on the Medical School, to show the actual training. *(Left)* Anatomy book open, a student works on a cadaver. *(Right)* A group of young students examine the patient.



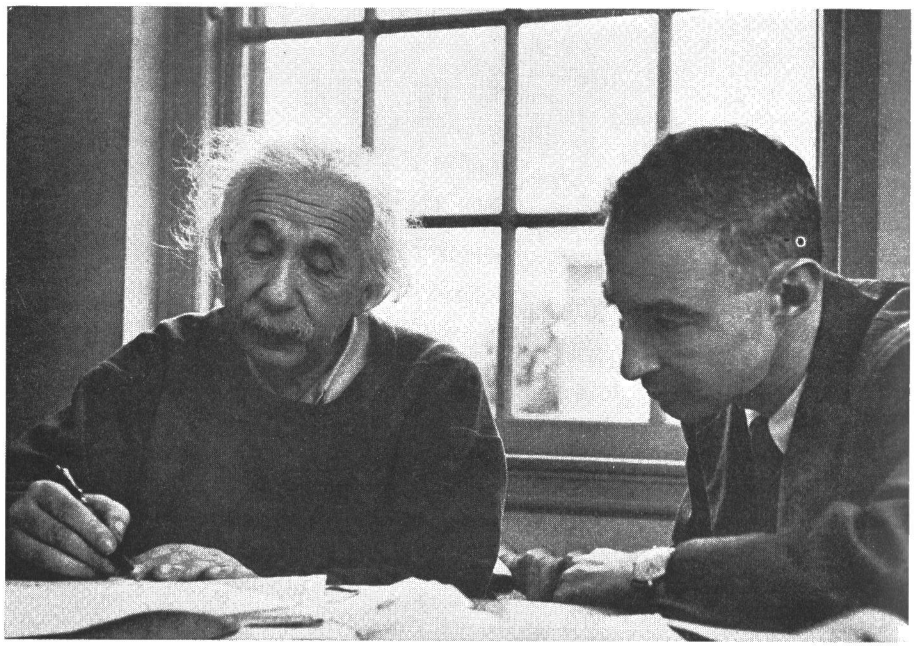
9. Junior at medical college offered the photographer a pleasing variation in the photo series on the "University of Michigan" assignment. Although Junior is having his arms held back and his legs are in mid-air, he is apparently enjoying the ordeal.

eye sees, but also by what his other senses grasp. To achieve an equivalent feeling or atmosphere in the picture, it may become necessary to rearrange things. I try to do this as inconspicuously as possible, so as not to alter the integrity of the situation or of the prevailing mood. This may involve either the redirection of the subject, introduction of some extraneous element, or merely bringing into the field of the lens something that will "frame" or point up the desired emphasis. The photograph of Phil Murray was made this way, after what seemed hours of hopeless waiting for something to happen during the interview. I asked someone nearby to move to another chair, which put a man's leg into the foreground, giving the picture perspective, strength, and a sense of drama.

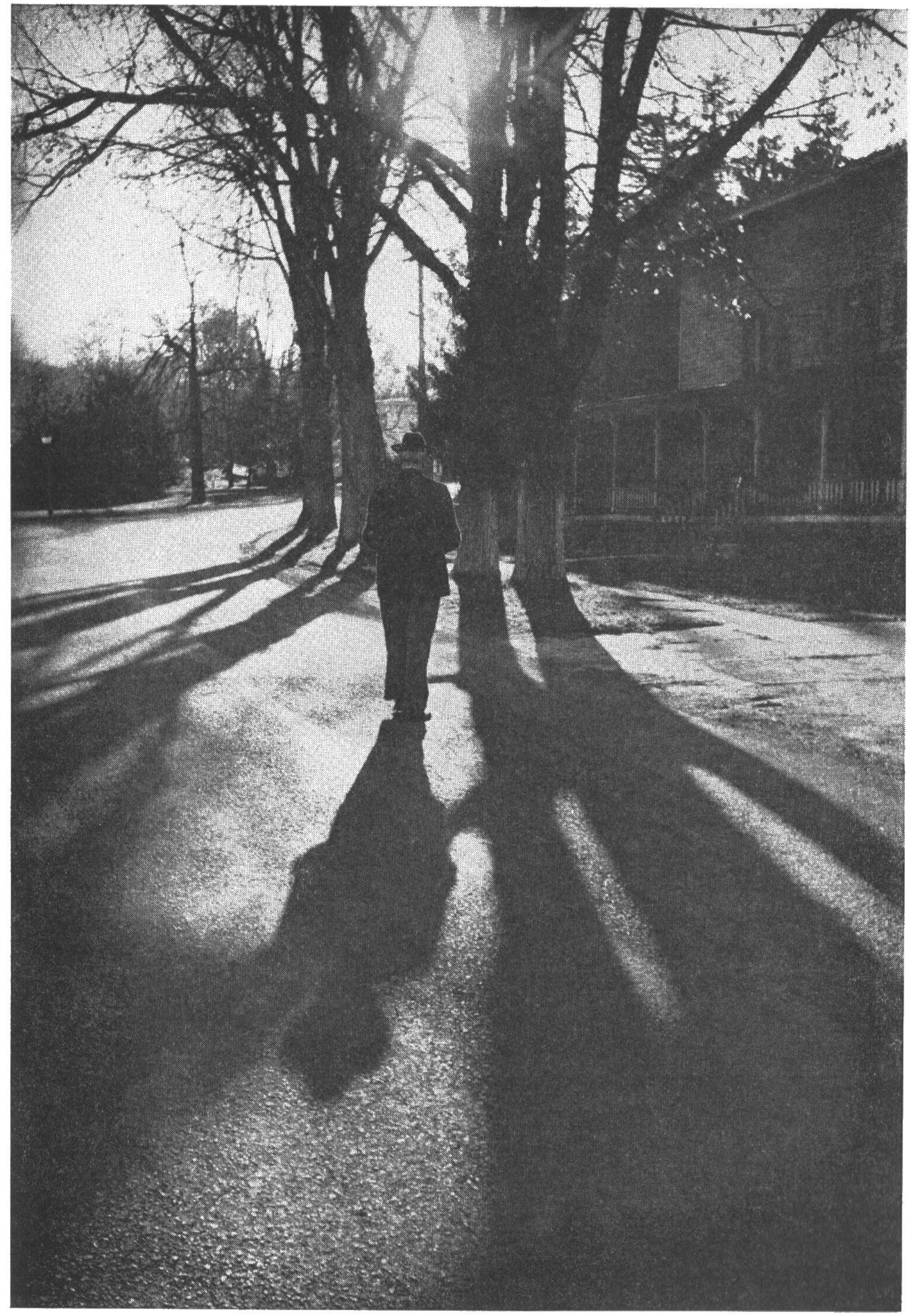
And then, one must have patience; sometimes just waiting for a picture may bring it about. When I went to cover the return of Gary Davis from Europe, after shooting all day I waited around until he had to leave the pier. I got some good pictures of him quite alone in the darkness, then carrying his own luggage in a freight elevator, and several others that were worth waiting for. Davis, incidentally, was a subject after my own heart from the moment he refused to do any special "posing" for the photographers.

I cannot think of a formula for good pictures. Formulas are good for developers but not good for making pictures. If you are aware of the world you live in, if you like people and approach them with a sympathetic and warm understanding, if you have or can develop the ability to place yourself in the position of the people facing the lens — you will get good pictures.

There is one thing, however, that is quite important: your proficiency with the camera. You cannot hope to get the good pictures you want unless you and your camera are fused into a single functional unit. When you are no longer aware of the mechanical aspects of how your pictures are taken, then—and only then—will you have the picture you want every time your shutter clicks, and not just another negative taken in 1/60 second at f/11 with a yellow filter.



10. Absorbed in a problem, Albert Einstein and J. Robert Oppenheimer, both camera-shy subjects, are photographed the "natural way" as mentioned in the text. Backlighting from the window helps to give the appearance of depth to the photograph.



11. "On each assignment I always look for one 'terrific' shot, which often makes the story. I feel it and take it all in a split second. I was very excited when I took this picture of Owen D. Young walking home into the sunset."

LISA — Jay Risling

The Leica camera with a medium focal length lens is used by this photographer for most of his portrait work. 90mm Elmar, 1/60, Plus-X film.

CHILD PORTRAITURE WITH THE LEICA

JAY RISLING

Most Leica owners have taken snapshots of children. To be successful in this field, one must have a real desire to work with youngsters and a willingness to accept the many difficulties that are apt to arise. My own belief is that child portraiture offers the lens of your camera the most fascinating and challenging problem of all the great number from which you may choose.

Whatever success I have achieved in photographing children I attribute to the fact that I love working with them and, perhaps more important, I have a recipe, or rather a method, of working. I don't believe it is possible to overstress the necessity of having a method that is dependable and will give consistent results if followed faithfully. The mechanics of taking the picture should be standardized, leaving the photographer free to concentrate on capturing the ever changing expressions and moods of the child. Delay caused by fussing around with experimental lighting effects is to be avoided, in spite of all temptation. My method of working is simple, the lighting equipment is inexpensive, and the whole procedure is as near foolproof as I have been able to make it.

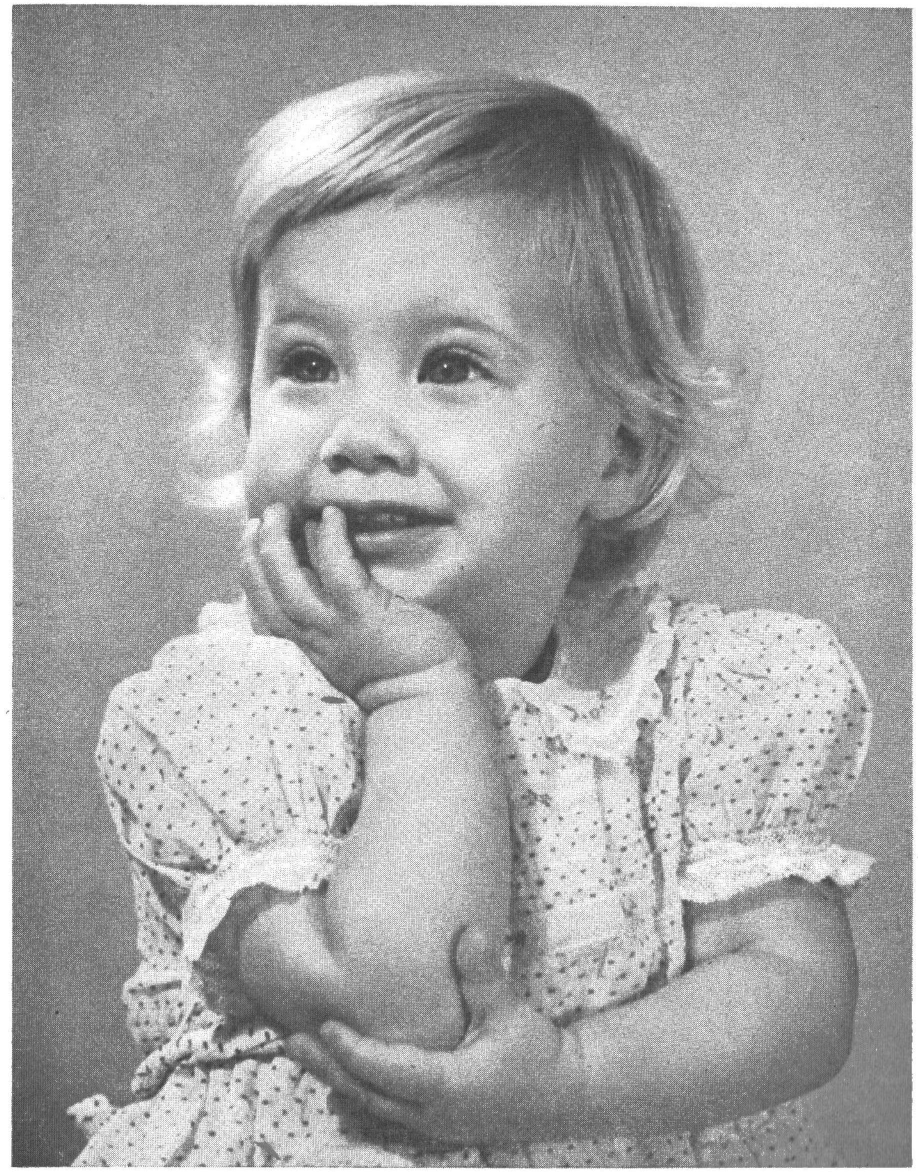
The Camera · During the many years I have worked with children I have found that the advantages of using the Leica far outweigh any possible disadvantages. The chief reason usually given for taking a child's portrait with a larger camera is that the bigger negative can be retouched. I am not willing to accept this as a valid reason. It is too easy to fall into the trap of overretouching, which is the surest way to ruin a child portrait. In the Leica we have a compact, functional camera the size of which will not frighten the most timid child. The cost per negative is relatively low, and the advantage of being able to snap as many as 36 shots in rapid succession is especially valuable in child portraiture. Because of the inherent characteristics of the camera, we can reduce our picture-taking outfit to an easily transported size.

For head and shoulder portraits, the longer focal-length lenses are almost a necessity. My favorite is the 90mm Elmar, with which I do virtually all my work. For full-figure shots where I am limited for space I use the 50mm Elmar. The Imarect Finder is a great help in ensuring that I'll get the ever moving child framed properly on my negative. It is advisable also to use a suitable lens shade, to guard against stray lights hitting the lens.

Lighting Equipment · Assuming now that you have a Leica camera, you are probably wondering what further equipment is necessary to take a successful portrait of a child. Well, you need a lighting equipment, but luckily it can be quite simple and inexpensive. It consists of two No. 2 Photofloods in reflectors, two light stands, and a small spotlight. One photoflood reflector is of the clamp-on variety; the other must have a fitting that will enable it to be fixed to the top of one of the stands. The spot should burn a 150-watt projection bulb and have some means to control the beam of its light. An extension cord with a triple plug completes all the lighting equipment needed to begin work. As an added luxury you can invest in a high-low switch, which will enable you to burn your lights at a low intensity while you are adjusting them properly.

Taking the Picture · Let us imagine now that you wish to photograph little Michael, age six months. It is unimportant whether you are doing it as an amateur or as a professional; the approach should be the same if the venture is to be successful. First, consult the child's mother as to the best time to take his picture. You should work only with a well-fed, rested baby in good health. When you arrive at the home, look for a medium-sized room with a plain light wall suitable for use as a background. The wall on one side of this background should have windows. Allow enough daylight through these windows to give the room an over-all subdued illumination.

The baby is best photographed on a card table. (A baby too young to be photographed on a table can be pictured in a crib, or held by his mother and snapped as he looks over her shoulder.) Place the table about 3 feet from your background wall and cover it with a blanket. Fix one of the Photofloods in its reflector on a stand and place it on a diagonal line about 3 feet from a front corner of the table. I prefer to set this light on the window side of the table. This will be your *key light*. The other Photoflood is clamped to the back of a chair and placed about 6 feet away from the opposite front corner of the table. This will serve as your *fill-in light*. Its purpose is to lighten the shadows thrown by your key light. Now fix your *spotlight* on the remaining stand and place it next to your background wall. It can be diagonally opposite either rear corner of the table, but I like to use it on the same side as my key light. Now raise the two lights on their stands to a position approximately 3 feet above the surface of the table. Connect the 3 lights to the extension cord and plug that into a light source. After you have checked your camera carefully you are ready.



1. NANCY. For head and shoulder portraits, the longer focal-length lenses are almost a necessity. My favorite is the 90mm Elmar, with which I do virtually all my work. This portrait was made with the 90mm Elmar, f/4, 1/60 second, and Plus-X film.

Place a chair next to the table on the same side as your key light and ask the mother to sit there. Explain that her only job is to give the child assurance by her presence, and to prevent him from falling off the table. At six months it is extremely unlikely that he can sit up well enough to be photographed, so you place him on his stomach with his head toward your key light. Your spotlight must now be adjusted to throw a light from the rear on the baby's hair.

If you choose to hand-hold your camera, make yourself comfortable on a low chair or stool. This is extremely important if you wish to avoid camera movement. I would advise, however, the use of a firm, steady tripod to ensure a good sharp negative. A ball-and-socket head on the tripod, which will enable you to change your camera quickly from a horizontal to a vertical position, is a good investment. A 10-inch cable release is well worth its cost when the camera is used on a tripod.

Tricky camera angles are to be avoided in child portraiture. It is best to photograph your subject with the lens of your camera at about the baby's eye level. The distance from you to the subject will naturally depend on the lens you use. With the 90mm Elmar I find 4 feet from the baby's head a good working distance. A reliable exposure meter will give the proper setting for the camera at this point. If you have no meter, set the lens at f/4. Shutter speed should be 1/100 second for a light-haired child or 1/60 for a darker one.

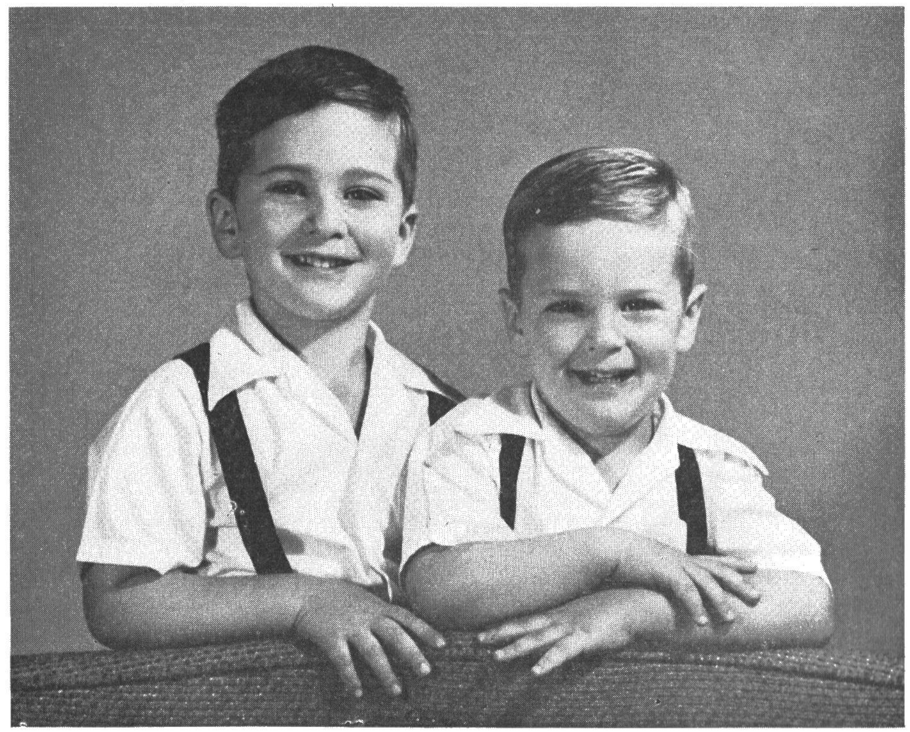
Now take a good look at your subject to see that clothes and hair are properly arranged. After you have made sure that there are no shadows on the background within the area to be photographed, you are ready to go to work. If you have a way with babies you can easily coax your subject to raise himself up on his arms, and possibly to smile; that is the instant for you to click your shutter. After you have shot half the negatives you intend to take, change the baby's position so that his body is pointed toward your fill-in light.

Six months later, when Michael is a year old, you can photograph him using only slight variations of the same routine. He can now sit securely on top of the table with his mother holding him just below the part of the body that will appear in your final print. It will be necessary to raise key light and spotlight slightly to compensate for the higher position of the head. However, if the child has deep-set eyes, keep your key light low in order to illuminate them sufficiently. If his nose throws a disturbing cross shadow, move the fill-in light nearer the camera.

When Michael is no longer an infant, but a young boy who can sit securely on a bench, you can dispense with the card table. The relative positions of subject, lights, and photographer remain the same. The older he grows,

however, the more care you will have to take in order to light him properly. His features now throw awkward shadows, requiring careful adjustments of your Photoflood lights to get a suitable balance. This method of photographing can be followed all through childhood. If you follow faithfully the routine I have outlined, you will get well-lit portraits regardless of whichever way he turns his head.

This, then, is the method of working. It takes care of the mechanics of child portraiture, leaving only the problem of securing the child's willing co-operation. Unfortunately this part of picture taking cannot be reduced to a formula. Considerable natural talent is involved, which it seems some people have and others haven't. In working with a child you must remember that you are dealing with another human being, one whose will is capable of saying no with enough authority to frustrate your best efforts. The problem, then, is how to win the child's willingness to accept the discipline necessary for you to take his photograph. During the years I've worked with children I have found a number of ways of securing this co-operation.



2. MICHAEL and DONALD. The double portrait makes a pleasing variation from the single poses. 90mm Elmar, f/4, 1/40, Plus-X film.

The Infant • The younger the infant, the more difficult it is to photograph him successfully. In most cases a two-month-old baby will fall asleep long before you have been able to shoot your full roll of film. Infants live in a world in which sounds are most important. The cooing and loving words he hears from those who adore him are what make him feel happy. Tell him he is the most beautiful baby in the world even though he obviously isn't. If it embarrasses you to behave in this manner, it will be necessary for you to have the assistance of someone who has this ability and to confine yourself to the operation of the camera. Avoid loud or sudden noises. Keep the atmosphere of the room as calm and quiet as possible.

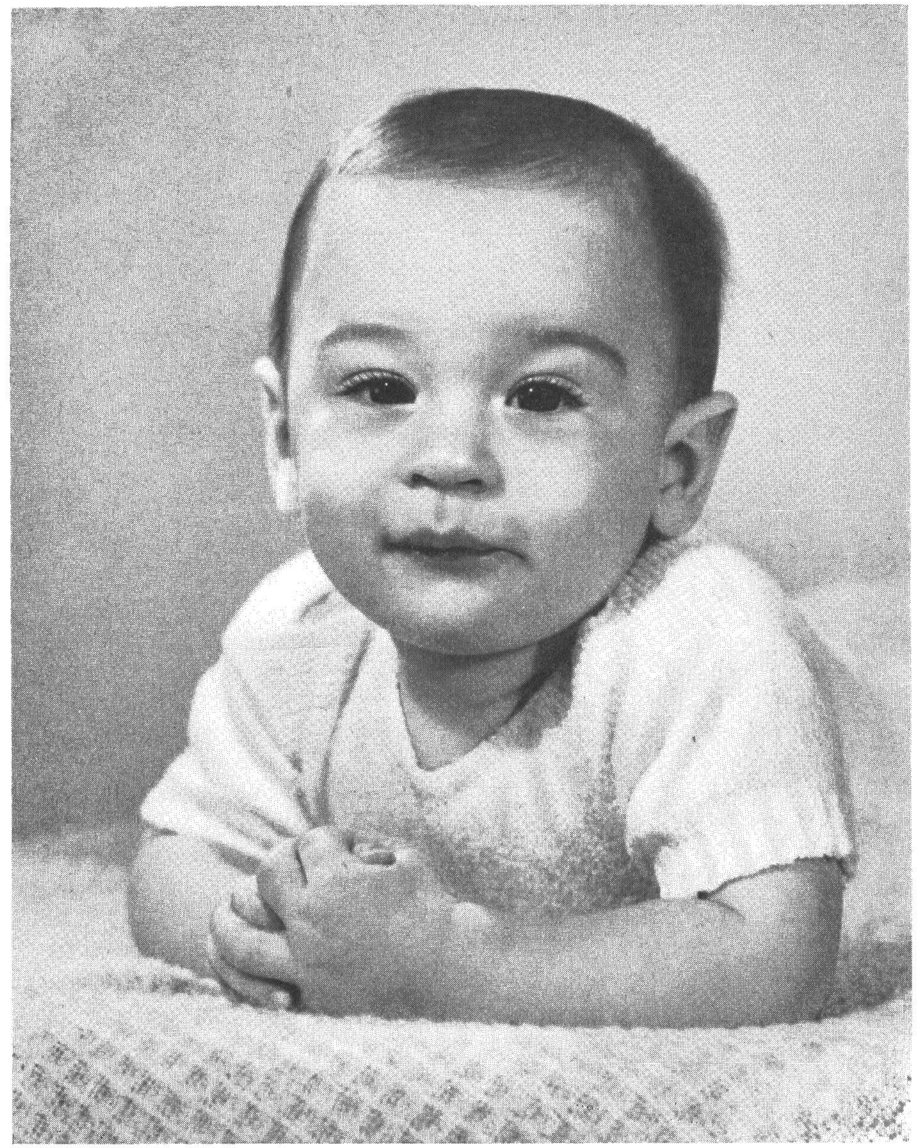
In portraying the child, regardless of age, it is necessary for the photographer to assert his authority. Tact here is most essential. It is inadvisable to allow more than two people to assist on a job, and those two must be willing to take your directions. How to clear the room of unwanted though eager-to-help relatives and friends without creating resentment is a real problem. A calm explanation of why this is necessary often solves the difficulty.

If your best efforts fail to arouse the baby, you can enlist the services of his mother while a third person sits next him at the table. Have the mother take different positions in the room as she coos to her baby, so that you can get a variety of poses. Often the sound of a familiar rattle is useful in attracting the baby's attention. In some of your shots look for opportunities to include the child's hands while he holds a small toy.

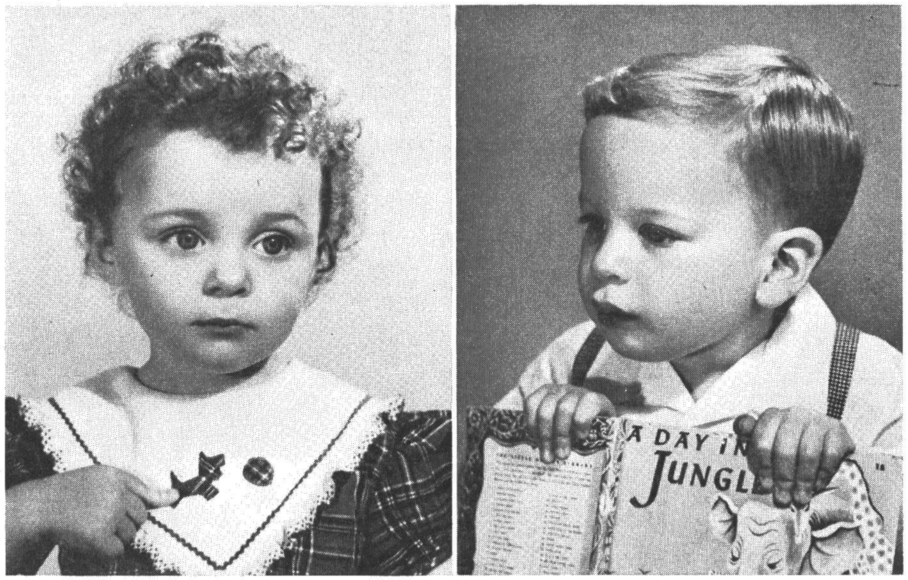
Don't worry about the effect of your lights on a baby. Frequently a seemingly dull infant is stimulated by them into an active, interesting subject. In warm weather, however, you must be careful not to let the little one become overheated or you will have a fretful, crying child on your hands.

As the infant's personality develops, you should learn to recognize his dominant trends. If the baby is naturally sober, he is better photographed in a serious mood. An aggressive child loves to pound and throw things. While he is enjoying himself in this way you can get pictures in keeping with his character. The older infant reacts to what he sees, such as your playing peekaboo with him from behind the camera. If something displeases him and he starts to cloud up, try diverting him with some new sound or activity. A mother will often give the baby a mirror or a brush with a shiny back that he will be loath to give up. These articles throw ruinous reflections and do not look well in a photograph. You can get him to give up these undesirable objects willingly only by offering him a suitable substitute.

The Older Child • Some children become self-conscious at an early age, but they all tend to offer this problem to the photographer as they grow older. When you arrive at your young subject's home, greet him in a casual manner; give him plenty of time to make up his mind about you. A youngster's



3. MICHAEL. At six months it is extremely unlikely that Michael can sit up well enough to be photographed, so you place him on his stomach with his head toward your key light. Your spotlight must now be adjusted to throw a light from the rear on the baby's hair. 90mm Elmar, f/4, 1/60 second, Plus-X film.



4. CLAIRE and LARRY. 90mm Elmar, f/4, 1/60 and 1/40 seconds, Plus-X film.

natural curiosity will lead him to ask questions while you are setting up your equipment. If you can learn to do a few simple tricks of magic, you will be able to win over most children quickly. After the ice has been broken, however, you have to depend on the willingness of your small subject to do his part in the picture taking. He will do this more readily if he is having a good time, and particularly if he is not being forced. Under no circumstances ask a child to smile or to assume a given expression; the result is artificial.

Unless the child is unusually fearful and needs the presence of his mother to give him a feeling of security, it is better to work with him alone. Each child has a different personality, and a game or a trick that will evoke a spontaneous expression from one will only bore another. If an idea fails, pass it off casually and go on to another. Eventually you are bound to find something that interests the child.

While I believe it is unwise to pose a child, he should be coaxed to sit up as well as he can. Here again more is gained by tact than by a direct order. A slumping child will often do better standing in an overstuffed chair looking over the back.

It is advisable to allow the mother to dress her child according to her own taste. Be sure, however, that the clothes fit well. Garments that have been worn and washed are usually more suitable than new clothes. Be careful of collars that are likely to flap up and cover part of the child's face.

5. SUSAN and RICHARD. Pets often give another variation for interesting photographs of children. Don't overlook the possibility of using the family dog, cat, or even the pet canary. 90mm Elmar, f/4, 1/40 second, Plus-X film.

The Negative · Now the question is: What type of film? I have found the medium-speed panchromatic films, such as Ansco Supreme or Kodak Plus-X, to be the most suitable. You can save money by buying this film in 100-foot lengths, but be sure it is frame-numbered.

Let us suppose now that you have just finished photographing the child and are anxious to see the results. In spite of your exhaustion, you are tempted to develop your films immediately. My advice is to put your camera aside and wait until you are well rested before doing this most important task. Film development is a rather simple matter, but it does require careful workmanship. To get consistent results you should use a developer that can be replenished after each roll of film has been processed. At the present time I am using Ansco Finex and find it entirely satisfactory. I develop my film in the conventional manner, with strict avoidance of any short cuts or freak techniques.. The things that seem important to me are 1) that you have all your solutions at the same temperature, and 2) that you agitate the tank sufficiently to get an evenly developed negative. You will have trouble with grain only if you overdevelop your negatives and allow them to become too dense.

The Print · The paper you use to make your enlarged prints can be left to your own choice. If your enlarger is fast enough, I would advise the use of a chlorobromide paper, such as Opal or Cykora. These papers have a warm tone that is especially flattering to the portrait of a child. It is a rare negative that can be printed well without considerable dodging, and these slower papers allow exposures of sufficient length to accomplish this. Of the many surfaces offered to choose from, I favor Opal G, and Kashmir when working with Cykora. To achieve brilliant prints, the particular developer you use is not so important as being sure that the materials are fresh.

If you would avoid hours of spotting on the final print, be sure that the negative you put in your enlarger is clean before you print it. A small amount of film cleaner on both sides of the negative, wiped dry with a tuft of cotton, will remove whatever dirt there may be on the film. With the aid of a soft camel's-hair brush you should be able to get your negative in the enlarger free from dust or lint.

Your success in child portraiture will depend largely on your ability to produce consistently good results. Work with the materials you have decided to use until you are thoroughly familiar with them. Elsewhere in this manual you will find excellent advice on proper darkroom procedure and print finishing. If you follow faithfully the method I have outlined for photographing the child, I am sure you will find working with youngsters both profitable and enjoyable.

LANTERN SLIDES FOR PROJECTION

WILLARD D. MORGAN

Projected Leica pictures in black-and-white or color must be seen to be fully appreciated. A well-made positive retains all the fine tone gradations of the original subject. The illumination from the projector lamp gives life to otherwise dead shadows and brilliance to highlights. This helps to re-create the original object or scene, and to give a greater feeling of naturalness in comparison with the usual paper print.

Today the miniature lantern slide has been accepted along with the television set. The family has formed fixed habits of watching and being entertained by projected images on the vacuum-tube screen or on the home projection screen. In order to retain this group interest in projected Leica pictures it is important to have interesting and well-selected slides for showing. Remember that your audience has been trained to watch the movie and TV screens, and to know when they are bored with a show. This makes the challenge to the Leica photographer all the more fascinating.

Subjects for the lantern-slide enthusiast are unlimited. Family records, animals and pets, scenery on trips, subjects from every country in the world, form the basis of pleasant half-hour showings. Other slide sets may illustrate special hobbies, architectural subjects, geological formations, close-ups of insects or flowers, portraits, and all kinds of subjects for lecture purposes. When these slides are produced in full color, the showing has reached a new high in picture presentation. In addition to his own photographic work, the avid slide collector will exchange views with friends and also add others by purchasing from the many sources available. Every slide should be carefully mounted, cataloged and kept in handy slide boxes for immediate use.

When making the original pictures, there are a few important points to observe in order to make the final projected lantern slide more effective. Here are some of them:

1. Be selective in subject matter. Avoid taking the broadside type of picture. Concentrate upon the essential part of the subject and fill the view finder with what you see to be important.
2. A neutral background helps to give greater interest to the main foreground subject.

3. Try to get the foreground part of the picture sharp right down to the bottom of the frame. A fuzzy foreground gives flatness to the projected image and detracts from the total impact of the scene.
4. Catch the natural positions of people, and avoid the deadpan stare. On the other hand, the forced candid-type picture often becomes dull with repetition.
5. It is taken for granted that careful focusing, exposure, and lighting all add up to the making of fine transparencies.
6. In making black-and-white positives care should be given to the exposure and the development in order to produce an image of good contrast without its being either too light and washed out or too dense and flat.
7. Strive for picture variety, as well as change in camera position. A golden bed of daffodils will give one type of picture while the ultra close-up of one flower will give still another emotional interpretation to complete the presentation.
8. Use a few orientation pictures in every group of subjects. Such pictures may be a general view of the town or a picture of the railroad station showing the name of the city; or a series of county-fair pictures may show the entrance with all its banners, dates and the name of the fair. Such pictures help to change the pace from general to selected scenes and give unity to the slide set.
9. Actually, the essentials for making good pictures for projection are the same as making good photographs for any other purpose. Careful study of the chapters on exposure, lighting, color, development, filters, and other subjects will help produce the fine lantern slide.

The Illustrated Lecture • The universal exchange of information and experiences has become a tradition in modern society. A local expert in news photography will certainly be called upon many times to talk before camera clubs and other organizations. A doctor may be asked to present his methods or his research before a medical society. Or the world traveler will be invited to tell local business organizations about his experiences. In every case, if the talk is supported by lantern slides the total effect will be many times more effective than just words. Thus the projected picture becomes an essential medium for informing and holding the attention of an audience.

With the popularity of the illustrated lecture, there are important things to remember to keep audience attention.

1. Clean all glass-covered slides to remove dirt and finger prints.
2. Clean lens and condenser of the projector.
3. Use a good projection screen to fit the size of the room or hall. A beaded screen gives the highest reflection but restricts the angle of view. The flat white screen has a wider angle of vision and is satisfactory for most places, especially if there is a strong lamp in the projector.
4. Always check the location of the projector to make certain that the distance from the screen is satisfactory, and also that the nearest electrical outlet is within range of the connecting cord. It is good insurance to carry along an extra extension cord. The projector should be placed on a firm support to avoid any motion during use.

5. Check the sequence of the slides and see that they are all in the right position, to avoid occasional jolts from seeing upside-down pictures on the screen.
6. Whenever possible, use a small pilot-light signal at the projector to indicate slide changes during the talk.
7. Never be without a spare projection lamp—the old one may fail right in the middle of an important lecture.
8. An average rule to follow in a large hall is to have the width of the projection screen about one-tenth the distance to the last row of seats. In the home, this rule may vary considerably. However, an image should not be too gigantic for close-up viewing.
9. Have a pointer handy, to be used if needed.
10. Keep sufficient illumination in the room so that the lecturer can be partially seen. This will help the audience follow the gestures of the speaker and also will reduce eyestrain.
11. Occasionally one may find a picture projected beyond the screen limits. In such a case move the projector closer or get a larger screen.
12. Set the projector so that it will be perpendicular to the screen and not at an angle from right or left or below.
13. Use a uniform binding for all your lantern slides. There is nothing more annoying than to see the operator trying to keep odd slides in focus. Glass and paper-mounted slides have different thicknesses, and should be grouped for showing, or the thin slides remounted in the glass mounts. All color transparencies should be bound between glass for protection and to maintain uniform focus during projection.
14. Attention to preliminary details will ensure smooth operation during the lecture, and avoid distractions.

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 in the Leica enlarger and then printing directly by projection. 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 can be utilized. Both of these methods will be described in detail.

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 8 feet of positive film. The raw stock is wound on one spool and unwound on another take-up spool after each contact print has been made. A ratchet clicks for each space of ¾-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 on the Eldia Printer a single-frame window that is interchangeable. The accompanying illustrations will give a more definite idea about the appearance of the printer.

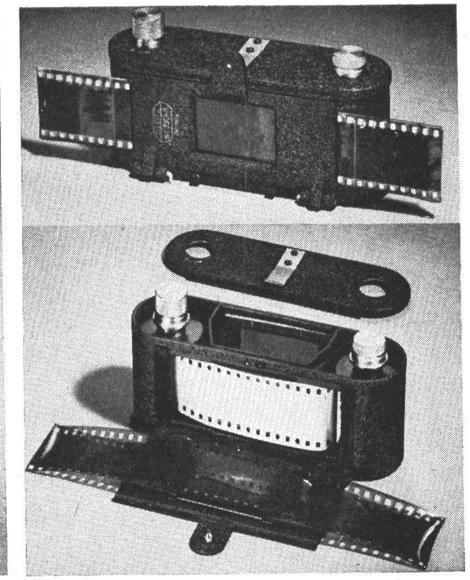
In using the Eldia Printer, it is possible to print each negative in its original sequence, or if necessary, important negatives only may be selected and printed on the positive film stock, which is later developed and used in one of the projectors. In doing this, the negative is pulled past the window 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.

Making the Leica Glass Positive · Glass 2x2-inch positives can 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 2x2-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 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 making 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 wet test slide can be projected and the best exposure quickly determined for the next slide.
3. The glass slides are developed in the usual slide developer. Formulas are given in the same package with the 2x2-inch glass slides.

The Eastman Kodak Company supplies the 2x2-inch glass slides in soft and medium as well as contrast grades. When making glass slides, it is best to have all contrasts available, in order to obtain the best results from negatives that may be contrasty or flat. Usually, the contrast grade will be used. After the glass slide is exposed, developed, and fixed, it should be tested in

1. Eldur Glass Slide Printer for making 2x2-inch glass slides by contact printing.



2. Eldia Film Printer designed for film positive printing by contact from Leica negatives.

the projector for correct exposure and development. While still wet, after a quick rinse in fresh water, it may safely be projected 2 or 3 seconds. After making thousands of glass slides, I still recommend that each slide be placed in the projector and flashed on 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 2 or 3 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 half a minute or more, the emulsion will warm up and melt, thus ruining the slide. It is very easy to have the projector in the darkroom for this purpose. A small image projected on a white cardboard is sufficient for determining the quality of the slide.

Developers for use with the 2x2-inch glass slides are prepared as follows:

ELON-HYDROQUINONE DEVELOPER		Kodak D-72
Water (125°F or 52°C)	16 ounces	500.0 cc
Elon	45 grains	3.1 grams
Kodak Sodium Sulfite (desiccated)	1½ ounces	45.0 grams
Kodak Hydroquinone	175 grains	12.0 grams
Kodak Sodium Carbonate monohydrated (2 oz.)	290 grains	80.0 grams
Kodak Potassium Bromide	27 grains	1.9 grams
Add cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given. For *Lantern Slides* dilute 1:2. Develop 1 to 2 minutes at 68°F (20°C). For greater contrast, dilute 1:1, and for less contrast, 1:4. For line drawings, Formula D-11 is recommended.

Make certain the exposure is such that the positive plate will remain in the developer for at least 2½ to 3 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 that are obtained 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.

Whenever more contrasting results are required, it is necessary to use a contrast developer. The Eastman D-11 Developer produces good contrast.

ELON-HYDROQUINONE PROCESS DEVELOPER		**Kodak D-11**
Water (125°F or 52°C)	16 ounces	500.0 cc
Elon	15 grains	1.0 gram
Kodak Sodium Sulfite (desiccated)	2½ ounces	75.0 grams
Kodak Hydroquinone	130 grains	9.0 grams
Kodak Sodium Carbonate, desiccated*	365 grains	25.0 grams
Kodak Potassium Bromide	73 grains	5.0 grams
Add cold water to make	32 ounces	1.0 liter

*If monohydrated sodium carbonate is used, the quantity given above must be increased to 1 ounce (30 grams).

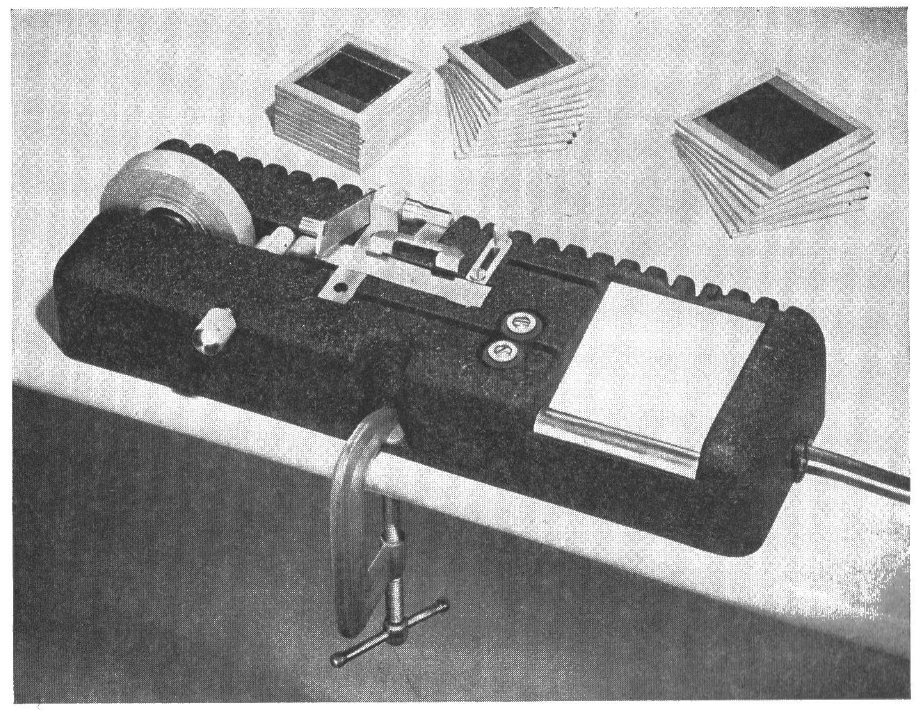
Dissolve chemicals in order given. Develop about 5 minutes in a tank or 4 minutes in a tray at 68°F (20°C). When less contrast is desired the developer should be diluted with an equal volume of water.

Using Projection Paper for Testing · In 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 the glass plate for testing the exposures. A paper such as the Ansco 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 can be easily determined for this paper, as well as for 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 can 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 that is made into a positive for projection. These paper prints are useful for classifying the pictures later. There is a special metal pressure plate that may be placed over the square rubber plate 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.

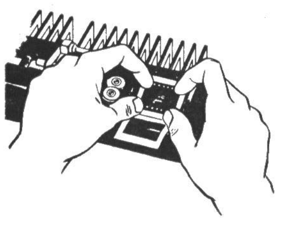
After each positive glass plate has been developed, it should be rinsed for a few seconds in fresh water and then placed in the hypo clearing solution

for about 8 to 10 minutes. After clearing, the slide is then placed in running water and washed for half an hour. When washing has been completed, wet a piece of cotton, or use a wet viscose sponge, and swab off both sides of the lantern slide plate, place 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 that might settle on the wet emulsion of the plate and later show up on the projection screen.

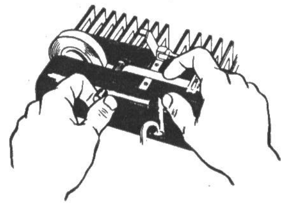
When all the slides are dry, they should be projected before binding in order to check on the quality. In case there are scratches, pinholes, or other defects, the slide must either be touched up or discarded. Small pinholes and breaks in the emulsion can usually be eliminated by spotting with a fine 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. Slides showing machinery parts, and copies of irregular subjects that are to be shown without a background, will require this method of opaquing before binding.



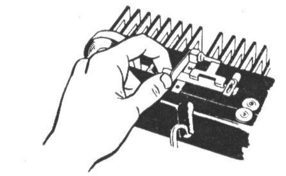
3. The Bindomat is a valuable accessory for binding 2x2 glass slides. There are two operations involved in using the Bindomat, 1) mounting the transparency between foil masks and 2x2-inch cover glasses, and 2) binding the edges.



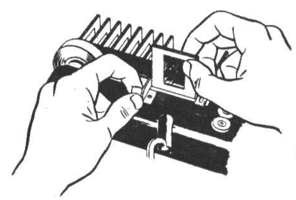
1. Center transparency on mask, above one glass plate; complete the "sandwich" with a second plate. Lift the mounted transparency and stand it on edge in the rack.



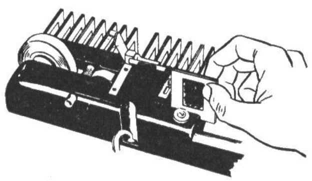
2. Feed tape along channel — up to the sliding stop, which must be across the channel if 2" glasses are to be bound; leave stop in back position when binding 2-7/16" glasses.



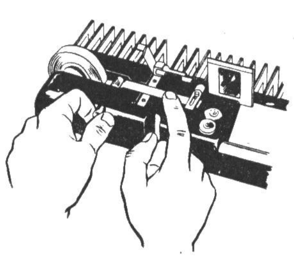
3. Lower knife just to edge of tape—but do not cut. As knife is lowered, the "fingers" of the attached spring stop will drop down to hold tape.



4. Using the spring stop as a guide, center edge of the mounted slide on the tape—and press down. Cut tape with slight pressure on knife, then swing knife upward to free slide.



5. Press taped edge of slide down into binding slot and pull through the rubber rollers. This action seals tape to glass.



6. Stand slide in short slot while feeding tape along channel. Repeat the cutting and binding operation for each of the three remaining sides. Slide is now completely masked, bound and ready for projection.

4. The simple steps in binding a lantern slide insure uniform results when using the Bindomat.

Mounting the Finished Glass Slide • After the glass slide is dry, bind with a clear cover plate together with a cutout mask and a strip of lantern-slide binding tape. The binding tape can be cut into four lengths of 2 inches each, or if preferred, one full length about 8½ inches long may be cut. Place the cutout 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 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 can be cut with scissors and bound between glass plates. Some Leica users prefer this method, since the pictures can be made at less expense. Two or three positives can 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 binding tape in order to keep the picture centered while binding. This method is especially recommended for natural-color film.

A good Leica transparency is always worth permanent binding between 2 x 2-inch cover glasses. The Bindomat has been designed to make this work easier and quicker. This Leitz accessory ensures uniform bindings and a neat appearance of the finished sides. The Bindomat has a cast-metal base with depressions for holding the roll of binding tape, the glass plates, a cutting knife, and a transparency viewing glass.

The accompanying illustrations show the important steps in mounting the transparencies. More detailed directions are furnished with the equipment.

After a slide has been bound, the final step is to label it and place a white identification spot of paper or tape on the corner. To determine this position, hold the slide so that the picture is correct for viewing on the Bindomat illuminating glass. Stick the white spot on the lower left corner of the cover glass and the title along the side. When the slide is inserted into the slide carrier of the projector, this identification spot will be at the upper right corner facing the projection lamp. This mark makes it easy to place the slides in the projector in a dim light without any hazard of showing pictures upside down or reversed. The white spot and the slide title can also be placed between the glass plates before binding.

Leitz supplies special cover-glass plates that are uniform in thickness and size, and which are provided with edges that have been ground to a smooth even finish.

Still another method of preparing film positives for projection is by mounting three positive films between two clear-glass plates that measure 35x120mm. These plates are bound like the 2x2-inch glass plates. The VIII-S 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 35x120mm slide.

Making Film or Glass Slides by Projection • My favorite method of making film or glass slides is by using the enlarger. The negative is placed in the Focomat 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 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 with a smooth white surface may be cut for this purpose, or two printers may be used.

Film positives can 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 can 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) can 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 can be made by reduction from the Leica size 24 x 36mm negative. The Eldia Printer equipped with a single masking window can be used for this purpose. The Leitz Enlarger is equipped with a 60mm 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.

In 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 can be pushed into the corner of the easel in such a way that a second plate can be substituted 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 can 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 VIII-S projector.

An orange filter is convenient to use while making glass slides. Such a filter can be thrown across the projected negative image in order to make certain that the unexposed glass plate is centered before 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 can 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 that should be printed longer. In fact, the projection method of making glass-slide positives is the ideal way in order to ensure 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 methods similar to those 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 that will produce beauty and brilliance equal to those of slides made from larger negatives.

When using the Leica enlarger for making film or glass positives, it is necessary to use either a 30mm or a 60mm extension tube between the 50mm lens and the focusing mount of the enlarger. When the 30mm tube is used, keep the lens barrel pulled out and locked in position. However, in case the 60mm tube is used, the lens barrel can be pushed in as far as it will go. The

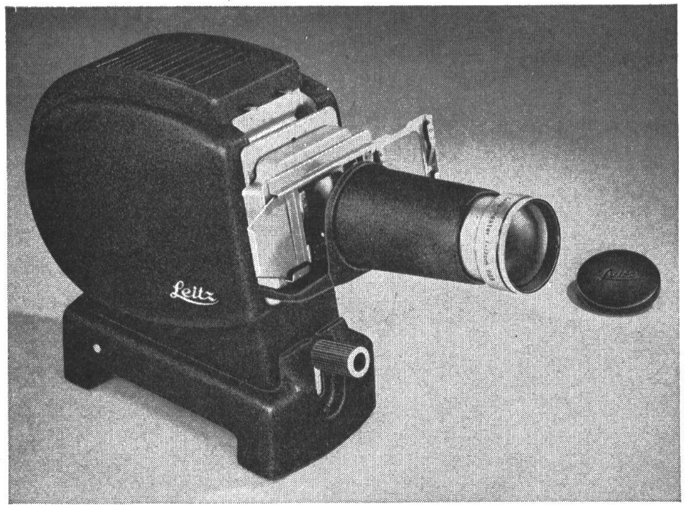
correct focus is obtained by turning the focusing mount of the enlarger. Naturally, other extension tubes or any combination of tubes may be used, depending upon the results required. In case a longer working distance is required, a 60mm tube and 90mm Elmar lens can be used.

Finishing the Lantern Slides · After printing, the slides should be mounted between the 2x2-inch glass plates for permanent protection. Clear glass plates, masks, and binding tape are the only materials required. The hinged or double mask is used for holding the positive film in place between the two glass plates. Only a single mask is necessary when the positive is on a glass plate. When masking and binding glass plates, be sure that the emulsion side is on the inside, covered with a clear plate.

The Bindomat is convenient for binding the 2 x 2 slides. With this accessory a great number of slides can be bound in a short time. The illustrations on page 272 show the few steps necessary in binding when using Bindomat.

The VIII-S Projector · Good lantern slides should have good projection equipment. A lantern slide takes time to produce, but if it is shown in a poorly designed projector or with an inferior lens, much of the slide quality is lost. The Leitz VIII-S-400 has been designed as an all-round projector

5. The VIII-S Projector gives brilliant projected Leica pictures in either horizontal or vertical positions.



6. The Parvo II is a small lightweight projector. The 300-watt projection lamp gives ample illumination for projecting color slides.

for showing black-and-white and color slides. This projector has a 400-watt projection lamp, interchangeable condensers, and provision for using the Leica camera lenses or the special 85mm and 120mm Hektor projection lenses.

The general characteristics of the VIII-S-400 projector are as follows:

1. Dimensions: 13 inches long (without lens), 10⅝ inches high and 6¼ inches wide.
2. Equipped with a double lamphousing.
3. There are three internal condensers available (Nos. 1, 2 and 3), which are mounted separately. This provides efficient ventilation and allows the condensers to be rapidly removed. Condensers 1 and 2 are used with the various Leica and special projection lenses with the exception of the Elmar 50mm lens, in which case condensers 2 and 3 are employed. Interchangeable external condensers are supplied for lenses of different focal lengths. Interchangeability of condensers enables the correct condensing system to be used with each individual lens which permits maximum and even illumination on the screen.
4. A window shutter for reading or making notes in a darkened room during projection is provided.
5. There is a built-in tilting device. Turning a screw to left or right raises or lowers the projector housing.
6. The front of the projector revolves permitting the projection of vertical or horizontal film slides.
7. 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.
8. To further ensure maximum illumination, the lens carrier (which also supports the film gates) can be changed in its position relative to the lamp house.
9. 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. There are small bars over the knobs of the film spools. To turn the latter, one must push the small bars forward. This action causes the glass pressure plates to separate so that scratches on the film are prevented while being moved.

10. To remove a film or glass-slide gate, it is merely necessary to release a lever, after which the gate is lifted off the projector. This permits quick interchangeability of the different gates.

The Parvo II is a compact projector for use with the 2 x 2 lantern slides and 35mm strip films. This projector has a 300-watt projection lamp, coated long-focus Hektor f/2.5 lens, of 100mm or 120mm focal length.

Finally, after you have mounted and labeled the Leica lantern slides, you should file them in a dustproof container. There are various types of files available, including small cabinets for larger collections. As your collection grows there should be some indexing system established. This can be a simple grouping according to subjects or a complete listing of each slide with index numbers. You are now ready for showing your slides whenever the occasion arises.

Projection Distance and Size of Image with Leica Pictures (1x1½-inch.)

Distance:	10 ft.	13 ft.	16 ft.	20 ft.	23 ft.	26 ft.	30 ft.
50mm lens	7'4"x5'	9'6"x6'4"	12'x8'	14'4"x9'6"	16'8"x11'2"		
73mm lens	5'x3'4"	6'8"x4'5"	8'x5'4"	10'x6'8"	11'6"x7'8"	13'x8'8"	15'x10'
80mm lens	4'6"x3'	6'x4'	7'6"x5'	9'x6'	10'6"x7'	12'x8'	13'6"x9'
85mm lens	4'2"x2'10"	5'8"x3'8"	7'1"x4'8"	8'4"x5'8"	9'8"x6'6"	11'4"x7'6"	12'8"x8'6"
90mm lens	4'x2'8"	5'4"x3'6"	6'10"x4'4"	8'x5'4"	9'x6'4"	10'6"x7'	12'x8'
100mm lens		4'6"x3'	6'x4'	7'6"x5'	8'x5'6"	9'6"x6'4"	10'8"x7'2"
120mm lens		4'x2'8"	5'x3'4"	6'x4'	7'1"x4'8"	8'x5'4"	9'x6'
135mm lens			4'6"x3'	5'8"x3'8"	6'x4'	7'1"x4'8"	8'x5'4"
150mm lens					5'8"x3'8"	6'4"x4'2"	7'1"x4'8"
200mm lens							5'8"x3'8"
Distance:	**33 ft.**	**40 ft.**	**46 ft.**	**53 ft.**	**60 ft.**	**66 ft.**	**73 ft.**
80mm lens	15'x10'						
85mm lens	14'x9'4"	16'10"x11'2"					
90mm lens	13'6"x9'	16'x10'8"					
100mm lens	12'x8'	14'x9'4"	16'4"x10'10"				
120mm lens	10'x6'8"	12'x8'	14'x9'4"	16'x10'8"			
135mm lens	9'x6'	10'6"x7'	12'8"x8'6"	14'x9'4"	16'x10'8"		
150mm lens	8'x5'4"	9'6"x6'4"	11'2"x7'4"	12'8"x8'6"	14'4"x9'6"	16'x10'8"	
200mm lens	6'x4'	7'1"x4'8"	8'4"x5'6"	9'6"x6'4"	10'8"x7'2"	12'x8'	13'x8'8"
250mm lens	4'6"x3'	5'7"x3'9"	6'6"x4'4"	7'4"x4'10"	8'4"x5'6"	9'3"x6'2"	10'9"x7'2"
300mm lens	4'x2'8"	4'10"x3'3"	5'7"x3'9"	6'6"x4'4"	7'4"x4'11"	8'1"x5'5"	9'5"x6'

DEATH ON THE RACETRACK Peter Waugh

Here is a photograph which is literally packed with flaming action. Such a picture can be used in many ways . . . in publications, posters, a safety first campaign, or special report. The sudden action of the catapulting car has split the crowd and left the injured and dying in its wake. The photographer was eighteen years old and had just purchased his Leica camera at the time this picture was taken during the International Trophy Race run by the Junior Car Club at Brooklands, England. 50mm Elmar, f/5.6, 1/200, medium speed film.

VISUAL COMMUNICATION OF IDEAS

ROBERT DE KEIFFER

Education is the transmission of cultural heritage from generation to generation, a process by which the young are indoctrinated into the mores of the group and the group is adjusted to its environment.

In primitive tribes, education is a relatively simple procedure of first-hand experiences. The boys learn the dangers and the art of hunting at the side of their father or other elders. By observing their mothers the girls are trained in simple domestic arts and tasks—weaving, cooking, and so on.

Education in a modern civilization is extremely complex. Because of the rapid pace of life and the ever expanding technological developments, first-hand experiences in many of the basic processes are impossible. It is at this point that photographic media make a tremendous contribution. Photographs, slides, filmstrips, and motion pictures bring to the classroom vicarious experiences that enhance learning and improve instruction.

In our modern society we recognize that education is not limited to the young, for adult education, business, industry, the armed forces, and religion all have a large stake in the education and training of vast numbers of people. To them, visual communication has presented a medium by which methods can be explained, procedures outlined, mechanisms studied, installations scrutinized, and instruction standardized.

With our expanded concept of education and a recognition of the need for giving the learner experiences that closely approximate the *real* experience, the educational value and significance of photographic media become apparent. They are tools in the hands of the user to assist him in transmitting information.

The motion picture combining both motion and sound is an area of study in itself. Serious consideration should be given to the use of this dynamic instructional instrument. In this chapter, however, the discussion will be confined to the other pictorial media.

Whenever there is a teaching or learning job to be done, the use of a Leica camera can and will assist in communicating ideas.

Selecting a Method of Approach · Educators recognize the effectiveness of visual presentations in clarifying concepts and increasing the power of retention. They also realize the necessity for careful selection of the medium for specific teaching situations. Photographs, slides, and filmstrips all have certain inherent advantages and limitations. It is up to the individual teacher or supervisor to select the medium that will best accomplish the particular educational objectives.

The importance of careful selection of the most effective media also applies to other fields of interest. Churches, clubs, businesses, industries, and individuals must all be conscious of the specific objectives they are anxious to accomplish with visual presentations. Too often enthusiasm for production by-passes the basic consideration of the job to be done and the most effective method of attack. A large sales organization anxious to train salesmen in methods of meeting the customer would find difficulty in developing such a program with the use of only a bulletin-board presentation. A more effective method would be with a series of sound filmstrips.

To meet varying educational needs, the effective use of a camera can develop a wide variety of materials such as:

1. Photographs
   a. miniature
   b. enlargements
   c. murals
2. Transparent positives
3. Slides
   a. miniature (2 x 2)
   b. standard (3¼ x 4)
4. Filmstrips
   a. silent
   b. sound

The selection of the proper visual material to be used in any situation will depend upon the educational problem and the physical properties of the learning environment. An economics teacher has an educational problem when she desires to have her students understand the fluctuation of wages in business and industry for the past 20 years. Figures and percentages are hard to understand and compare when given orally. A visual presentation of this data would be considerably more interesting and instructional.

In the religious field, the difficulty of translating ethical, moral, and religious values into understandable and vital ways of life is extremely arduous. Paintings, pictures, and drawings of Biblical personalities, social customs, and modes of living activate the learner into the realization that Bible characters were human beings and were subject to the same trials and tribulations that we face today. With the use of photographic material, religious leaders can also reinforce the doctrine that religious faith can be practiced in the world about us in the Atomic Age. Filmstrips, slides, and photographs can be produced that will vividly portray the ideas of fair play and co-operation. Such materials can also graphically present areas of

human endeavor that could be enriched by understanding, sympathy, and devotion to religious ideals.

The work of foreign missions can be captured with the camera and presented to a congregation that formerly had only a vague notion of the enterprise. Equally effective is presentation of local community problems the church is anxious to attack. If religion today is to compete with the mass media of communication, it must itself use these tools in telling its own story.

Original data may be found in the form of charts, graphs, and tables in old newspapers, books, or magazines. By careful selection of available graphic and pictorial materials, as well as some original drawings, the teacher would have a number of kinds of excellent material for classroom presentation. The physical properties of the learning environment and the availability of equipment will dictate how the material is to be projected. Material usable year after year would best be photographed and developed into a series of Leica 2 x 2 slides for ease of handling, storing, and use. Materials of current value only might best be shown with an opaque projector, and then discarded.

An extremely important factor in the selection of methods of presentation is the recognition of the need for a variety of approaches. Any type of presentation, regardless of its effectiveness, will lose some of its intrinsic value if it becomes routine.

Color is also an important consideration in the selection of photographic and graphic material. Color has a definite appeal to the learner, and in many situations color is imperative for clear understanding. In a botany class studying various types of wild flowers, the use of color slides is imperative. On the other hand, a social-studies class considering the housing problem would not benefit particularly from seeing housing units in color. Other factors, such as expense, true color representations, and availability of materials, make it impractical to use color in all cases. A thumbnail rule that is often helpful to remember is: "When color is necessary for clear understanding, color should be used."

The use of student groups to assist in the selection of methods of presentation and materials to be used should not be overlooked. Some of the most dynamic learning experiences have resulted from student participation in planning and presenting particular units of study.

Types of Presentations and Materials Used.

Photographs · One of the best-known and most widely used visual materials is the photograph. It is relatively inexpensive, easy to file and store, simple to use, and readily available from original camerawork and from clippings from magazines, books, pamphlets, and other similar material.

When photographs are shown one at a time, their greatest effectiveness is with individuals or with small groups. They add greatly to the sincerity of the presentation and create a feeling of personal familiarity with the subject under discussion. One of the most effective methods of presenting photographs in sequence is the use of a loose-leaf ring notebook fitted with plastic folders in which the photographs are placed. In this way a picture story can be unfolded while the teacher drives home each point as the pictures are shown. Sales forces of business concerns have found the photo album extremely effective in contacting potential customers. With a sequential story in pictures, the prospective customer can be shown how the product is manufactured, processed, packaged, and shipped and at the same time become familiar with ideal working conditions and the personnel relations in the plant. The human element shown in pictures carries a terrific impact for the client.

It is generally not advisable to pass photographs around the classroom while a presentation is being given. Individual students concentrate on the photograph they have in their hands rather than what is being said by the speaker. There are occasions when it is advisable for students to study photographs in detail, necessitating continuous handling of the prints. To protect them from fingerprints, ink, soil, and rough treatment, photographs can be laminated. Lamination is a process by which individual pictures are encased between 2 very thin sheets of clear plastic. In this way prints of any size can be kept clean and usuable for years at relatively low cost.

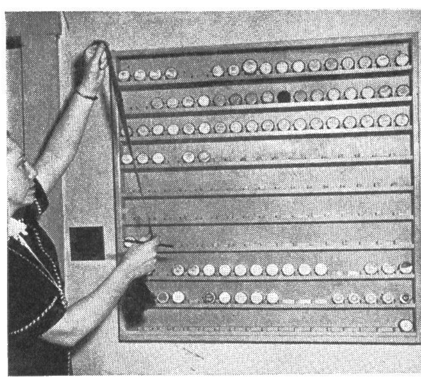
The use of photographs for display and bulletin-board presentations is an extremely effective way to present an idea visually. Neatness, simplicity of design, and selection of dramatic material are imperative. There should be a central theme, and all related material used should supplement, not distract from, that theme. Models, charts, clear printing, good lighting, colorful mounting, and careful layout will add greatly to the effectiveness of the display. In all areas of instruction the bulletin-board technique has the inherent values of repetitive impact, stimulation of interest, supplementation of instruction, and presentation of new but related ideas. Bulletin boards in the factory and business office if kept current not only keep employees informed about topics of interest, changes in policy, and benefits being offered, but they add to a feeling of belonging on the part of the staff. If the material is carefully planned and effectively presented, everyone who is associated with the company develops a sense of pride in his work as a member of the team.

When presentations call for projecting flat pictures on a screen, an opaque projector makes this possible. This projector, similar in operation to the old reflectoscope, or magic lantern, can throw on the screen the reflected image of objects, pictures, maps, or other similar materials. Although the

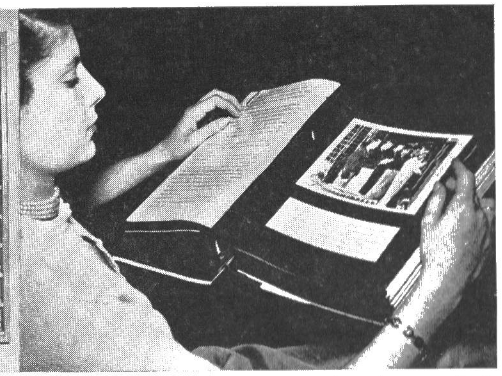
older models of opaque projectors limited the size of material to 6 x 6 inches or smaller, newer equipment is designed to project materials up to 11 x 11. One of the major drawbacks to the use of this equipment is the necessity of an almost totally darkened room for satisfactory projection.

Transparent positives · The use of positive prints on film for display purposes is a forceful way of exhibiting photographic work. The placement of these prints in a light box has been used for years by business and industry, and recently has been utilized in education. Instead of being printed on paper, negatives are printed on film, either by contact or by enlargement. The film is then placed in front of a diffuse-light box, making it an illuminated display case in which small and enlarged films, either in black-and-white or in color, can be exhibited. The size of the film and of the light box will vary, depending upon the size of film stock and the specific educational objective under consideration.

A relatively new classroom technique in the utilization of photographic media is the projection of large transparent positives. During World War II there was a demand for the development of projection equipment that could be used at the front of the classroom, upon which an instructor using drawing instruments, rulers, and triangles could demonstrate the basic elements of navigation to officers and enlisted men in training. Devices known commercially as the Visual Cast and the Vu-Graph were introduced. Pencils or colored plastic inks were used to draw diagrams on pieces of cellophane or clear plastic sheets. With continued use, it was found that predesigned sketches could be photographed on 8 x 10 film. When these transparencies were projected they could be altered, added to, and explained by drawing with a wax pencil. When the class was over the instructor wiped off the wax pencil marks and the transparency was ready for the next class. Many schools have adopted this equipment for their own instructional purposes.



1. Slide-film file mounted on a wall takes little space and is accessible at any time.



2. Visual notebook for presenting photographs in sequence along with text and special references.

Journalism instructors have found that for the first time they can teach the basic theories of editing to an entire class — with projected transparencies of typical copy. By making their own editing marks on the spot, they can demonstrate how the copy should be edited. This same technique has found wide acceptance in other curricular areas, such as geology, geometry, and anatomy. In these areas a series of progressive cells can be produced that are overlayed one at a time, building geological structures, geometric problems, or physiological frameworks. The only limitations to the types of presentation that can be designed are the time and the imagination of the instructor. In scientific areas and industry, the use of large projected transparencies has wide application. A series of prepared transparency overlays is invaluable in presenting complex theories and contemplated developments of plants and facilities. Complicated machinery that must be carefully explained can be built up one layer at a time, each gear or pinion added until the machine is completely assembled. Interpretations of the process can be made, and misconceptions can be clarified throughout the presentation.

Slides · One of the oldest types of projected photographic techniques is the use of the slide transparency. There are two sizes of slides in common use, the 3¼ x 4 (commonly referred to as lantern slides or standard slides) and the 2 x 2 miniature slide. Formerly only black-and-white slides were available (except for those which were hand-painted), but today, with the introduction of color film, the teacher or instructor has the option of using either color or black-and-white.

For many years the 3¼ x 4 slide has been much used by teachers in many curricular areas, but the 2 x 2 Leica slide is rapidly rising in popularity. The major reason for this change is the ease with which the smaller slide can be produced, mounted, used, shipped, and stored as well as the comparatively low cost of production. See the chapter on Lantern Slides for more detailed information.

Regardless of the size of the slide used, the projected transparency, if effectively utilized, is one of the most useful visual materials at our disposal. There are no areas in the school curriculum that cannot be interestingly complemented with slide material. Many schools have authorized the science class or the photography class to make slides for teaching purposes. These schools are developing their own collections of inexpensive visual materials that will assist their faculty do a better job.

Many businesses and industries are developing collections of slide materials. Current office and plant practices and routines are photographed and used for analysis in devising more efficient methods, or are used for instructing both old and new employees. Many businesses which are decentralized geographically are using 2 x 2 slide material in developing a sense of company

unity, and in some instances it is used to develop a spirit of competition among various units. The 35mm negatives are then used for enlargements to be used in company news letters.

Filmstrips · The educational filmstrip (also known as slidefilm, stripfilm, and filmslide) is recognized as a logical sequence of individual pictures printed on 35mm film. Its major contributions to education are that it is relatively inexpensive, and is easily produced, projected, stored, and shipped. Business and industry have also found the filmstrip valuable in their training programs, because of the pre-designed pattern of presentations that standardizes instruction and points up specific training problems.

Filmstrips can be produced in a variety of ways, and include a number of visual and audio techniques. Some of the most commonly found types are as follows:

1. Single-frame (projected vertically)
2. Double-frame (projected horizontally or vertically)
3. Black-and-white
4. Color
5. Silent (with printed titles of explanation on the film or in an accompanying manual)
6. Sound (with the commentary on disk, wire, or tape)

Let us presume that you as a teacher want to produce a filmstrip. How would you proceed? There are only a few simple steps to follow in developing this effective teaching tool. These are:

1. Consider the educational problem.
2. Outline the content.
3. Develop the script.
4. Photograph the material and enlarge it.
5. Place it in sequence and shoot it.

1. *Consider the problem.* In considering the educational problem you wish to complement with the use of a filmstrip, ask yourself the following questions:

a. What is the purpose of the filmstrip?
b. What objectives will it achieve?
c. Who is the intended audience? What is the level of their understanding? What are their basic assumptions of the subject matter?
d. How is the production to be financed?
e. Would other institutions be interested in using it?

Always remember that if you are going to the trouble and expense of producing a filmstrip for your own instruction, it should be tailormade for you. Too often, perspective of the objective is lost when the originator begins to consider mass production, distribution, and nebulous financial gains.

2. *Outline the content.* The effectiveness of any filmstrip lies in the adequacy with which it tells its story. Some of the most technically perfect material has fallen far short of its mark because little attention has been devoted to careful planning. It is wise to outline in detail the story you want the filmstrip to tell. At this point, keep in mind only the subject matter you want to cover. Do not confuse yourself by trying to visualize what pictures should be included and what narration should accompany it. When the detailed outline is made, recheck it to be sure that you have covered the topic, that the details are clear and to the point, and that no extraneous items have been included.

3. *Develop the script.* There are several forms and types of scripts in common use, but for our purpose we will consider only the shooting script.

You have gone far enough now to determine whether the final result should be a silent filmstrip of pictures only, one with printed captions, or a synchronized filmstrip with narration on wire, tape, or disk. Let us presume that you believe that the synchronized filmstrip with narration would be the most efficient medium. (The steps to follow in the production of the other two types are identical except for the preparation of a narration script.)

The attention to detail in outlining will be of great assistance in developing your shooting script. Your entire attention can be directed to such questions as:

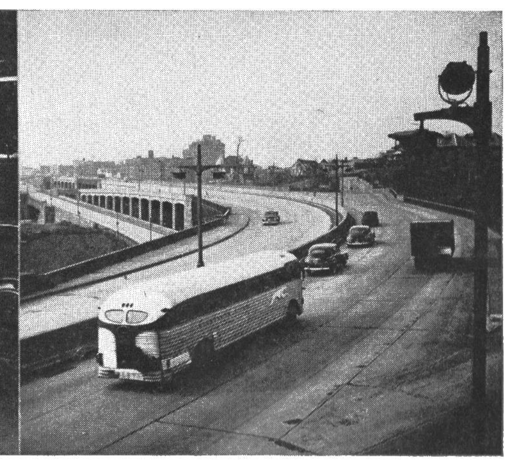
a. What type of pictures will tell the story best?
b. Will original artwork, such as sketches, graphs, charts, be necessary for complete understanding?
c. Where can the pictures or other illustrative material be procured?
d. What should each picture show?
e. What sequence of pictures will best present a well-rounded story?
f. What type of titling, if any, is needed?

Next, your job is to work your outline into a visual presentation that will picturize your ideas and assist with the actual photographing. For ease in preparing your shooting script, divide several pieces of 8½ x 11 typing paper down the center, leaving ½-inch margin at the top. On the left side draw a sequence of rough pictures that illustrate the story. A piece of cardboard 1½ x 2 with rounded corners can be used to trace the outline of the frame. If it is to be a sound filmstrip, on the right side of the paper write the narration. If it is to be a silent filmstrip, with printed titles, put these titles on the right side of the paper. When the shooting script has been developed, check for logical story development and smooth transitions from picture to picture. Remember, however, that the final filmstrip may not follow exactly your rough drawings, for a filmstrip is a growing, changing thing from the time it is conceived.

4. *Photograph the material and enlarge it.* The translation of your rough drawings into photography is the most exciting phase of your project. In working over your script you have become aware of the shots you want. Some of them can be found in the field, some in books and so on, while others may have to be drawn specially for the filmstrip. Do not rely too heavily upon your script in an attempt to duplicate your roughs. The script should adapt itself to new facts and ideas. Changes in camera angle, exposures, and setups often intensify the final results. Be liberal with film. A number of shots of each frame, taken with variations provides for selection and eliminates reshooting, or missing the material entirely.

After you have collected your materials from the field, you can begin the job of supplementing these pictures with graphs, charts, etchings, or other materials if necessary. If photographs other than your own are to be used, check for limitations imposed by copyright laws. You should now have a variety of shots of each frame. Select those which present the picture story most effectively and enlarge them on 8 x 10 paper.

5. *Place it in sequence and shoot it.* When you are satisfied with the results of your enlargements, spread them out in sequence and check for continuity, accuracy of details, and authenticity. If there are to be titles, they can be printed on plain white cards. If titling is to be superimposed on a picture, it can be drawn on clear cells, using plastic ink. (Titling found on commercially developed filmstrips is made by a process known as hot press, which will not be discussed here.)



3. *(Left)* Passengers boarding a bus at the loading platform.

4. *(Right)* Greyhound bus leaving the Lincoln Tunnel from New York City. Note: All Leica photographs for the bus series were taken by Esther Bubley and furnished by the Standard Oil Co. (N. J.). Pictures of this quality are excellent for many types of visual uses.

In reshooting to produce the final filmstrip, an ordinary copy stand with adjustable lights and your Leica camera are the necessary equipment. If you want to develop a single-frame vertical filmstrip that can be projected in any filmstrip projector, cut a double-frame mask and place it over two 8 x 10 prints. A single exposure will take two individual pictures and yet give the effect of individual shots when used in a filmstrip projector. For double-frame horizontal filmstrips, this process is not necessary.

A board with registration pins may be used, on which 8 x 10 prints, mask, and plate glass are placed. This eliminates the necessity of refocusing after each shot, and holds the prints flat. The focus and exposure settings for the first frame are used throughout the process.

A 35mm direct-positive film and direct-positive development result in a complete filmstrip!

Recording the Narration • Returning to the script, you can now check to see if your previously suggested narration complements the visual material adequately. Remember that the pictures should tell the story and the narration should be subservient to them. The recording can be made to include narration, dialog, sound effects, music, either singly or in any combination. Consider the following points when working on the commentary.

1. Keep it short and to the point.
2. Use only words that the audience will understand.
3. Write it to be heard—not read.
4. Avoid discussing points not shown on the screen.
5. Use it as transition from picture to picture.
6. Keep it natural. Don't overdo dialog.
7. Devote less time to unimportant frames.
8. Lead up to climax.

In selecting the type of recording to use (wire, tape, or disk) consider the cost, the accessibility of recording equipment, and the availability of playback equipment.

Select your cast, prepare additional scripts, and rehearse several times, having the filmstrip projected as the commentary is given. A bell, a chime, or some other signal should be sounded between the narrator's remarks, so that as the filmstrip is projected, the operator is notified when to change frames. Check the timing for necessary additions or deletions in the commentary. Then make the final recording.

You now have a visual device that is tailor-made to meet your specific instructional needs.

Presentation of Material • Modern photographic techniques and materials have given the classroom teacher a wide variety of media. Too often attention is given to methods of production and little time is devoted to

considering how the materials can be most effectively utilized. Teachers must develop techniques in effective utilization if visual materials are to be of significant value in the learning situation. A tractor would be of little value to a farmer if he didn't know how to drive it or was not familiar with the accessories and their purposes. Familiarity with various photographic materials as to their values and their limitations in classroom presentations is a prerequisite to the planning for their most effective use.

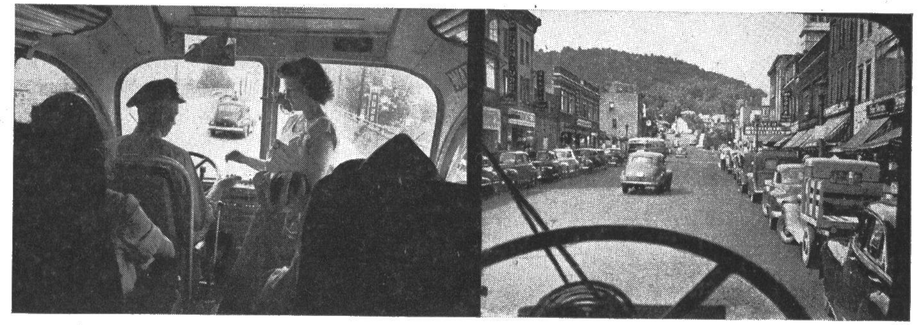
There are no new teaching techniques involved in utilizing audio-visual materials in the classroom. Any teacher who has mastered the art of teaching and understands the psychology of learning is capable of incorporating the use of these materials into the course of study. Depending upon the objectives, visual materials can be used to introduce, amplify, clarify, or summarize a

5. *(Top left)* Reservations office in a large bus terminal. 6. *(Top right)* Ticket agent making out a long-haul ticket. 7. *(Lower left)* Dispatcher at a Greyhound lines office. 8. *(Lower right)* Driver helps a young passenger out of a bus.

unit or a class period. In many teaching situations they can even be used for testing purposes.

There is no *one* way to utilize photographic materials in the classroom or for special groups. There are, however, guideposts that, if followed, will add greatly to their effectiveness.

1. *Prepare yourself.*
   a. Select the media that illustrate best the points to be developed. Make out in advance a schedule of all materials to be used in the course.
   b. Preview the materials. Delete any that are of no particular value.
   c. Plan introductory remarks, including the answers to the following questions:
      What will the materials show?
      Why are they being presented?
      What should the class get out of them?
   d. Plan the method of utilizing the materials effectively. Consider objectives, methods of presentation, summary, test (if desired), and practical follow-up activities.
2. *Prepare the classroom.*
   a. Be sure that the correct materials are on hand, and are in the proper sequence.
   b. Arrange to show the materials so that all students can see them without effort and without distortion of the pictures.
   c. If necessary, have a pointer ready.
   d. If projectors are used, set up the equipment, focus properly, etc. before the class begins.
3. *Prepare the class.*
   a. Explain why the material is being shown.
   b. Discuss one by one the points to be developed. (Advise the group that questions may be asked at any time.)
   c. Announce that a test or a discussion will follow the material. (In some instances a pretest may be advisable).
4. *Present the material.*
   a. Stand to the left of the enlargement or screen, facing the class and using a pointer with the left hand.
   b. Go slowly. Correlate each picture, slide, or frame with the over-all objectives being discussed.
   c. If projecting, arrange with the projectionist an unobtrusive signal system for changing slides or frames.
   d. If a slide needs more detailed explanation, project it on the blackboard, trace with chalk, turn off the projector, turn on the lights,

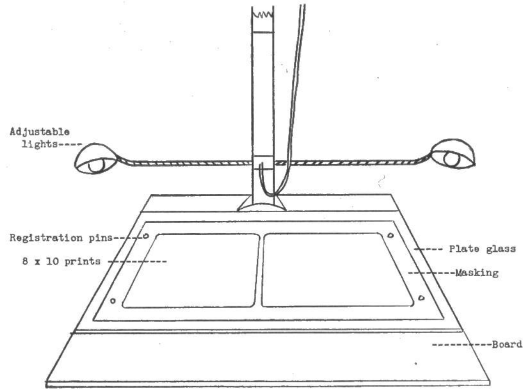


9. *(Left)* Short-haul passenger boarding a Syracuse-Watertown Greyhound bus.
10. *(Right)* Main street of Dover, N. J., seen through the windshield of the bus.

   and discuss. The drawing can then be labeled, using colored chalk for emphasis.
5. *Summarize and follow up.*
   a. Discuss the points developed in the presentation.
   b. Test the group on the material.
   c. Go over the test and discuss debatable points.
   d. If results are doubtful, show the material again.
   e. Provide an immediate opportunity to apply the new knowledge.

The preceding list of guideposts has been designed to give teachers or instructors, whether they are in the school, the plant, the office, or in the church, a concrete step-by-step procedure to follow in effectively utilizing photographic materials in the classroom. It is not a panacea for all utilization problems, but gives suggestions on what to do and how to do it. Careful planning, vital presentation, and thorough summarization are essential in successful teaching and dynamic learning. This list is only a point of departure for more extensive study and use of various visual materials. Successful utilization of these teaching tools may necessitate adaptations to specific classroom situations; the skill in using these tools rests in the hands of the teacher.

Filing Systems • The over-all effectiveness of the audio-visual program of a school or institution rests on the availability of materials and equipment. The inherent values of photographic media are lost if they cannot be drawn upon and used at the precise moment when they will enhance the learning situation. Inadequate filing systems for photographic materials are a constant source of annoyance to teachers, and drastically limit the usefulness of the material. Elaborate filing systems that necessitate constant attention are not necessary. The primary objective of any system is to have the material readily available and easily located for instant use. A school that is developing collections of student and teacher photographic work would



11. Single-frame filmstrips can be made with the Leica copying equipment by using a cutout black mask as shown. The black mask is placed over two 8x10 prints and copied on the double-frame Leica negative. A glass plate will hold mask and prints flat. This filmstrip copying method was designed by Robert de Keiffer.

be wise to set up a double-entry file system at an early date—one an identification file in which negatives are listed, the other an identification file of small positives.

Negatives should be handled with extreme care and should never be removed from the file except when they are to be used. All negatives should be numbered (India ink and a small pen can be used for numbering on the emulsion side of the negatives), placed in cellophane envelopes, and slipped into heavy manila jackets. In this way they will be free from dust, dirt, and damage, and will be readily available when needed.

The identification files should consist of a series of 3 x 5 or 4 x 6 cards upon which a small print of each negative is affixed. Pertinent information concerning photographer, date, place taken, negative number, and necessary descriptions will assist in the identification of the material. They may be filed either numerically or classified by types. This file allows for cross-referencing, and also protects the negative file from extensive handling and possible damage.

Slides, both 2 x 2 and 3¼ x 4, can be filed in a variety of ways. File drawers and boxes specifically designed for the purpose are available from a number of commercial sources. A very convenient type of filing cabinet for large collections is equipped with vertical slide frames, each holding from 90 to 120 2 x 2 or 30 to 40 3¼ x 4 slides. Each frame when pulled out provides for quick visual reference and use. Each cabinet is equipped with a light-diffusing screen serving as a background for viewing the slides.

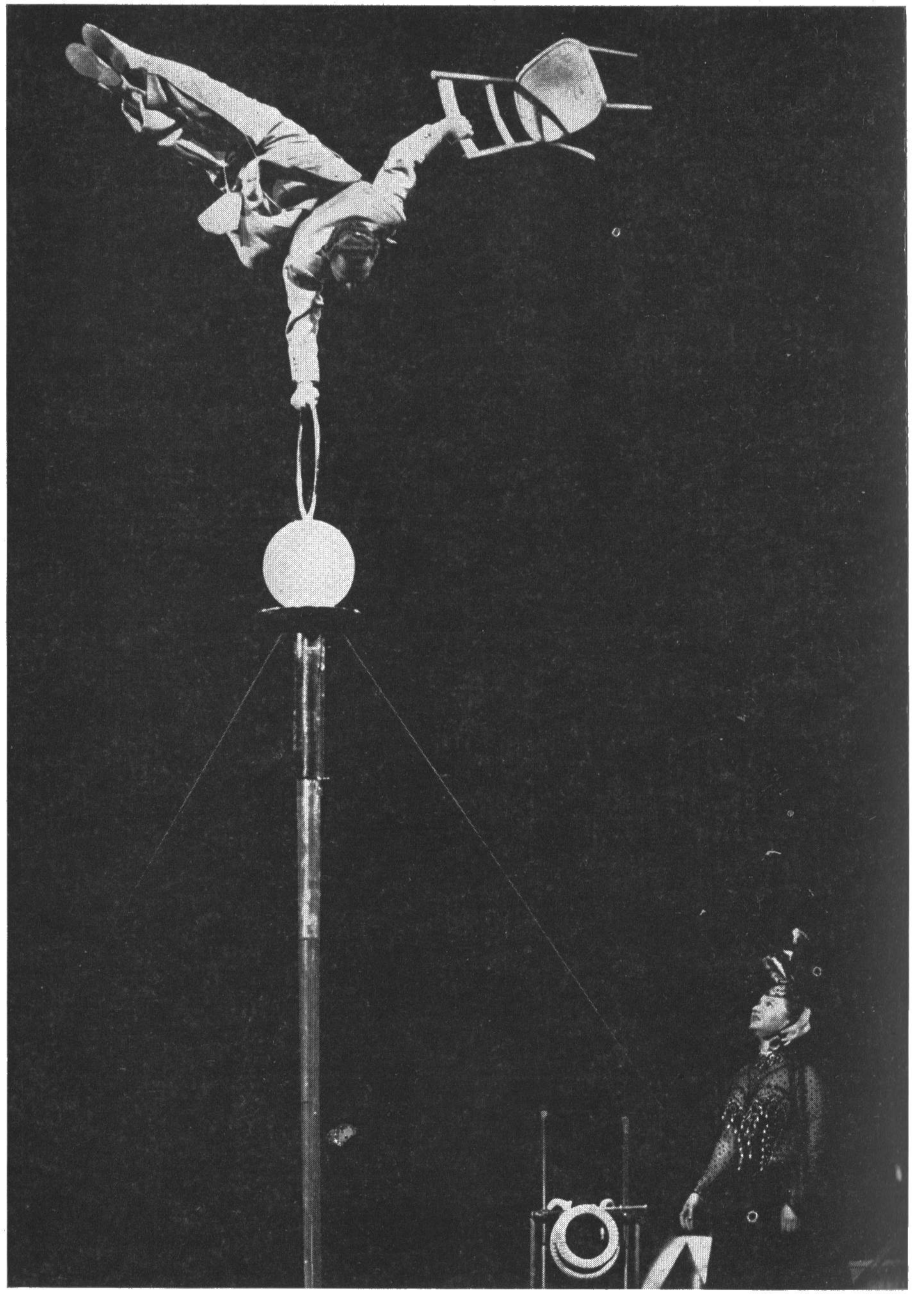
Filmstrips can be easily stored in shallow drawers in which small wooden dividers placed 1½ inches apart provide space for numbered film cans. A more accessible type of storage is the visible-wall film strip cabinet, which can be built in any school carpenter shop. A box 2 inches deep with narrow shelves 3 inches apart can be mounted on any wall. Dividers spaced 1½

inches apart on the shelves allow for simple storage of filmstrip cans that are easily selected and readily located.

Summary • This discussion of the educational values and use of photographic materials has stressed the teacher's role in the learning environment. All of us, however, are constantly teaching or being taught in our daily activities. The points raised here can be readily adapted to meet specific needs, whether they exist in business, industry, church or clubwork. A knowledge of the variety of media available is of importance in the selection of the teaching tool that will best accomplish the instructional job. When the materials have been prepared and are available for use, their effective utilization rests in the hands of the teacher or other user. Even the best material, carefully prepared, may fail to complement instruction unless consideration is given to the type of audience, the level of their understanding, and the idea that is to be communicated.

It is important to note that the best and most permanent learning results when it approximates closely the actual experience. In essence, the use of photographic material presents to the learner frozen slices of life, and will assist the teacher to improve instruction by communicating ideas effectively.

12. Passengers in a bus-terminal waiting room kill time by sleeping, reading, talking, or just plain stargazing. Leica photos by Esther Bubley, from Standard Oil Co. (N. J.). Interesting pictures like these help to liven up a filmstrip story of bus traveling.



Stage and circus acts offer many picture possibilities by available light. 85mm Summarex, f/2.8, 1/100, Plus-X film developed in Panthermic 777. Photo by Julius Huisgen.

PICTURES BY AVAILABLE LIGHT

JACOB DESCHIN

As the trend to naturalistic photography gains increasing impetus, camera workers are turning wherever feasible to the use of available lighting in picture taking. The movement in this direction is being advanced principally by photographers who work with the Leica camera, which is particularly adapted to this purpose by its design and its convenience in handling. The lighting that illuminates the subject normally, and without the introduction of regular photographic light sources, is more and more preferred by photographers who want to retain the original atmosphere and authenticity of the subject.

It is true that in the hands of experienced photographers the simulation of "normal" lighting can often be achieved through the use of auxiliary floodlight or flashlight judiciously introduced. Nevertheless, such maneuvers call for a fairly high degree of skill that takes long practice to acquire and even then may fail to yield the impact obtained in photographs made with available or natural light. It is not only a question of skill but it also relates to a worker's temperament and general approach to subject matter. When photographic light sources must be used in a manner to give the illusion of not being used at all, the photographer must often sacrifice a necessary feeling of spontaneous, unimpeded shooting.

Flash illumination, for example, does have a valued place in the field of naturalistic photography, and often must be introduced in cases where existing light is inadequate to stop movement. But when some subject movement can be tolerated, or is actually desirable, a prized true-to-life record of importance can be photographed in the available light, and improved if necessary, by careful developing and printing. Unless a controlled flash technique can be used without changing the natural value of the material, it is often better to abandon the picture entirely.

In this chapter the use of flash is ignored in favor of exploring the results possible with available or realistic lighting. Although some of the most remarkable photographs of our time would have been lost to us without the aid of the flashlamp, others of a different nature are created more effectively with existing lighting. Remarkable possibilities open, especially to the miniature-camera worker, in this era of improved films, developers, and other aids that have greatly multiplied opportunities for taking pictures with available light.

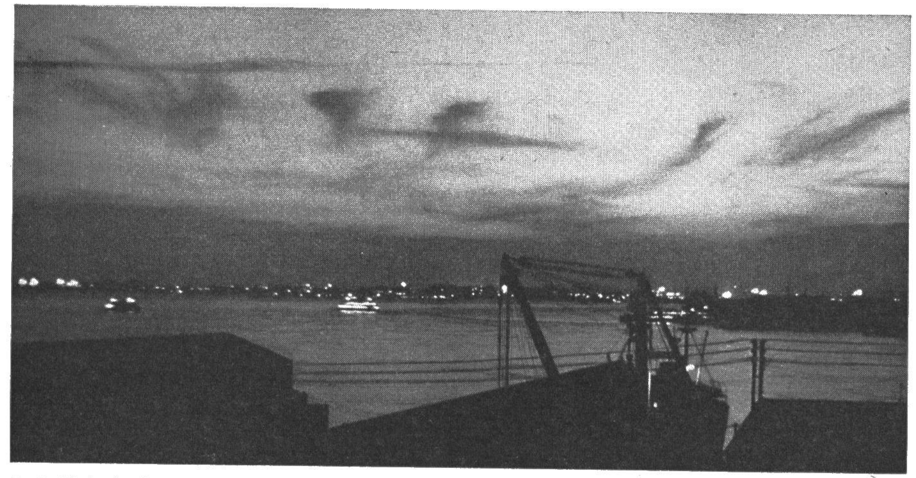
The new world thus revealed to the photographer is a challenge to both his craftsmanship and his ability to understand what he sees, plus the sensitivity to record its most meaningful aspects. If the advantages that modern methods offer him still seem too limited, he must experiment to push the medium to its extremes. On the border line between image and no image, he will make the necessary compromises between technique and expression that the physical limitations of the medium make inevitable.

It is surprising how long the list is of so-called available light sources by which it is possible to make printable photographic exposures with a camera. From the meager illumination of a burning match, a candle or moonlight, the sources range over a wide field in intensity, breadth of coverage, character and pattern. Consider at random these sources: the kerosene lamp, the lighted store window, street signs, theater marquees, lighted buildings and fountains, fireworks and lightning, street bonfires, torchlights carried in parades, restaurants, theaters, night clubs and subways. And add factories, foundries, bridges—anything that emits light.

All these can be used for novel effects, for fun-making, or with the serious intent to tell people about people and about the many aspects of the world they live in, photographed naturally, as they are and as the photographer sees them. Thus where one man may shoot the crowds on brightly lighted Times Square just to show the folks back home what the place looks like, or as an experiment in night photography, another will look for something special. For example, Dan Weiner, New York City magazine photographer, took his Leica camera to Times Square on New Year's Eve and photographed the merrymakers by the light of the theater marquees, to show the expressions of the strollers as they celebrated the event.

Every photographer makes his own choice as to subject matter and as to the way he will treat it. But whatever his viewpoint, certain mechanical requirements must be met. A lens shade is needed to protect the lens from stray light, especially in street photography at night or wherever lights are spread about haphazardly from the photographic point of view.

He must use some device or learn tricks to steady his minature camera wherever exposures of 1/25 second or longer are required. A tripod is essential for the longer exposures, as in street scenes calling for considerable depth of field, in very poor light, and in some other circumstances. Most miniature-camera workers frown at the use of a tripod and get away with it. But even these find themselves utilizing every means available on the spot to steady



1. Twilight harbor scene exposed just before dark. 50mm Summitar, f/2, 1 second, Super-XX. Photo by Jacob Deschin.

the camera in one way or another, such as holding it firmly against the face, or placing it on some such support as a window sill or steadying it against a wall. Others brace themselves against a solid support and steady the camera against their faces in ways they have acquired after long practice. Still others do like *Life's* Leonard McCombe, who rests the miniature camera on one knee while he is seated.

It has become a matter of pride with miniature-camera workers to be able to shoot at exposures as long as 1/4 second with the camera held in the hand, but most will admit that they have a trick device of some sort to help them keep the camera steady. For most people these comparatively long hand-held exposures are much too risky, particularly in view of the small size of the negatives and of the fact that many like to enlarge them to 8 x 10 or 11 x 14 or even larger prints. A cable release is often found handy for exposures on a tripod or other support.

A photoelectric exposure meter is not very useful under most available-light conditions, although an inexpensive visual-extinction type meter is often helpful, after some practice and experimentation. Fast panchromatic film is desirable for picture taking at night, both outdoors and indoors by ordinary room light, for its high speed and also because it is particularly sensitive to tungsten light. In the case of time exposures, as for lighted buildings and general street scenes, a medium-speed film may be used. It is advisable to choose one film, preferably a fast one, and stay with it for all night pictures, in order to familiarize yourself thoroughly with what the film can do under varying conditions of night illumination. In this way, you will in time be able to guess about how much time the lighting of a particular subject will require.

Incidentally, the fact is too little understood, especially among amateurs, that, just as with photographic light sources, the required exposure for a subject depends on the distance of the light from the subject. This holds for a candle flame, for a street lamp, or for any other light available. *The farther the light from the subject the longer the exposure must be.* For example, if the exposure for a candle 2 feet from the subject is 1/10 second, the time will be increased to 1/2 second if the candle is moved 2 feet farther away.

Since available-light exposure problems are mostly a matter of guesswork based on some experimentation and experience with various types of subjects and light conditions, the miniature-camera worker will find it very much worth his while to make several different exposures of important subjects. Then it is fairly likely that at least one will be right for a good print. This is common practice even with professionals when they are in doubt.

A small gadget bag is handy for carrying extra film and for storing the exposed rolls. In addition, a small pen-light flashlight will be helpful in such places as the theater and other dark areas for checking on lens opening and shutter-speed settings.

2. Cowboys singing around campfire at the Quarter Circle "U" Ranch roundup, Montana. One shielded flash on extension cord. FSA photo by Arthur Rothstein. A substitute for available light.

Natural Light Applications • And now for some pointers on specific opportunities in this field.

Street-Lamp Lighting • This category usually implies general rather than detailed views of streets, ranging from the dimly lighted side street to the bright streets of the shopping and amusement districts. Exposures vary from a few seconds to 10 or more minutes, depending on the amount of available light (keeping in mind the need for recording some detail in the shadows) and the required aperture to get all the desired planes in reasonably sharp focus. The characteristic short-focus lens of the miniature camera makes it possible to use a relatively large opening compared to the f-stops needed with larger cameras and still achieve satisfactory depth. Thus at f/8 on fast panchromatic film, good exposures can be obtained in slightly less than a minute. Double this time may be needed to record more over-all detail.

Because of the great range of light reflections in night street scenes, requiring an exposure range of as much as 10 seconds for some areas and 10 minutes for others, compromise exposures are essential in most cases. Getting the light source into the picture is not always either desirable or necessary. Trees often serve to block the light source itself while allowing the illumination to spill over the scene. Tree branches help even better by screening the light so that its effect comes through to light both background and foreground without introducing the difficulties of shooting directly into an unshielded light source.

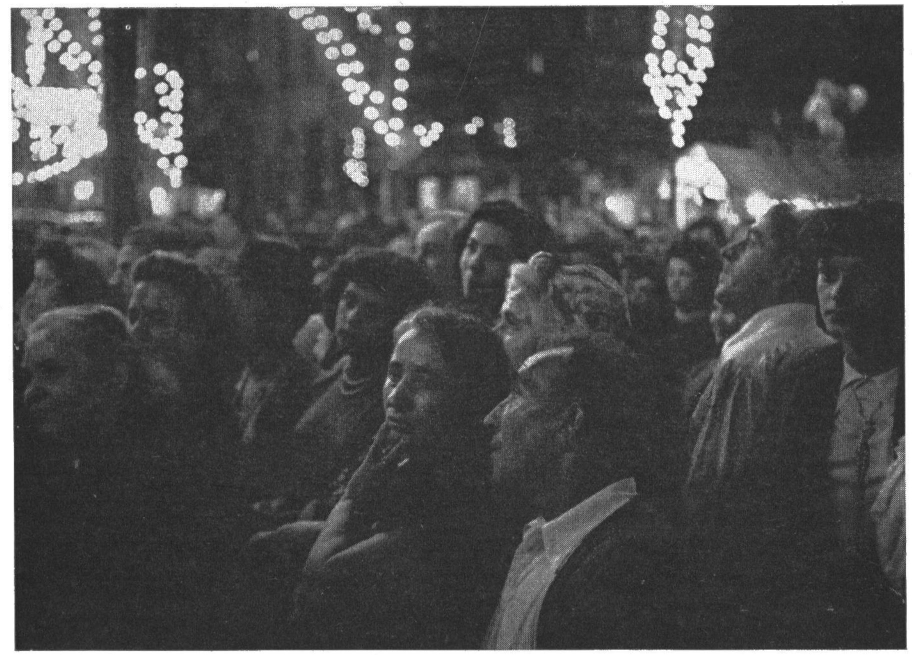
Bad weather offers some assistance to good exposures in outdoor night pictures. Detail and highlights are made apparent in street scenes made wet by a slight drizzle of rain or by snow on the ground. These effects also cut down exposure somewhat because of the additional light they reflect. Fog and mist serve to diffuse the light of street lamps and lighted house and store windows, so that it is spread around more evenly, giving a pleasing luminosity and permitting better control of exposure.

Moonlight • The exposure required for taking pictures by the light of the moon to get a result equal to that needed for the same scene by sunlight has been variously estimated at from 5 to 25 minutes for each 1/100-second exposure for the sunlit scene. If it is desired to include the moon in the view, the fact must be considered that unless the exposure is limited to a time duration under 45 seconds or so, the moon will begin to move and will come out elongated. A typical example of a moonlight scene in the city is that in which outlines of buildings with lighted windows break up the monotony of the huge shadow masses. A subject like this may be recorded in 20 seconds or so at f/3.5. Another favorite subject is the water scene, which by a full moon will produce an image in about 45 seconds at f/8. Exposure for other moonlit subjects will depend on whether you are content with a silhouette, in which case you will be concerned only with the light itself and its reflection in the surrounding sky, or whether you want some detail in terrestrial subject matter.

Theatrical Stage Lighting · Taking pictures during a theatrical performance has long been popular with the miniature-camera worker. An f/2 or faster lens will produce adequate exposures in most cases, and the normal 50mm focal length usually is enough to cover the complete stage action if the photographer takes a seat in the balcony just off center. This position in the audience is better than the front row of the orchestra, where the camera must be tilted up, with unsatisfactory results, or a box seat, where part of the show is cut off from the camera view. Fast film should be used to allow the photographer to be ready for the full range of lighting, which may vary considerably, especially in some musical plays, which may go from soft, dim lighting to very bright flood of illumination. Exposures may have to be as slow as 1/4 second or a little longer for some stage incidents. The miniature-camera worker, therefore, will learn how to steady his arms against the theater seat and hold the camera steady with the aid of a neck strap or a shoulder strap attached to the camera. Many exposures, however, will be possible at 1/20 second to 1/60.

Concert Stage Lighting · Exposures at f/2 and 1/20 or 1/30 second are often about right, but in the main only those who have the use of a long-

3. Subway riders offer daily changes of scenes for the Leica photographer. 50mm Summitar, f/2, 1/10, Super-XX film. Photo by Lou Bernstein.



4. Street crowds pass through many lighting variations such as: street lights, shop windows, lights of passing car, or the brilliant illumination of the theater marquee. 50mm Summitar, f/2, 1/20, Super-XX film. Photo by Dan Weiner.

focus lens, such as the 85mm f/1.5 Summarex, can hope to get anything worth while, since the target is limited to a small area rather than to a group occupying all or most of a stage setting. Those who are so fortunate as to be on the "inside" as in the case of Adrian Siegel and Fred Plaut (the one a member of an orchestra, the other an engineer in a recording studio) have made wonderful use of their opportunities in photographing the great at close range under ordinary lighting.

Night Club Lighting · This category includes also dances and similar events where a spotlight or a group of spotlights is used to illuminate the performance. Because the light is so concentrated, shorter exposures can be used than in ordinary theatrical shooting; the lens should be kept wide-open in order to use a higher shutter speed to stop dance movements, unless blurred motion is wanted. Exposures of f/2 at 1/100 second are reasonable. The shorter the exposure, of course the more one must be willing to sacrifice shadow detail.

Candlelight · This type of lighting is not as weak as it might seem offhand. Exposures of about 1/10 second at f/2 are possible if fast pan film is used and the burning candle is about a foot from the subject. If the room walls are light and there is a white cloth on the table, or a book or newspaper to kick the light around, the chances are better for getting adequate shadow detail as well as the main lighting effect. Candlelighting gives the picture a fine atmosphere, a feeling of romance, mystery, and mood. A good medium for the inveterate candid-camera shooter anxious to work against odds to achieve new technical triumphs.

Fireworks and Lightning · These call for a similar simple technique. They are best photographed from some elevated position, such as a roof or an upper-story window. The camera is set on a tripod, the lens wide-open and pointed in the general direction of the display in the case of fireworks, or of the approaching storm for lightning flashes. Open the shutter to Time, close it again as soon as two or three flashes or displays have been recorded. Since the sky is black at night, no impression will be made on the film except by the flashes or the fireworks. Limited control of the resulting pattern is possible with fireworks, because they can be observed for at least a short period; with lightning, the matter is more or less a gamble. Diaphragm openings of f/5.6 for lightning and f/8 or f/11 for fireworks are about right.

Match Light · Snapshot exposures on fast film are possible chiefly when the matchlight is close to the subject's face. Usually the picture is made just as the subject strikes a match to light a cigarette or a pipe. The most brilliant illumination occurs at this point, but the most pleasing results are obtained after the flame has subsided and burns steadily. If the subject will gently blow smoke toward the light, a beautiful diffusion will result.

Gaslight · The gas range or the gas jets found in the halls of some old-fashioned houses provide a surprising amount of light for photographic use. See for yourself by pressing down the pilot-light button of your range. Watch the four jets shoot toward the four gas plates, and notice the reflection of the light from the white-enamelled walls of the range. A person and kitchen utensils may thus be lighted sufficiently to make possible short exposures even on medium-speed film.

The Light of the Kerosene Lamp · This light source may seem a museum piece to the city folk, but country people in many homes throughout the United States still use it. Like the candle, but producing much more light, the kerosene lamp is best employed where it seems appropriate to the scene. Thus it will lend a touch of atmosphere and sincerity to the picture of the farmer's wife at her knitting after the routine of a busy day, but would be completely out of place in a modern city home. A snapshot exposure at a wide aperture should adequately record the most important details.

Bonfire and Fireplace Light · These are similar light sources, except that the first, being in the street or a lot, does not usually have the advantage of room reflections that help fireplace illuminations. Interesting and story-telling silhouettes or "dramatically" lighted faces give the photographer

5. Students look natural and unposed when photographed with the prevailing room light in their classroom. 50mm Summitar, f/2, 1/10, Super-XX film. Photo by Lou Bernstein.

unusual opportunities for candid-camera picture taking. The night fire is another good subject in this group. It will attract the miniature-camera worker who has a yen for chasing fires or is anxious to sell a picture to the local paper. Sometimes he does, too, which of course only whets his appetite for more such experiences. Exposures of about f/5.6 at 1/50 second on fast pan film are often adequate for bright blazes.

Window Light · Pictures of store windows at night often have more than merely a commercial value. Amateurs find striking, dramatic, and humorous displays in the windows of leading stores in the city that offer picture opportunities of an unusual sort. The photographer either shoots the whole display or selects a portion of it, thus concentrating on a feature that offers the best pictorial possibilities. Also, window pictures often are much more interesting when combined with "window shoppers" observing the display. Window lighting is often valuable merely as an illuminant for a street incident without reference to the display itself. Because the lighting is usually so bright, it is often possible to use an exposure meter. Ordinarily, for candid-camera shooting, exposures may be as short as 1/200 or 1/100 second at f/2, though in many cases where colored lights are used, thus cutting down the light intensity, exposures may have to be 1/20 or even 1/10 second at f/2.

The photographer must learn to watch for bad light reflections on the window glass from street lamps and signs; changing the position of the camera just a little this way or that is usually enough to get the unwanted reflections out of range. Should you wish to make a time exposure on a tripod to get a particularly valuable display that is not too well lighted photographically and requires a small stop to assure depth of field, do not worry about people passing back and forth in front of your camera. They won't blur the image if you use a small-enough lens stop and provided the strollers pass several feet away from the lens, keep on the move, and carry no lighted object, such as burning cigarette. Where you shoot across a street through which an automobile occasionally passes, cover the lens until the cigarette-bearing individual or the auto headlights have moved beyond the range of the lens.

Building Light · Buildings are best photographed at night when there is just enough light in the sky, furnished either by a full moon, the gleam of strong lights from the shopping or amusement district of the town or the last glimmer of daylight to outline the structures. The picture is most attractive when there are lights in the windows, although many impressively beautiful shots have been taken of a silhouetted skyline like that of downtown New York City on Sundays and holidays when the buildings are unoccupied and unlighted. Whether for skyline or other building scenes, probably the most popular photographic method is that of setting the camera on a tripod and giving two exposures: a time exposure between the dusk and the darkness, and at nightfall a short exposure when the lights go on inside the buildings. Often the two exposures can be combined into one, though at the risk of overdensity in the lights.

On the other hand, the two-exposure method also offers a risk, that of so overexposing the background lighting that the effect of night is minimized or lost. Some practice is needed in this subject before it is satisfactorily mastered.

Lighted bridges may be included in the category of buildings, as they offer about the same exposure problems, although the need for background lighting to outline the bridge structure is usually greater. The best times of year for this kind of shooting are late fall, winter, and early spring, when the sky light is just right for the maneuver. Industrial buildings, such as factories, shipyards, steel plants, and public buildings, are often floodlighted, providing ideal illumination for the cameraman. Frequently, short exposures of a few seconds at wide-open-to-medium lens stops will get the picture.

Electric-Sign Lights · These displays on busy thoroughfares never fail to attract the night-shooting visitor to the big city. Whether photographed for

their novelty, for record, or as interesting pictorial designs singly or in groups, they are comparatively easy to shoot, since the subject and the light are one. Many such subjects can be snapped at f/2 and 1/20 or 1/60 second on fast film. The colored neon signs will take perhaps twice this exposure, or longer. On wet nights, the soaked streets and sidewalks provide a fine mirror for the reflection of the varied assortment of signs, theater and store-front lights, the long beam of automobile and bus headlights, and so on. These reflections often transform a dull thoroughfare into a fascinating scene worthy of fine picturemaking.

Theater Marquee Light · Much of the life of the amusement centers is photographed by this generous illumination, which permits snapshot exposures. At the same time it poses serious problems of exposure compromises to assure good lighting for the strolling subjects without "burning up" the marquee banks of light. The best results, therefore, are obtained when the lights themselves are kept out of range. A sunshade with this subject is particularly important, because lights are kicking about all over the place. This kind of light is of course all from the top, with hardly enough reflection from the sidewalk, especially when many people are milling about, to illuminate the subjects over-all. So the photographer must watch for those chances when subjects are momentarily isolated from the crowd and are just coming under the marquee. At this point they receive the light both from the top and from in front. The marquee light has a true candid quality that has proved attractive to many a miniature-camera enthusiast who devotes himself largely to photographing the human scene in off-guard moments and in moods ranging from a depressed feeling to the heights of ecstatic enjoyment.

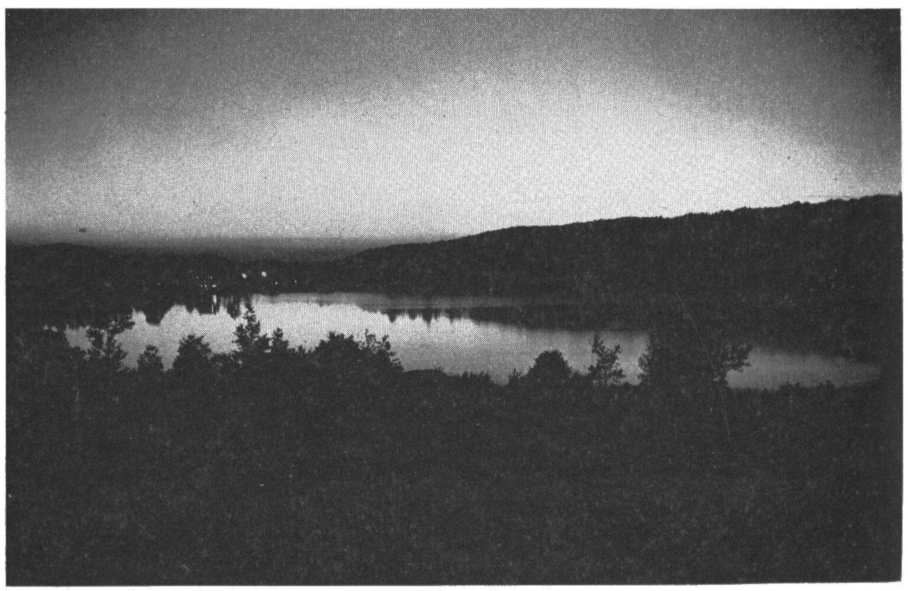
Room, Restaurant, Subway, Railroad Station and Similar Lightings · Exposures on fast film of 1/5 to 1/20 second, or somewhat shorter at wide-open apertures, are required in the photographically weak lightings of these situations. However, they offer some of the most effective picture opportunities for the candid-camera shooter. Working in the tradition of Dr. Erich Salomon—the granddaddy of today's candid-camera photographer who made pictures of notables in Europe around 1930 under the most difficult lighting conditions—he keeps eyes, mind, and heart on the alert for the unusual, the revealing, and the significant in people's attitudes, expressions, and relationships.

Many photographers shy at this type of shooting because it calls for tricks of hiding the camera and of trying to keep attention from oneself as well as one's photographic intentions. However, the tricks of the trade can be learned after some practice by those who feel they really want to do so. Often candid pictures are "set up"; that is, the subject is made aware that snapshots are being taken, but does not know exactly when. This is a professional approach, and with the best workers it has proved successful. In the main, however, pictures in the candid style are taken without the subject's knowledge. The small size of the miniature camera and the speed and ease with which it can be handled make anonymity possible.

Discretion in Shooting · While some people think that these "stolen" candids are an invasion of privacy, I would like to restate the comments from my book *New Ways in Photography,* published in 1935:

"Beware of indiscretion. When to shoot and when to hold your fire is a matter for each individual to decide for himself. Ordinary common sense and good taste must decide the issue. It is suggested that a person should never be photographed, whether or not he is known to the photographer, in a pose or situation that might embarrass him should he ever see the result. Candid photography should not be used as a tool for ridicule or from malicious motives. It is a valuable and useful medium; let it not be abused. Let us picture man as we would have him picture us, with understanding and sympathy; at his best, not at his worst. The true candid worker is a thoughtful, serious individual, and the pictures he turns out are valued for their human qualities, not their vindictiveness."

Developing and Printing · Picture taking after dark by available light means just that—you take it as you find it. That means the illumination is



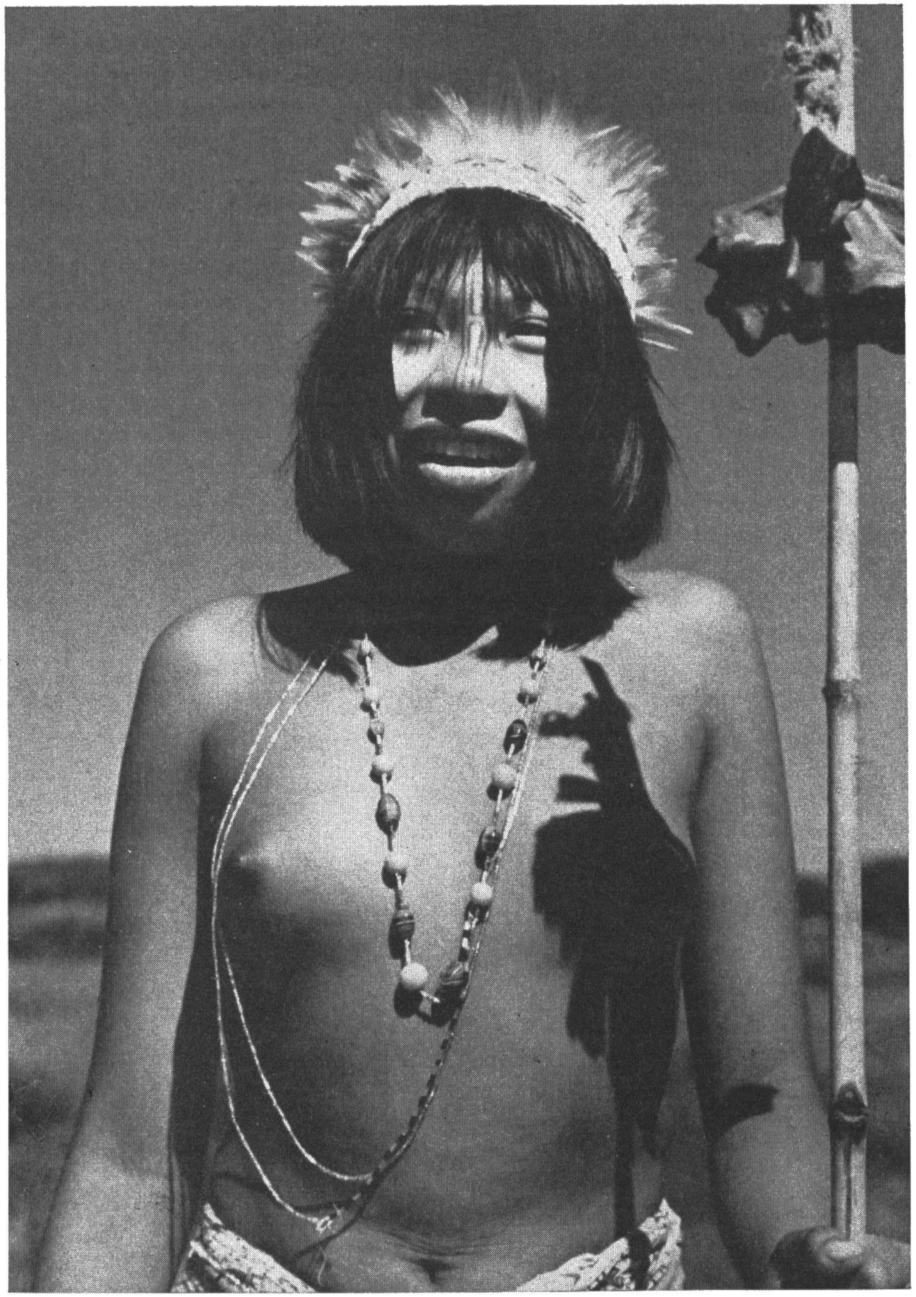
6. A quiet lake nestles among the surrounding forest shadows. 50mm Elmar, f/3.5, ½ hour exposure, taken after dark, Plus-X film. Photo by Barbara Morgan.

such, whether in the matter of light balance or in that of light strength, that often something has to give. Because overexposure for the highlights is frequently inevitable in view of the need to expose sufficiently to record adequate shadow detail, normal development will give blocked-up highlights. In candid-camera photography under adverse lighting conditions, where it is often necessary to push emulsion speed to the limit, overdevelopment may be in order, or development in a strong solution—and never mind the grain—may be the only way out. In fact, Adrian Siegel, who works his Summar f/2 lens at 1/20 second with fast film under concert-stage lighting, uses these image-forcing methods regularly. He feels, that in losing the values of gradation he gains others, using the grain to enhance and strengthen his print, thus achieving a strong impression.

Most subjects in the field discussed here are on the contrasty side: the highlights are very strong, the shadows are very weak. Normal development in ordinary solutions is out of the question. The situations call for soft development in a soft-working solution plus a reduction—as much as one-third—in the indicated development time. A reducer of the super-proportional type, like the Kodak R-1 formula, is often helpful, as it favors reduction of the highlight densities. Since it is impractical to reduce miniature negatives individually, the entire roll has to be treated the same way. The precaution is obvious, therefore—in shooting these subjects keep them on the same roll; don't mix them with ordinary exposures.

For subjects that call for the limit of film speed, and then some, candid-camera photographers have two principal means of achieving wanted results. In one, they run the weak negative, after development and thorough fixation and washing, through an intensifying solution that builds up an image with enough density to give an acceptable print. The other means is the hypersensitizing, or latensification, method, by which films are so treated, before or after exposure, that the film emulsion speed is considerably increased, providing an image where none was possible before. The details of intensification and hypersensitization are discussed elsewhere in this book.

The last resource of the photographer in these cases is the printing process. A hard grade of paper, sometimes the hardest available, will save many a weak negative, and a soft grade will do the same for a contrasty subject. In addition, the darkroom worker can juggle the situation around with a softer, more diluted, or a stronger, more concentrated, and vigorous print developer, to do his bidding. As a last step, a toning solution will give added contrast to the print that is processed in a soft developer.



MAKKA INDIAN Julien Bryan

Close photographs of people help to show their ornaments, method of dressing, tattoo marks if any, and facial characteristics. Photographed in Paraguay with a Leica equipped with the 50mm Summar lens, and sunshade.

TRAVELING WITH A LEICA

JULIEN BRYAN

On a recent boat trip I made to Europe there were dozens of amateur photographers on board, brandishing the latest camera models, both still and motion-picture. But there was one thing that struck me forcibly—most of these cameras were brand-new.

The moral is simple enough. Here were photographers, some of them quite competent, who were entering upon one of the exciting experiences of their photographic life with untried equipment. Each of them should have done just the opposite, either used a camera he was thoroughly familiar with or taken time before sailing to make many tests with his new apparatus.

So, Rule No. 1: When you go off on an expedition, be sure that your camera, your extra lenses and filters, and even your film and light meter fit you like a glove. Be sure that you can use them all easily and naturally.

I assume that you are a good amateur and that you are about to set off on a trip, either to an interesting section of the United States or to some foreign country. You want to make the most of it all. You wish to bring back several hundred fine photographs that will tell an interesting and important story.

Perhaps these pictures will never be shown outside of your own living room. Perhaps a few will be published in your local paper. On the other hand, if they are extra-good, pages of them may be published in a picture magazine, so you want them to be the best. What do you do first?

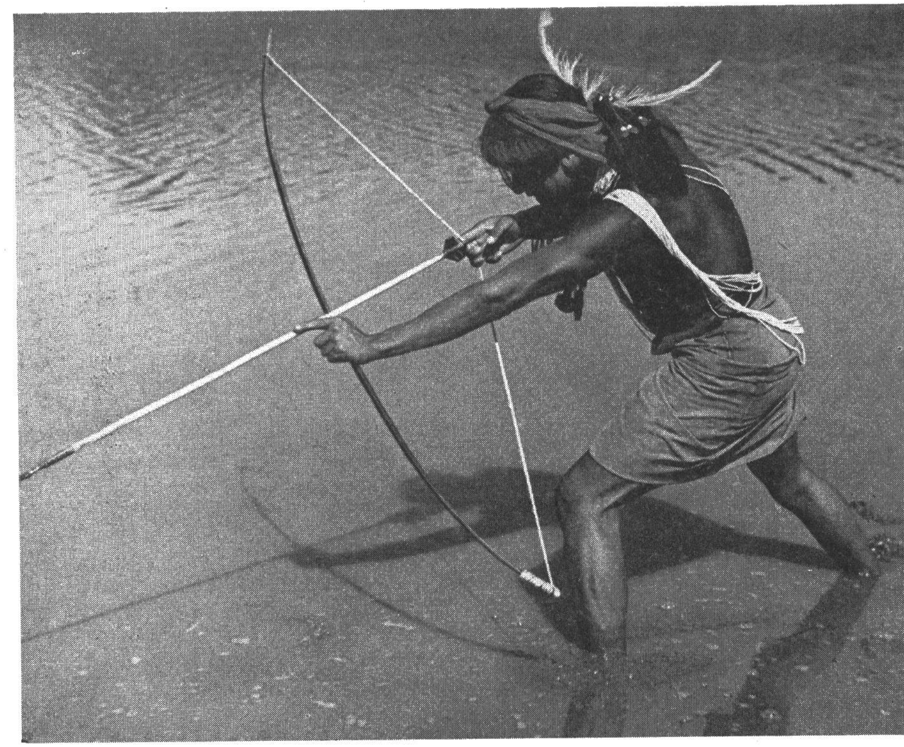
The first thing to do is not photographic at all, and is not concerned with new filters or lenses. It is simply to formulate an intelligent plan for your trip and for the pictures you intend to take. And it is well to have such a plan, whether you are 10 or 80. Careful consultation of maps, and months 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 London or Rome the afternoon they arrive 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.

Recently, my son Sam, age 10, went with his father and mother on a 4-day trip to Williamsburg, Virginia. He had a Brownie Reflex, price $8.95, and 5

2. MAKE-UP TIME. Makka Indian photographed by Julien Bryan near city of Ascuncion, Paraguay. Note how picture is improved by having the Indian doing something instead of just staring into the camera.

rolls of films. But even at 10 he was possessed on one fixed idea, one plan. He would go to Williamsburg and take pictures that would become the basis of a short talk or report which on his return he would deliver personally to his class in the fourth grade in public school. For they were studying about Colonial times, and his teacher knew of his forthcoming trip. This assignment then became just as important to Sam at 10, and just as meaningful, as a trip to Berlin or Moscow would be to a seasoned foreign correspondent. It took on new and intensified meaning when there was an important task to be done.

This story of a child's plan applies equally, I think, to all of us. Suppose I am to be sent on a government photographic mission to Chile. I begin by studying maps and by reading novels, poetry, serious books, geography, even back to Darwin's remarkable volume *The Voyage of the Beagle.* I look at all the geographies and picturebooks telling of Chile, I screen whatever motion pictures are available, some not too good. I ask endless questions of Chileans who have long lived here and of Americans who have lived a long time in Chile. I get saturated with Chile and things Chilean.



3. MAKKA INDIAN near Ascuncion, Paraguay. This active scene shows how a native uses his bow and arrow for spearing fish. Photo by Julien Bryan.

I formulate the best plan I can of attack—where I will go in Chile, the key cities or areas I will visit, and how much time to spend in each. And, of course, how much it will all cost.

Then, most important of all, how will I use this materials? Will it be in a book, as illustrations for newspaper articles, in a series of slide films for schools, as illustrations for a serious lecture on Chilean economics? Will it be people, recreation, arts and crafts? Will it be politics, agriculture, or sheep raising? What will it be?

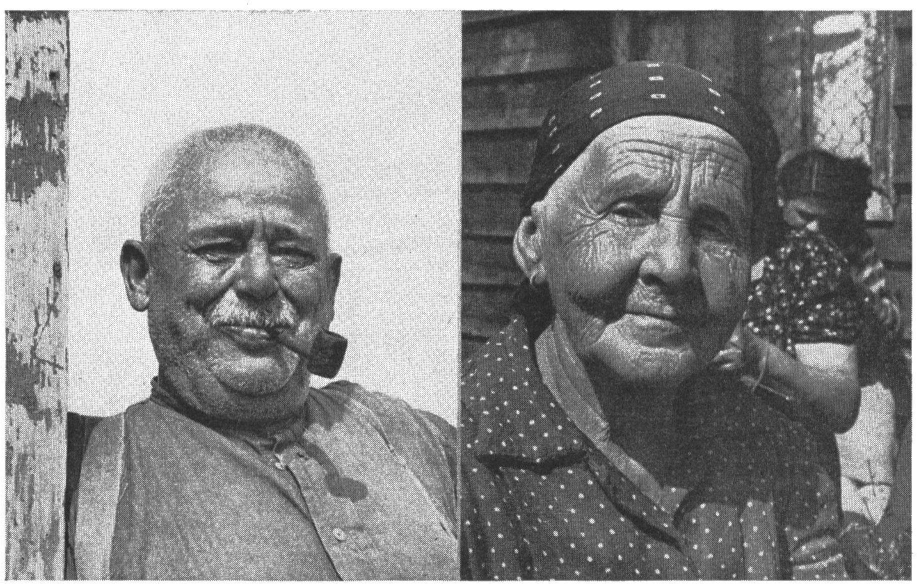
Having decided these matters and determined to do one thing well instead of scattering my shots foolishly all over Chile, I am ready to begin my trip.

Equipment for the Traveler • But first some precautions and advice about equipment. I think most well-intentioned amateurs going on their first long trip tend to overload. A Leica camera with one or two extra lenses at the most is sufficient. Sometimes I travel with just one Leica camera and its single lens. It is a comfort, however, to have a wide-angle lens in addition to the normal 50mm Summitar f/2 lens. The 135mm Hektor f/4.5 long-focus lens is also useful. Both of these extra lenses are valuable to have in case of emergencies. In contrast to many explorers who use telephoto lenses for close-ups of natives, I have found that the results are rather flat, and not nearly as attractive as when the camera is placed about 4 or 5 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.

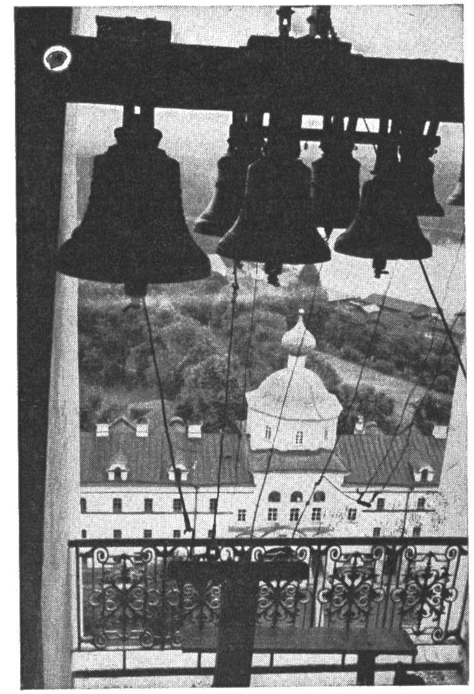
Usually I carry two Leica cameras, one loaded for color and one for black and white. For color I use Kodachrome, and for black and white Eastman Plus-X, though I am sure other makes are thoroughly satisfactory. Some prefer Ansco color because It is somewhat softer.

All of this film, both color and black-and-white, I have tropically packed by the manufacturers. It takes a little trouble, and sometimes some delay, to get this done, but it is worth it.

Exposure and Exposure Meters • There are two extremes in using the exposure meter. First, there is the expert who "guesses" and is his own private exposure meter. It is as though he had a sensitive photoelectric cell hidden inside of him. He has obtained good pictures for 20 years by guess, so why should he bother with a meter? Second, there is the chap who worships the



4. DISPLACED PERSONS at D.P. camps in Austria. Close-up portraits reveal the fine facial characteristics of these homeless people. Photos by Julien Bryan.



5. VALAMO MONASTERY. By using a small diaphragm stop on the 50mm Summitar lens Julien Bryan was able to show the bells in the foreground and the grounds of this Greek Orthodox monastery located on an island in Lake Ladoga, Finland. Today, in Soviet Russia.

meter, and follows every reading to the letter, but without regard to any testing or adjustment of the meter to his own camera.

Personally, I take a middle position. I find that I can often guess moderately well for black-and-white exposure, because of the wide latitude of such film as Plus-X. But even with black-and-white film I regularly use a meter.

Types of Film • There are many arguments over which film is the best. Some photographers are constantly changing to a new make of film. Others will take four or five varieties of type 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 you like and stick to it over a period of years. In my experience that I have found Kodak film 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 in 35mm black-and-white film, I use both Kodak and Dupont. For my Leica work I use Plus-X almost entirely, although Super-XX is valuable for pictures taken under questionable lighting conditions.

Filters • I feel the same way about filters that 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 (Leitz No.

2) and the other a 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 filter and the third with the red. I hope that one of these will be a satisfactory shot.

A very large part of my pictures are close-ups taken at from 3½ to 6 feet. This method is, of course, one of the remarkable advantages of the Leica camera, it is not so successful 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 the United States before audiences who have come to see my motion pictures that the intimate close-up shots of people draw the most enthusiastic response. My advice, then, to all amateur photographers would be to pack their films full of such intimate shots.

Developing Films · Unlike many explorers and travelers, I do not develop in the field, in bathtubs in India, the Amazon, or the interior of China. The difficulties are those of dirty water, poor solutions, and variable temperatures. But with both motion pictures and stills, I recommend frequent "short end" tests to be sure of exposure, focus, scratching, shutter adjustment, and other factors.

For over 20 years, from all points of the world, I have air-expressed or airmailed my negatives—both color and black-and-white—back home to be developed. It pays to get your negatives home quickly. Not by ship, where in the tropics the heat in the hold of a ship may range from 150°F to 170°F. Ship by air.

What to Photograph · What do I see to photograph, say in a little "dull" land like Uruguay? Well, I made three documentary films there not long ago, and over a thousand Leica stills. The longer I stayed, the more I came to like Uruguay and its people.

One film was about a middle-class Uruguayan family. The 300 still pictures we took of them gave us about 50 first-rate shots describing the daily life of an average family in Montevideo. Early morning at home, the windows being opened after being closed all night, breakfast, the children going to parochial school, the mother downtown shopping, a poster advertising an American motion picture; the old grandmother, and finally the *asado,* the wonderful barbecue in the backyard and close-ups of Pepe, the nine-year-old boy, grabbing his share and eating it a bit early.

It may sound dull, but it's a good series. It was fun to make, and all of the 60 pictures, except the Mother's trip downtown and Father at business, were made in or outside the one house.

Lighting Equipment · Most amateurs as explorers confine their pictures to exteriors. Yet many of the most interesting and novel shots are of course interiors—homes, churches, schools, hospitals, and even a mud hut in a primitive village. To photograph how these people eat, sleep, and worship, you need lights.

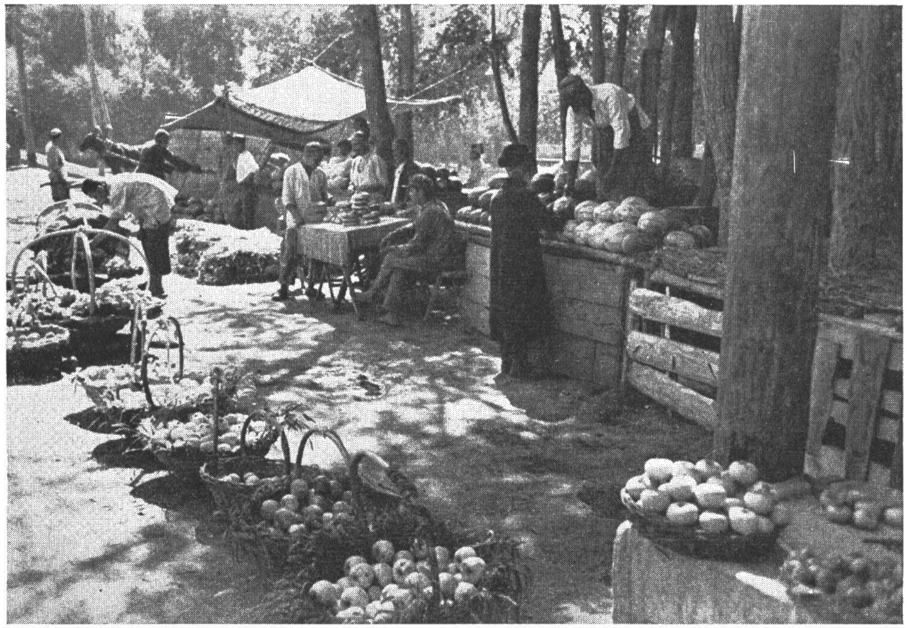
For some years I have carried a suitcase of Photofloods around the world. A dozen No. 2s weigh only a few pounds. These bulbs are guaranteed for 6 hours, but last much longer. General Electric supplies them today in several sizes. But the best for the traveler are No. 2s. These are made in two types, flood and spot, each with a built-in reflector. This gives a wonderful advantage over the old type. The G-E Reflector Spot is called RSP2, while the flood is RFL2.

During the siege of Warsaw, I had only two No. 2 Photofloods (old type) left. Yet with these I managed to get some of the most dramatic pictures of the war, 36 shots on a Leica roll, of women and their babies under fire in a Warsaw hospital. The lens was wide open at f/2 and the exposure 1/20 second.

Philosophy · I suppose every photographer has some philosophy behind his work. For me, it is basically an interest in people, in promoting better international understanding and in tracking down many of the prejdices and fears 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 Buryat-Mongolians and Tungus and Khevsurs. I love to visit the Makkas in Paraguay, or the Quechuas in Peru. I have found

6. COTTON CHOPPING in Mississippi shows the traditional method of thinning this Southern crop. Throughout the United States there are many interesting travel pictures to be made. Photo by William Vandivert.



7. FRUIT MARKET of Ining, capital town of the Ili Valley in Chinese Turkestan. Pictures like this are an important link in a series to show how people live in different countries. Photo by William Vandivert, (c) *Time* Inc.

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. I am careful not to offend them by disregarding 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 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.

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 primi-

8. RUSSIAN VILLAGE NEAR MINSK in White Russia. This is an excellent example of the travel picture which tells the story of a place. Note the old style peasant harness and the typical wooden farm house. Taken at —20°F by Julien Bryan.

tive 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 or 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 they normally do. Not until this point do I open my Leica—but when I do, I meet with excellent co-operation from the natives, who now feel that they are helping me in a very important project.

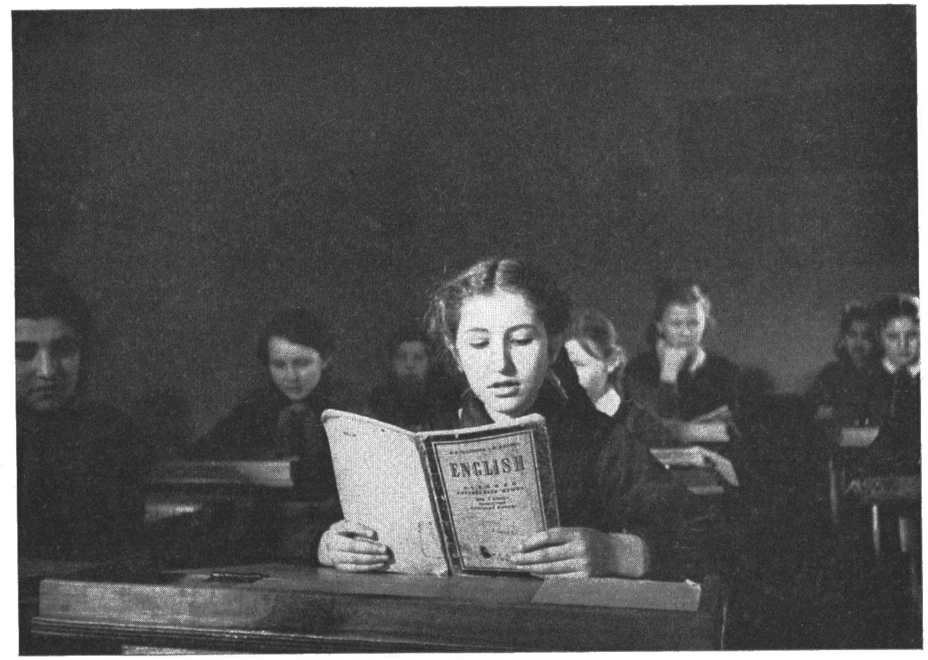
In motion pictures we use the terms "long shot," "medium shot," and "close-up." I find the same terminology very helpful in still photography. At first a preliminary number of pictures are taken from a distance, showing the village, the mountain, or the valley in its relation to the country as a whole. 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 the Leica camera gives me, I make an entire series of action photographs showing some form of work from beginning to end.

Customs Duties • This question begins even before you leave the United States. *If you possess a Leica, or any foreign-made camera, be sure to have it registered by number and the lens number before you sail or fly away to foreign lands; otherwise you will be charged duty on your return.*

Unless you are a professional with several trunks full of film and gadgets, you should have little trouble at most borders in the world. If you have a lot of cameras, however, and an unusual amount of film, tripods, and so on, I would recommend having all of these listed—cameras with their numbers, lenses, tripods, and the rest. It is well to have 10 or more copies of such a list to show at any border. I always have my lists typed on formal or company stationery and addressed to the Consul General (In New York, say) of the country I intend to visit. I simply state that I intend to visit his country, say in July of that year, to take pictures, and will appreciate any courtesies he or his country can offer me. I then give below the list of equipment I plan to take. This is certainly not necessary if your equipment and film supply is quite small.

Photographic Restrictions and Censorship • More and more countries today have restrictions for both amateur and professional photographers and many are the unhappy amateurs who have not bothered to learn local

9. QUEBRACHO TREE LOGS being hauled by the large-wheeled carts for processing into tannin. Photographed by Julien Bryan at Port Casado, Paraguay.



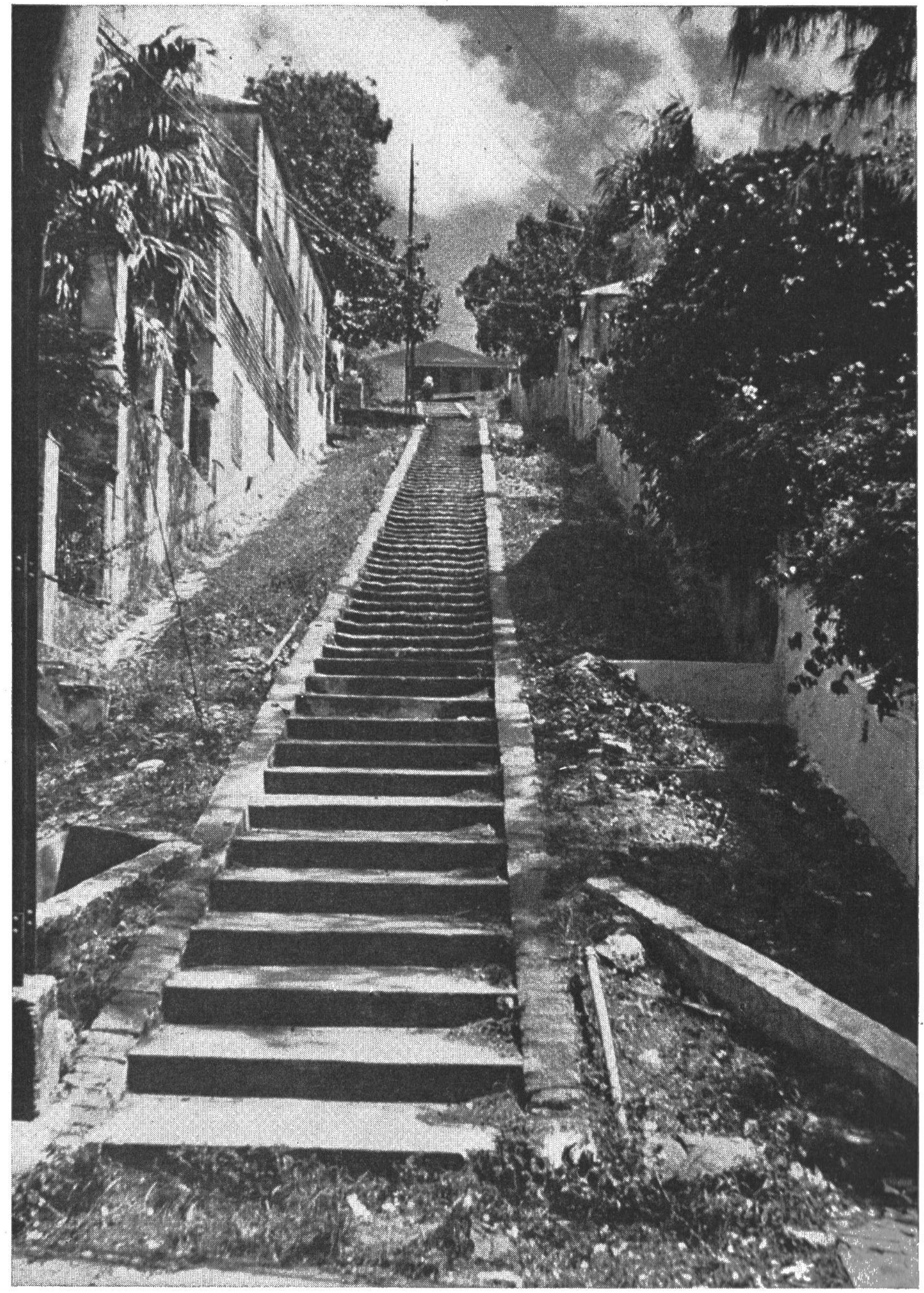
10. CLASSROOM at school in Minsk, Russia, shows the girl in foreground studying her English lesson. Photo by Julien Bryan made with available room light.

regulations. They have been stopped by the police of some foreign country for what seemed to them harmless photography. 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 that prohibit photographs of anything of a military nature. Some of these subjects 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, that to the foreigner do not deem fortified at all. What steps should the foreign photographer take in view of such restrictions? In many years of taking human interest pictures in places ordinarily forbidden, I have had little of the unpleasantness that other travelers frequently report. I have learned that every photographer from another country must depend a great deal upon the co-operation of the local government.

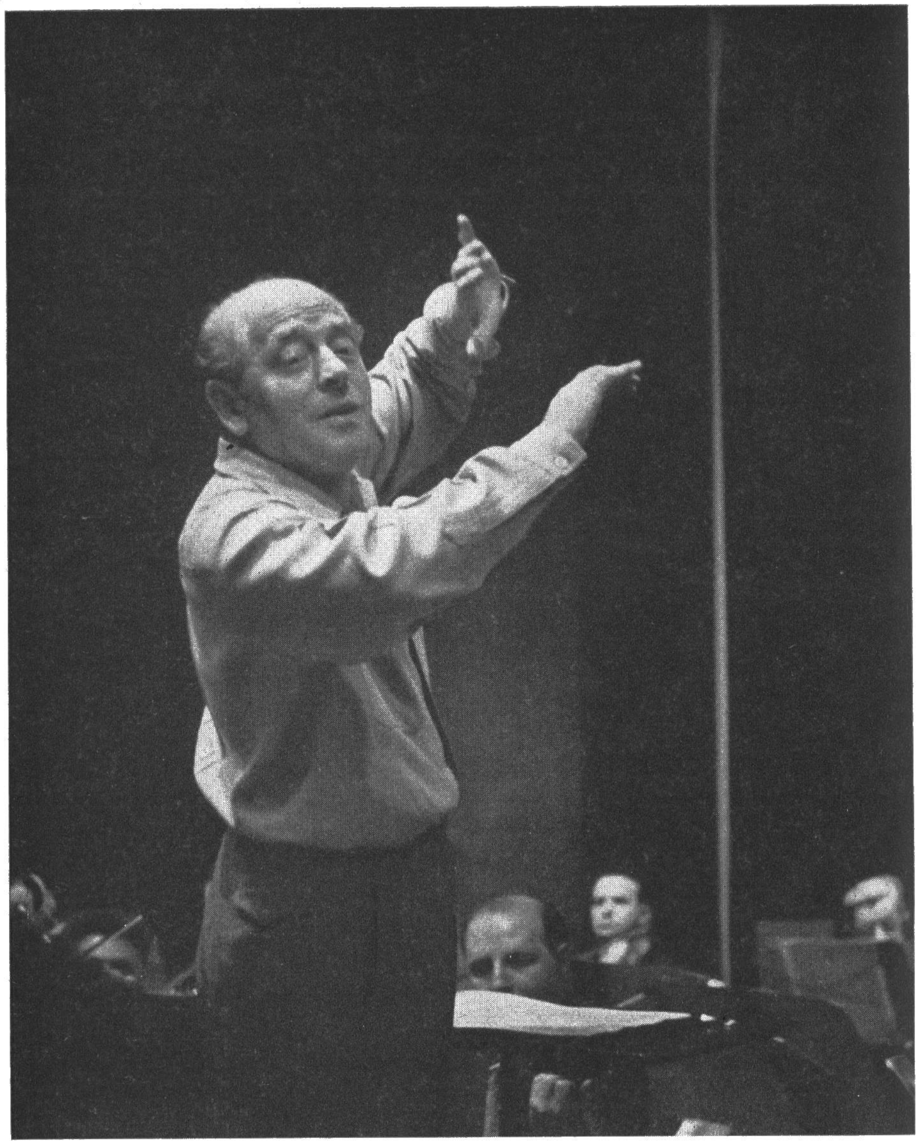
Usually, upon my arrival in the foreign capital I go immediately to the government officials and tell them the object of my visit. Even though this may mean some delay, I have found that it is much wiser to go to the authorities first rather than to have them come to you. This is a more polite and friendly way of approach, and in most cases has worked out very well for me. The officials will almost always be 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 that they do not permit their own nationals to take. More important, 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.

Summary —

1. I think it of the utmost importance to have a definite objective that my photographic work will serve.
2. The objective in my case is to obtain pictures that 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 underlying my approach.
5. Patience is an extremely necessary quality for a successful photographer-explorer. Display of temper over 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. You should make every effort to learn what is considered good manners among the people you are to visit.
8. It is important that you do not impose upon the people, and are not condescending in your attitude toward them.
9. Above all, you should take no shots unrelated to the story; rather, after the people have been put at their ease, you should make a whole series of shots 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 you make careful preparation for the trip, but wherever possible you should take along an expert who knows vastly more than you do about the customs and the lives of the people you plan to photograph.
11. An exposure meter must be used for color. But each camera and exposure meter must be tested to make sure that they co-ordinate.
12. Your equipment should be simple, with no useless gadgets. Your film should be limited to one make or brand.
13. In the field, you should be so interested that you are able to work sixteen hours a day and take hundred of pictures without feeling tired.
14. 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, these are enough.



11. THE HUNDRED STEPS STREET in St. Thomas, Virgin Islands. 35mm Summaron, f/9, 1/20, reproduced from a Kodachrome original. Photo by Henry M. Lester.



EUGENE ORMANDY — Adrian Siegel

The photographer made this picture just as the conductor of the Philadelphia Orchestra reached a peak of action during rehearsal. 85mm Summarex, f/1.5, 1/20, Plus-X film.

MUSIC AND THE LEICA

ADRIAN SIEGEL

When I joined the Philadelphia Orchestra many years ago, I bought a camera, a custom of every young musician who joins a large orchestra. My little folding camera gave me a wonderful collection of what today looks like groups of cigar-store Indians. Viewing these results wasn't encouraging to the pursuit of photography.

As the years went on I appreciated more and more my musical experiences of playing with the great artists, and I wished for a means of recording, with veracity, these unusual musical moments. How singularly fortunate that my realization of the photographic possibilities should coincide with the time when the miniature camera was coming into its own! To top all this timeliness, my good luck was that I could start my venture with the ultimate in the miniature camera. Eugene Ormandy gave me his Leica. That was over 13 years ago, and I am still going strong with this camera. I rarely go anywhere without it.

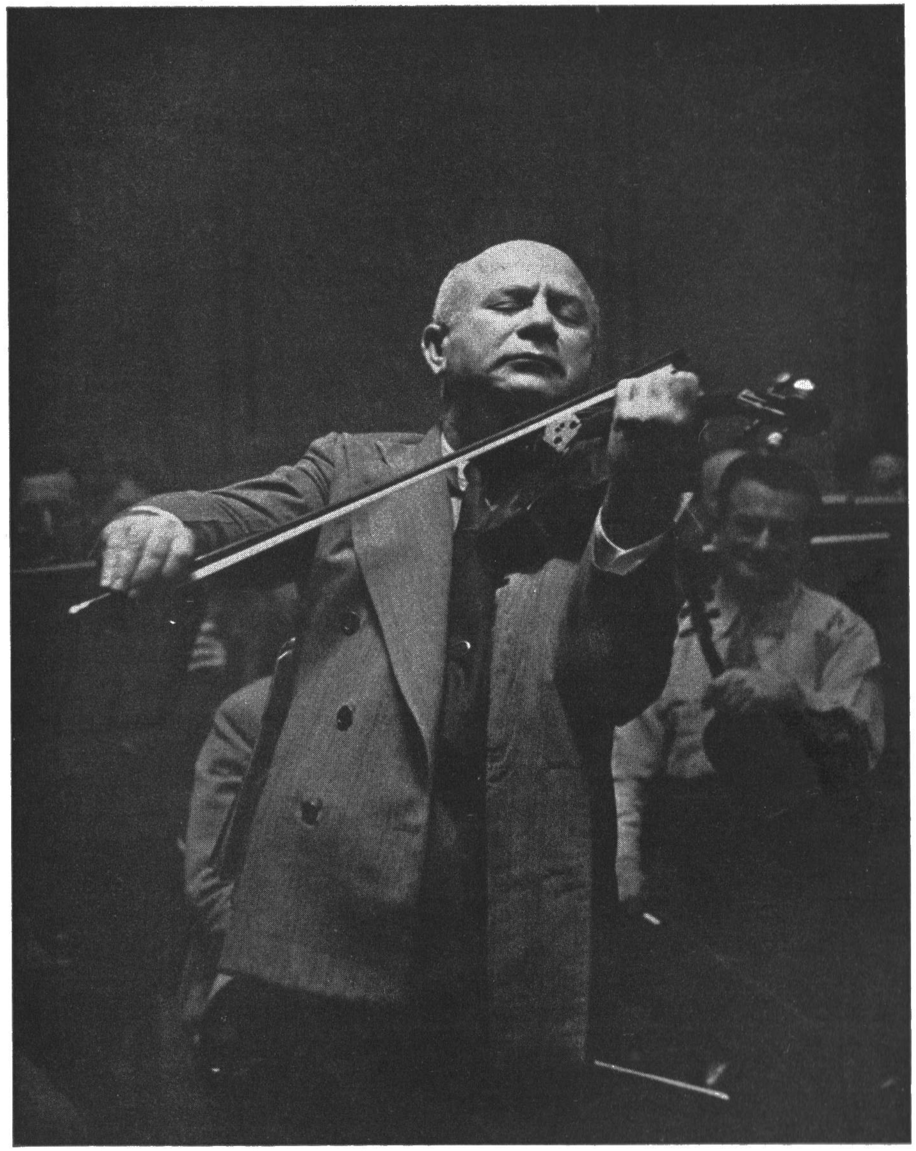
At first I had to steal shots from my seat in the cello section. One of my most dramatic pictures, of Rachmaninoff conducting, was taken that way. As my collection grew and received recognition (an exhibition at the Philadelphia Art Alliance and an article in *Life* magazine in 1943) the publicity value of my work with the Leica became evident. Since that time I have enjoyed carte blanche to photograph from any angle or any position in the hall where the orchestra is playing.

As a musician in one of the great orchestras of the world, I realize that with my photographic privileges my opportunity is unique. Of course every Leica owner does not have this good fortune, nor does every Leica enthusiast share my love for this particular specialty. But there are many parallel chances. For instance, every town has music in some form, whether it is the school orchestra, a conservatory of music, chamber music, or choral groups, all of which make wonderful photographic material for the high-speed Leica lens. There are also theatrical and dance groups, all meat for that fast lens.

Should you desire to record material of this nature, some of my practical experience may be helpful. I use 2 Leicas, because I have to make quick changes from the Summarit 50mm lens to the Summaron 35mm wide-angle lens in order to avoid lost opportunities and to have a sequence of 72 shots, instead of 36, without changing film. It is certainly possible to do the work with one camera with a 50mm lens, as I did for many years. The 300 shots I took of Toscanini during 2 rehearsals in 1943 were done this way. The Summaron 35mm wide-angle lens is extremely useful for groups in the orchestra where depth of field is important. With the focusing scale set at 20 feet and the aperture set at f/3.5, the acceptable depth of field will be from 12 to 50 feet. For action portraits of soloists during rehearsals or concerts, I use the 50mm lens. By focusing with the built-in range finder, using an aperture of f/2.8 or f/3.2, there is generally enough depth of field to allow for some movement on the part of the artist. Some of my successful pictures of conductors and string players show a bit of action, which for my kind of candid photography is not a detriment. The f/1.5 85mm Summarex, enabling one to shoot at a much higher shutter speed, is fine for photographing extremely active artists.

To use these lenses advantageously, an Imarect Finder is a necessary accessory. From my long experience I have learned to judge exposures without

1. Adrian Siegel has mastered the use of a Leica along with his cello in the Philadelphia Orchestra. He is here seen with his camera equipped with the 85mm Summarex lens, ready for a picture of some fellow musician.



2. MISCHA ELMAN **Adrian Siegel**

This picture was exposed just as the musician lifted his head and the full top lighting of the stage gave ample illumination. Taken during rehearsal with the 50mm Summarit, f/2.8, 1/20, Plus-X film.

the use of a light meter. Then, too, the great latitude of modern film gives ample safety margin.

Most of my exposures are made from f/2.8 to f/3.5 at 1/20 second. This is a good average with the regular stage lighting and for most individuals camera steadiness. Certainly the complexion of the artist and the color of his clothing must be taken into consideration when deciding on the correct exposure.

The normal lighting of the concert stage is usually overhead lighting, which casts deep shadows. With this type of lighting the time to shoot is when the performer lifts his face toward the light, thereby making interesting highlight patterns. Usually you can count on the artist's doing this at some time. All this requires patience on your part, and split-second response to capture that moment. To that end, some knowledge of the music being performed, the dance form, or the play, is invaluable, because it helps you anticipate action peaks. Every artist new to you requires a few moments of observation so that

3. SALVATORE BACCALONI. An expressive close-up taken from the podium during rehearsal. 50mm Summarit, f/2.8, 1/20, Plus-X film.

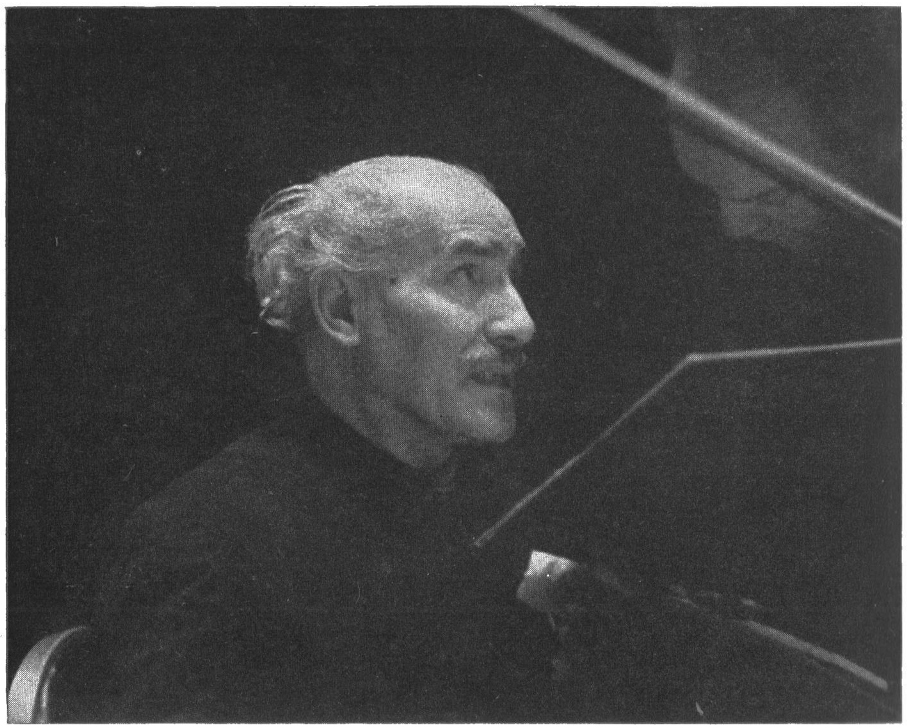
4. FERRUCCIO TAGLIAVINI. In this picture note that the exposure was made at the instant of arrested action. 50mm Summarit, f/2.8, 1/20, Plus-X film.

you can become familiar with his reactions to the music, because while some artists are deadpan, others run the gamut of facial expressions. Singers and wind players are easiest to photograph and, with a few exceptions, pianists are next. Conductors and string players, being most active with their arms and bodies, are the most difficult.

Holding the camera · There have been many recommendations as to how to hold cameras for steadiness. This is something most important for each photographer to work out for himself. My experience has taught me: *first,* to have a comfortably fitting jacket that does not bind the arms or the shoulders; *second,* that since I am short and rather stocky, my arms hold more steady in a raised position than tight to my side, as is frequently advised; *third,* that in order to get my best results in squeezing the shutter release I must avoid tension in bracing the camera against my face. In fact, lack of tension is one of the most important admonitions for the successful pursuit of happy results in candid Leica photography. My long years of working with the Leica have developed a sense of timing so that "squeezing" the shutter release is like blinking an eye—I am not conscious of it.

If it is possible, I try to meet the artist before he comes on stage, holding my camera so that he cannot miss seeing it. It is most important to avoid being a camera nuisance—not to click the camera during very soft musical passages, not to be obtrusive in your motions. Getting permission from the manager or the stage director is usually a wise precaution. Recently I lost a wonderful shot for the good of diplomatic relations and photographic reputations. When the orchestra went to England in the spring of 1949, we met Queen Elizabeth at a reception given by the Douglases. My Leica was with me, of course. When the Lord Chamberlain saw it in my hand he said: "Put that camera away! Don't let her see it!" I obeyed, with deep regret.

Many times flash is very useful. However, with the versatility of the Leica it is possible to get shots without flash that would be very difficult with another type of camera. For me, pictures without flash, particularly on or around the stage, are more evenly lighted and show the natural background to advantage. The blinding effect of the flash, especially the focal-plane bulb that has a flash

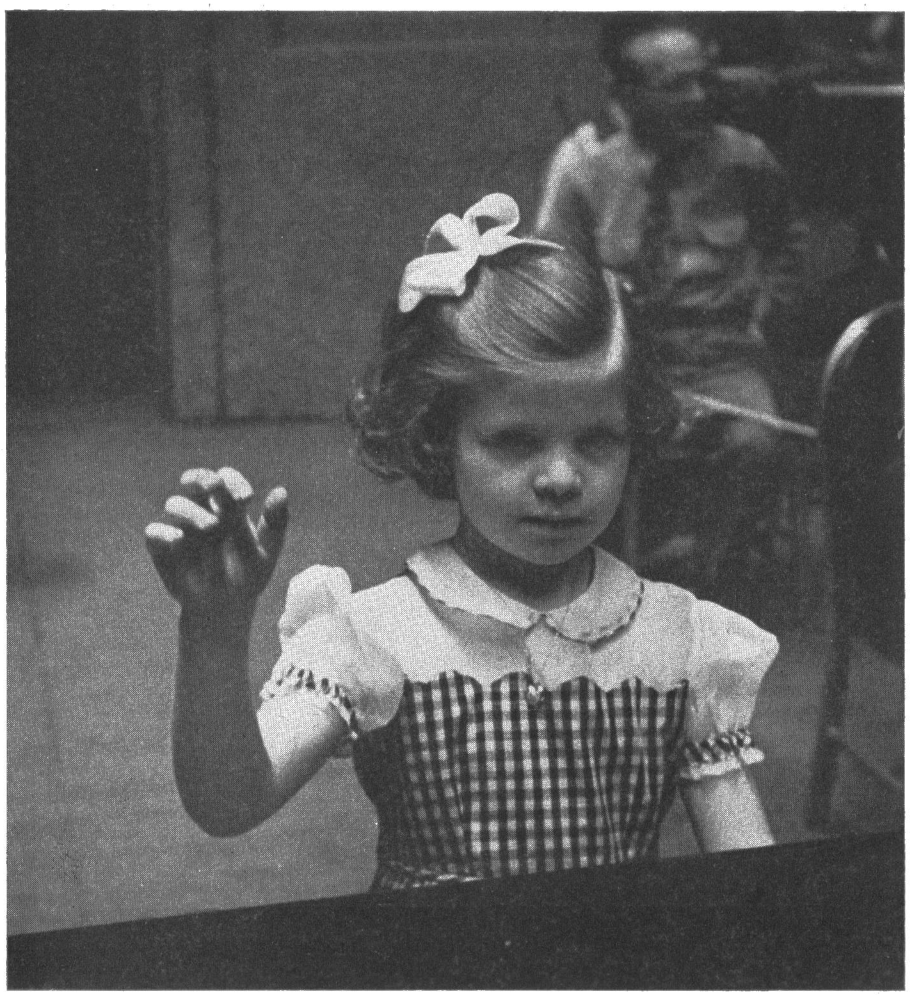


5. ARTURO TOSCANINI. 50mm Summarit, f/2.8, 1/20, Plus-X film.

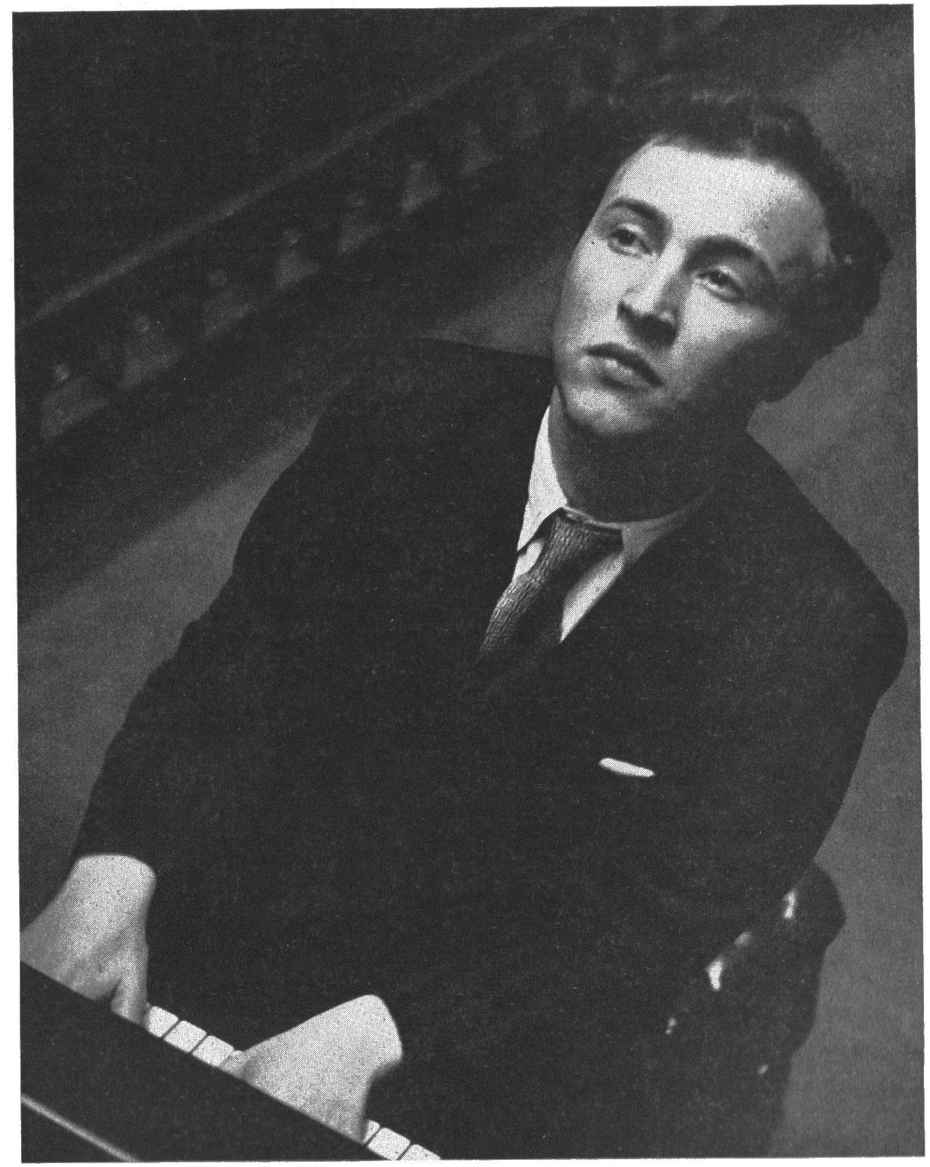
6. GREGOR PIATIGORSKY — Adrian Siegel

Off-stage pictures of musicians can be made with available room light or with the aid of one or two photoflood lamps when necessary. 50mm Summarit, f/2.8, 1/40, Plus-X film.

of longer duration, is very disturbing to musicians while they are reading music. Although both my Leicas are equipped with flash, I use it only on special occasions. With Toscanini, any photographer who unexpectedly uses flash may find himself with a broken camera. But Toscanini was most kind and gracious with me because of the unobtrusiveness of my Leica. When Sir Thomas Beecham was guest conductor with the Philadelphia Orchestra, one of the news photographers flashed a bulb. Beecham wheeled and shouted: "I know your creed. All of you get out!" But I went on shooting with my Leica from my place in the cello section.



7. ZOLA MAE SHAULIS. 50mm Summarit, f/2.8, 1/40, Plus-X film. Exposed with available room light.



8. MENAHEM PRESSLER — Adrian Siegel

Again the photographer has waited for the instant when the musician has reached the peak of a gesture and the room light is most effective. 50mm Summarit, f/2.8, 1/20, Plus-X film.

Your behavior as a Leica enthusiast in this specialty can make friends, and also has renumerative possibilities. Parents would be happy to pay for a good candid shot of their little Susie playing Paderewski's "Minuet" at the conservatory concert.

After experimenting with all types of film fast and slow, and with all the fine-grain developers put on the market, I have come to the conclusion that my best results are obtained with a medium-speed film, such as Eastman Plus-X, and with a medium-fine-grain developer like Kodak D-76. The only precaution is to keep the temperature of the solutions and the wash water between 65° and 68°F. Therefore, a wise investment is a good thermometer, such as Weston or an Eastman process thermometer. Before I had the good luck of breaking my cheap thermometer, which must have been 10° off, I was troubled with grainy negatives. A developer such as D-76 brings out details in the shadows that are usually lost when using ultra-fine-grain developer for this type of exposure. Of course for a well-lighted shot I heartily recommend a fine-grain developer.

When a gallon of developer is mixed, I fill three quart and four 8-ounce bottles. I then use 8 ounces of fresh developer with each roll of film. Employing fresh developer with every roll of film assures brilliant negatives.

For making prints for reproduction I find that a glossy paper, grade 2 or 3, depending upon negative contrast, is most practical. For other purposes a warm-toned paper is helpful in order to avoid chalky highlights and to retain detail in deep shadows. Once you have established a standard working procedure, good results can be expected from every roll of film.

9. CLAUDIO ARRAU. This Chilean pianist is furiously rolling out the notes during a rehearsal. 50mm Summarit, f/2.2, 1/100, Plus-X film.

10. YEHUDI MENUHIN photographed from podium during rehearsal.

11. ARTUR RUBENSTEIN — Adrian Siegel

REFLECTIONS Fritz W. Neugass

Fascinating reflections are to be found in mirrors, show windows, water, and high-gloss surfaces. The photographer with an eye for these subjects can find many fine compositions. 50mm Summitar, f/6.3, 1/60, Super-XX film.

PHILATELIC PHOTOGRAPHY WITH THE LEICA

RAYMOND D. KERSHNER

In philatelic photography—the photographing of postage stamps and related items for collectors—absolutely no control work or retouching of negative or print is tolerated. The finished print must be a perfect reproduction of the original, as even the most minute markings on a stamp have a meaning to the collector. These are scientific pictures made solely for a particular purpose, and if they accomplish that purpose they are good photographs.

The demands of philatelic photography are exacting, and require a camera with the utmost versatility, with a lens that will define sharply the minutest speck on a postage stamp, and in addition be economical to use. The Leica is the ideal camera for this exacting work.

There are many uses to which the stamp collector can advantageously put his Leica. Every member of a stamp club at some time or other is called upon to give a talk or hold a discussion about his collection before his home or some other stamp club. Rather than merely display his stamps, he can make an interesting set of slides of outstanding items, showing dramatically by means of extreme close-ups the important features of items under discussion, which when magnified many times on the screen will enable everyone in the group to understand better the points he is explaining.

It should be mentioned at this point that slides must be in black-and-white, as it is illegal to reproduce U.S. or foreign stamps in natural color. Also, it is not permitted to reproduce U.S. stamps in normal size; the reproduction must be either 1½ times or larger or ¾ size or smaller.

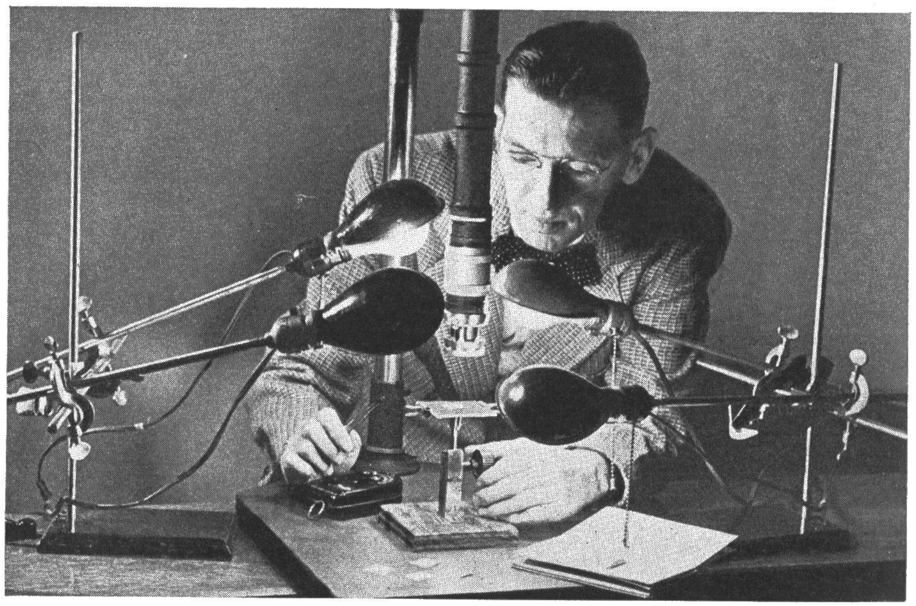
Photographs of stamps are used to illustrate auction catalogs, they are a necessity for illustrating articles in the philatelic press, and the collector-photographer can easily and economically make a photographic record of his entire collection for insurance purposes, or for identification in case of theft. Practically every specialized collection entered in competitive exhibitions is profusely illustrated with photographs.

Photographing philatelic items for insurance purposes, illustrating catalogs, and making pictures for magazines and albums is a high class of copy work and it would be well at this point to review the chapter on Copying carefully. Examining stamps to decide their authenticity is a highly specialized field requiring a complete mastery of photographic technique, clean and careful processing and printing, a knowledge of stamps and the methods by which they are made—including printing, engraving, papermaking, and so on.

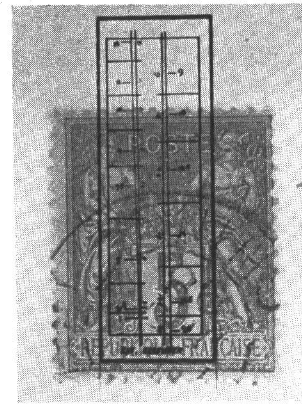
Equipment • In addition to the Leica and the Focomat enlarger, the most important piece of equipment for philatelic work is the Focaslide, with a full assortment of extension tubes. I use 2 sets of tubes in order to obtain any degree of close-up desired. As an aid to critical focusing, the Focaslide should be equipped with a magnifier over the ground glass. For preliminary examination, various types of magnifiers are necessary. Although expensive, a binocular steroscopic low-power document microscope is well worth having if you contemplate much stamp examination.

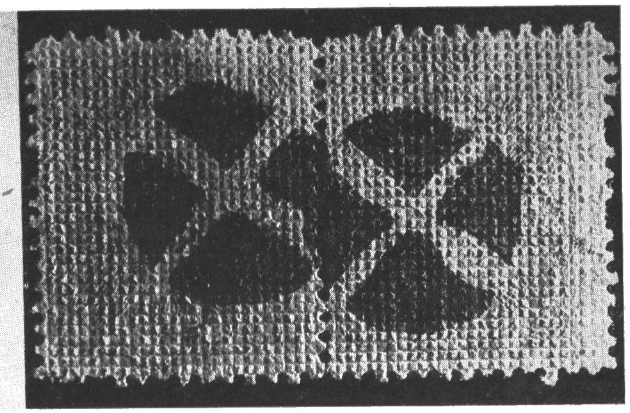
Various measuring scales, all marked in the metric system, are used for determining distances between points on stamps. Many of these scales are made of glass and are placed directly over the stamp, the measurement being included in the photograph to furnish documentary proof. A small millimeter scale is often included in the photograph to show the degree of magnification on the print.

Filters • A set of 5 color filters, which should be of the best-quality optical-glass, will cover every philatelic photographic problem adequately.



1. The author and his setup for photographing stamps. Shown also is the micrometer focusing stand used for fine adjustments when raising or lowering the object on the table.





2. *(Left)* Glass measuring scale over stamp for checking fine lines from zero to 20/100 inch.
3. *(Right)* Face of rare "grilled all over" stamp has been removed by use of color filter. Use of strong side lighting shows indentations of grills.

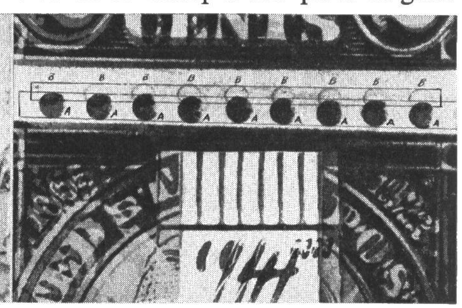
These are the Wratten Red F-29 (8X) or the A (4X); the Green 61-N (7X) or the B-58 (6X), and the Blue C-5 No. 47 (10X) or the No. 50 (40X). Critical focusing should always be done with the filter over the lens. The 2 other filters required are the ultraviolet, which is practically clear but requires an increase of 10 times in exposure, and the opaque infrared filter No. 87 for use with infrared film. Among the many uses to which these filters are put is the study of watermarks on chalk papers, which cannot be immersed in the watermark solution, to eliminate the design of a stamp in order to study a cancellation or an overprint, very often to remove the heavy cancellation in order to study the stamp design without interference, and, with the ultraviolet lamp coupled with the ultraviolet filter on the lens, to determine whether a stamp has been repaired or had a cancellation or an overprint chemically removed (called *cleaning* or *washing* a stamp). With these filters it is also possible to photograph a stamp printed weakly, or in a color hard to distinguish visually, so that the design will stand out in sharp contrast. Stamps printed in yellow ink are very difficult to examine visually, but either a green or a blue filter will make them seem to have been printed in black ink.

In order to determine the proper filter to use, merely view the stamp through the different filters to see the effect you will obtain. To increase contrast on yellow, orange, or red stamps, use a green or blue filter. Contrarywise, if you wish to eliminate the design, use a filter of the same color. It is impossible to lighten some of the blue inks, while others of a different chemical make-up can be lightened considerably. If necessary to eliminate a blue color, this can often be done by using a positive or a color-blind film. With the exception of infrared film, a fine grained panchromatic film is always used. In order to have at hand a chart that will instantly show the effect of the different filters, arrange about 20 different-colored stamps on a black background and photograph them through each of the filters. The set of resulting photographs, will enable you to know at a glance just what your filters will do to the various colors.

Lighting • Another essential piece of equipment for the examination and photography of stamps and questioned documents is the quartz (ultraviolet) lamp, equipped with the proper filter. I use the ultraviolet lamp manufactured by the Hanovia Chemical & Mfg. Company, Newark, N. J. This is a small, compact unit with a lamphouse easily adjusted for photographing documents and stamps, and operates at the wavelength most suitable for examinations of this kind. The ultraviolet lamp is used for preliminary visual examination, to determine whether any alterations have been made.

As photographs are made by both reflected and transmitted light, the lighting units must be as mobile as possible. They should permit even illumination over a complete album page and concentration on a single stamp. When you do only occasional stamp photography 2 ordinary goose-neck desk lamps will suffice. But if there is considerable work of this nature, a specially designed unit will make for easier and better work. I designed a setup consisting of two units, each containing two 60-watt lamps. This arrangement is composed of laboratory stands and clamps that make it possible to manipulate and place in any manner desired. The illustration on page 336 shows how these units are made.

Focusing • Focusing of the camera is facilitated, particularly when making extreme close-ups, by the use of a micrometer focusing stand or table. For rough focusing, raise or lower the camera itself, for fine focus, raise or lower the stamp on the micrometer table. Clamp a 5x7 piece of glass



4. *(Left)* Block of six 2¢ Hardings was made up of three pairs of stamps joined at the perforations by splitting the perforations on one set of stamps and inserting the thinned-down perforations of the other set. Strong side lighting shows the joining.

5. *(Right)* Comparison photograph made by overlapping two transparencies, one of the *patient* and one of *control*, both of exact size, out of register to show the difference in size of perforation holes. The black holes (A) are of the genuine stamp, the smaller holes (B) are of the patient. The difference is caused by the interweaving of the patient at the perforations causing the holes to be smaller than genuine ones. Scale shown is ¼ inch.

on the focusing table and place the item on the glass. You can obtain a black background by using a sheet of black paper. Also, with this arrangement it is possible to place one of the lights directly under the glass in order to make a photograph by transmitted light.

Main Types of Philatelic Faking and Methods Used to Detect and Expose • As a guide to procedure in examining and photographing questioned philatelic items, the chart below lists the main types of philatelic fakery and the techniques used in examination. The code numbers describe each method or technique. This is the first time such a chart has been published, in either philatelic or other publications. The explanations listed under the code numbers will give the Leica stamp collector a working knowledge, using which, he can experiment and work out his own particular technique.

TYPES OF PHILATELIC FAKERY

Type of Fake	*Code*	*Technique of Detection and Exposure*
Counterfeits	1	Comparison with known genuine stamps
Repairs		
filled-in thin spots	2	ultraviolet examination and photography
added perforations	4-1-3	magnification, measurement, comparison with genuine
regumming	2	ultraviolet comparison with genuine
trimmed perforations	3-4	measurement, magnification
ironed creases	3	magnification, examination for broken paper fibers
Alterations		
portions painted in	5	infrared photography
center lines painted in	4-5	infrared photography, measurement
inverts	3	magnification
changed watermarks	3	magnification
faked overprints	4-1	measurement, comparison with genuine
grills	4-1	measurement, comparison with genuine
multiple pieces	4-1	measurement of perforations, comparison with genuine
Cleaning		
chemical	2	ultraviolet examination and photography
abrasive	3	magnification, study of paper fibers
Faked Covers		

Use a combination of the above methods. This particular type of fakery, which is very prevalent, requires a specialist's knowledge of postal rates and routings.

When a philatelic item is submitted to you for examination, you are told what is suspected to be wrong with the stamp or the particular portion to be examined, so that you have a starting basis. For comparison work you must have yourself, or have access to, collections with known genuine copies of the stamp under question that you can use as a control. In professional examination work the questioned item is known as the *patient*, the known genuine copy is called the *control*. Many years ago counterfeiting of stamps was popular with the fakers, and there are few large general collections that do not contain a number of these "album weeds." Today, however, counterfeiting is rarely done, the faker using instead a comparatively cheap genuine stamp and by various methods changing it into a rare and costly piece. This type of work is often more difficult to detect than is a counterfeit stamp.

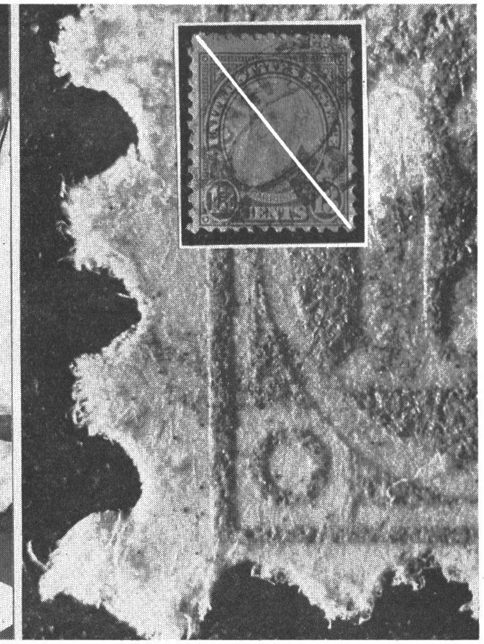
Examination and Photographic Technique

1. *Comparison with a known genuine stamp* · There are various methods whereby you can make a comparison by photographic means, including photographing with a grid over each stamp and examining the 2 stamps space by space. There is, however, a quicker and absolutely infallible photographic method. Place the 2 stamps, the patient and the control (and each stamp should be identified), side by side and photograph them together. Then make 2 transparencies on positive film. When these transparencies are dry, place them in register with the patient on top of the control. If the patient fails to register in every detail with the control, you know that it is not genuine.

2. *Ultraviolet examination and photography* · The ultraviolet lamp has the ability to distinguish between papers that, while appearing the same visually, are composed of different chemical structures. Thus the lamp is used to determine whether a stamp has been altered by the addition of paper different from that used in the original stamp—for example, to fill in holes and thin spots and to add perforations. When you desire to obtain the very sharpest definition of ink structure or paper fiber, use the lamp without the ultraviolet filter over the camera lens. However, when you desire to show the alterations in the photograph, place the ultraviolet filter over the lens. In this method what you are photographing is actually the fluorescence of the object. During ultraviolet examination and photography turn off all other illumination.

A peculiar phenomena of ultraviolet photography is the fact that sometimes a visual examination under the ultraviolet lamp will fail to reveal any alteration but the photographs will clearly show the changes. For that reason it is well always to make a photograph by ultraviolet light, whether the preliminary examination shows a negative result or not.

The fluorescent reactions of the various papers when examined under the quartz lamp are as follows: The fluorescence of pure cotton-fiber paper is nearly pure white; linen papers give a distinctly bluish reaction; wood-pulp paper gives a dark color that sometimes is almost black. When focusing, use the ordinary lamps that are turned off during exposure. When determining the exposure to be used turn on only the quartz lamp, and direct the exposure meter on the stamp. The light is very dim and sometimes it is difficult to read the meter. The ultraviolet filter factor of 10x is multiplied by the factor of the extension tubes being used. In many instances the exposure is quite long; avoid any unnecessary movement that could cause camera vibration.



6. *(Left)* Ultraviolet lamp used for examination and photography. Note filter on lamphousing that is always used for ultraviolet examination and photography.

7. *(Right)* Huge magnification of lower-left perforations. Note details of engraving and paper fibers. Insert is entire stamp. Photographed with Focaslide and extension tubes.

3. *Magnification* · While preliminary examination should be made by using various types of magnifiers, the use of the extension tubes on the Focaslide, coupled with the blowup possible with the enlarger, enables you to make a print having the same effect as viewing the object through a microscope. It is possible to enlarge the dot of an *i*, for example, to 5x7 if necessary. In close-up work the lighting is important, and you should experiment with adjusting the lamps until you secure the desired effect. Glance lighting will bring out detail in ink and paper structure.

4. *Measurement* · All measurements are made by the metric system, using various types of millimeter scales on transparent material. In preliminary examination you can measure distances by the use of fine dividers, but you must exercise care to prevent the points of the dividers from injuring the stamps in any way. Unless you are skillful in the use of these dividers, it is well to leave them alone, as the danger of harming a valuable stamp is ever present.

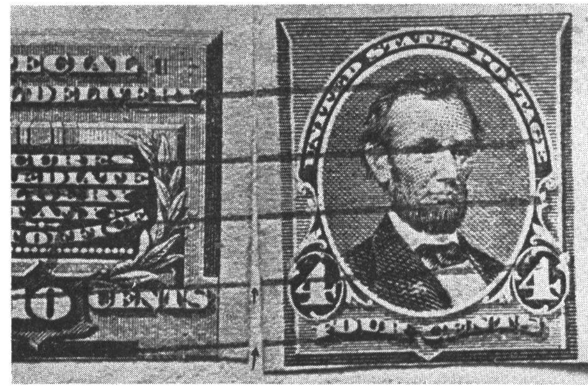
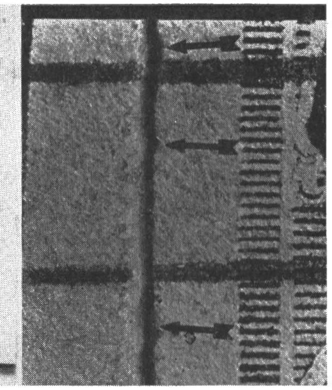
5. *Infrared photography* · In pictorial work, infrared film with the red filter is used to give dramatic dark skies with beautiful cloud effects, or to cut the haze on distant scenes, but in philatelic photography, instead of using the red filter, the opaque No. 87 is used over the camera lens. This filter prevents

any light from entering the camera, the infrared film being affected only by the heat rays emitted by the lighting units. Infrared light has the ability to distinguish between various pigments that appear the same color when viewed visually but which are of a different chemical content. Thus you can differentiate between genuine and false cancellations and overprints. Very often, if the chemical structure of the cancellation is such that it will be absorbed by the infrared rays, it is possible to eliminate completely a heavy cancellation, in order to study the stamp design underneath. This technique is also used when a portion of a stamp design is suspected to have been painted in to complete a missing part. The difference between the ink used in printing the stamp and the paint used by the faker is immediately shown in the infrared photograph. When using infrared film, use the regular lighting unit for illumination, and after careful focus has been made, turn the lens to the small infrared dot on the lens mount to compensate for the difference in focus.

Faked covers • The types and methods of faking covers (envelopes) are so many that it is impossible to do more than suggest that you use a combination of the above techniques to study the entire cover carefully, particularly around the stamp area and the cancellation. A study of the watermark in the paper of the cover, or the composition of the paper itself, will often reveal the approximate age of the cover. Thus if you examine a cover bearing a U.S. Confederate stamp, or another stamp of that period, and find that the cover is composed of wood-pulp paper, you immediately know that the cover is a fake, because wood pulp was not used in the manufacture of paper before 1890. The counterfeiting of rare covers is always going on, but fortunately the faker rarely, if ever, knows the proper ratings and routings used by the postal service during the period in question. If careful examination fails to show any evidence of tampering with the cover, have it examined by a specialist who is an expert on postal rates and routes during the period when the cover is supposed to have been used.

Very often a question will arise as to whether an overprint on a used stamp is on top of or underneath a cancellation. In order to verify this, make a third-dimension photograph, which is simply our old friend the bas-relief photograph. If you make this correctly, it will definitely show which of 2 lines is on top of the other. If the photograph clearly shows that the overprint is on top of the cancellation, you know that it is fraudulent, because the overprint is placed on the stamp by the issuing government before cancellation.

When you realize that many stamps subject to examination are worth hundreds and in some instances thousands of dollars each, and that it is not permitted to tamper with them in any way—such as placing in water to see if they will come apart—you will understand the importance of photography in the examination and analysis of a questioned item.

8. *(Left)* Pair of imperforate stamps on cover. Note wide margins on the 4¢ Lincoln clipped close at the bottom. Note also lack of cancellation ink on cover between stamps.

9. *(Right)* Magnification shows remains of perforation holes on 4¢ Lincoln. Faker, in order to leave as large margins as possible, failed to cut completely the indentations caused by the perforation machine.

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CHAPTER 22

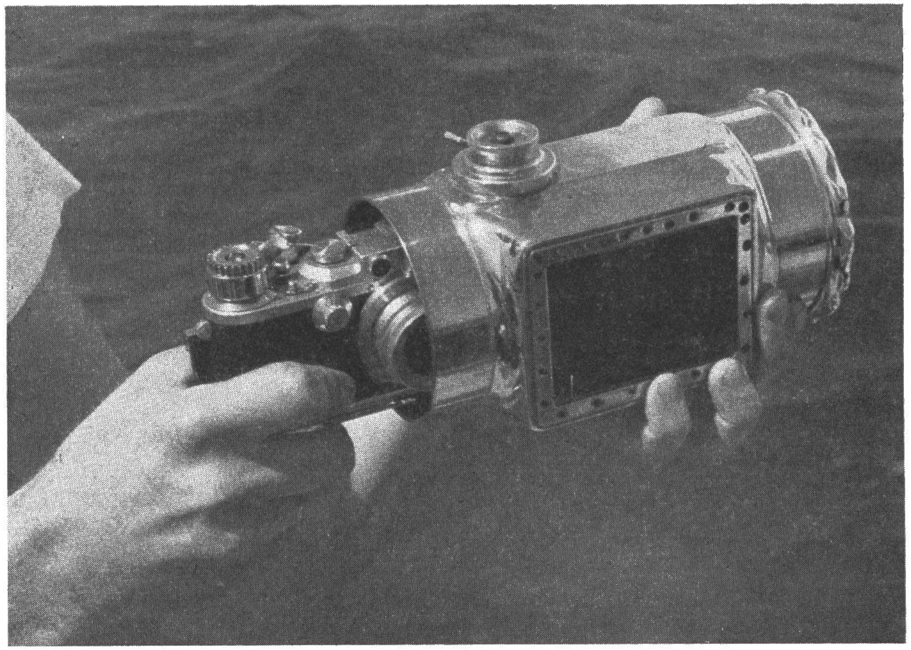
UNDERWATER PHOTOGRAPHY WITH THE LEICA

PETER STACKPOLE

Ever since man's first dive in cumbersome conventional diving apparatus he's wanted to bring back a record of what he saw. Not long ago he built large and heavy watertight boxes for still and movie cameras, usually mounted on an underwater tripod. This restricted his chance for variety in subject matter, and he could only search for pictures as far as the hose from the diving ship would allow. It is only in recent years that anyone has thought to build a box small enough for the swimmer to carry and one that wouldn't hinder his ability to move about, but now you have the ideal camera in the Leica. Helped by such devices as swim fins, you can propel yourself about with more speed and using less energy, leaving your hands free to operate the camera; moreover, the simple face plate gives you a clearer view than you get from a diving suit. Except for the camera box itself this is all that is needed for most diving between 1 and 25 feet.

I have found it surprising how many fine pictures of sea life or of other swimmers can be made from just below the surface. I recommend that if the box is homemade and not tested previously under pressure, you confine most photography with your Leica to depths no greater than 5 feet. I completely ruined a Leica once by diving directly to 35 feet with breathing apparatus only to find several ounces of salt water inside the camera when the picture taking was over.

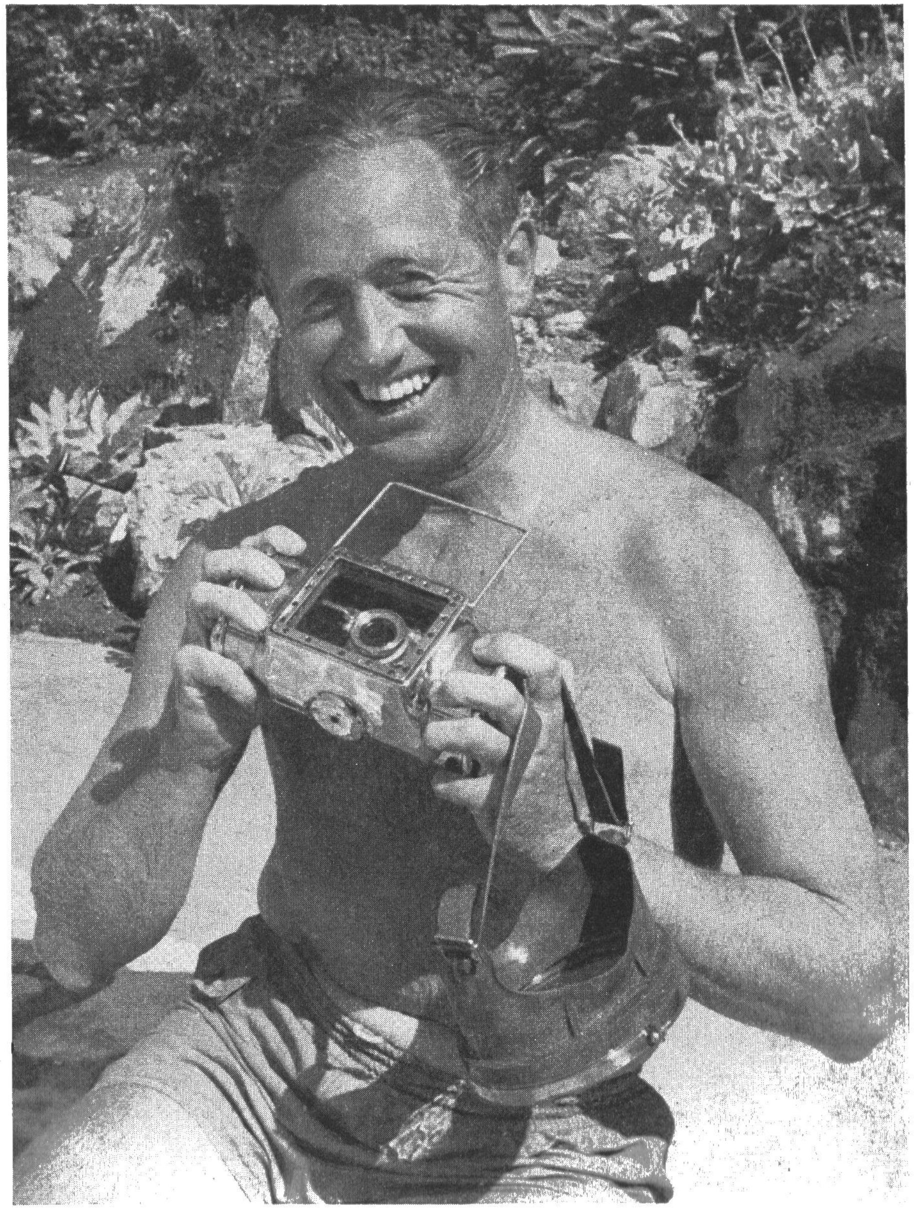
This occurred with a plastic box I built in 1941 that was successful down to 8 feet. Below that, water forced its way under the rubber cap over the tripping plunger. I'm sure that more can be done with plastics in building underwater boxes, but it is difficult to cement all joints close enough to make them watertight. A plastic casting would be preferable if one surface could be kept optically flat. I have heard of other more simplified contraptions, such as an aerographer's balloon or a hot-water bottle with an opening cut into it large enough to receive the Leica. A glass window is sealed into one side for the camera window, and the opening is either clamped or tied. All camera manipulations can be made externally through the rubber. Such an outfit is practical only for work in shallow water, and there can be no view finder.



1. The Leica camera slides into the underwater box on a special track. This photo also shows the comparative size of camera and protective box. Camera and container weigh approximately 9 pounds.

Not being content with the limitations of the plastic box or other more simplified bag-type containers, I consulted Bill Salmi, my camera technician, who had once built a box for a man in Tahiti for a movie camera. After I outlined the problems to him—portability, use of all controls, safety from leakage at depths accessible to any swimmer—he came up with a design that, though costly, did meet the problem. This meant having castings of bronze made, watertight ball bearings for the controls, and above all a system of sealing the camera quickly and then removing it from the container with ease. Instead of using many screws for the lid Mr. Salmi used a cylindrical box and large knurled caps that screw into either end of the box. These can be tightened with sufficient pressure on a rubber washer to prevent leaks. At this writing the box has been used at a 25-foot depth without leakage, and should stand considerably more pressure.

One way of partly offsetting internal pressure is to pump air into the box by means of a simple bicycle valve. Should deeper dives be necessary, this can be done. I have found that as many as 3 pictures can be taken on a single dive without the use of breathing apparatus, but never did I experience such freedom to roam about exploring underwater as when I started to use the Aqua-Lung, an ingenious French invention that uses compressed air through

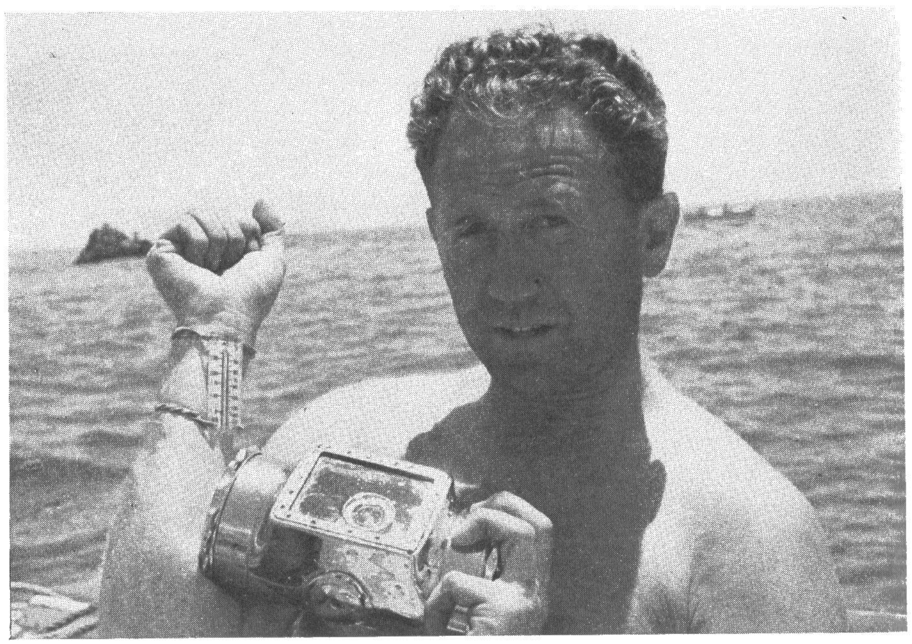


2. After an underwater dive Peter Stackpole holds the camera in its watertight container. Note French diving mask. Three exposures can be made on one breath of air.

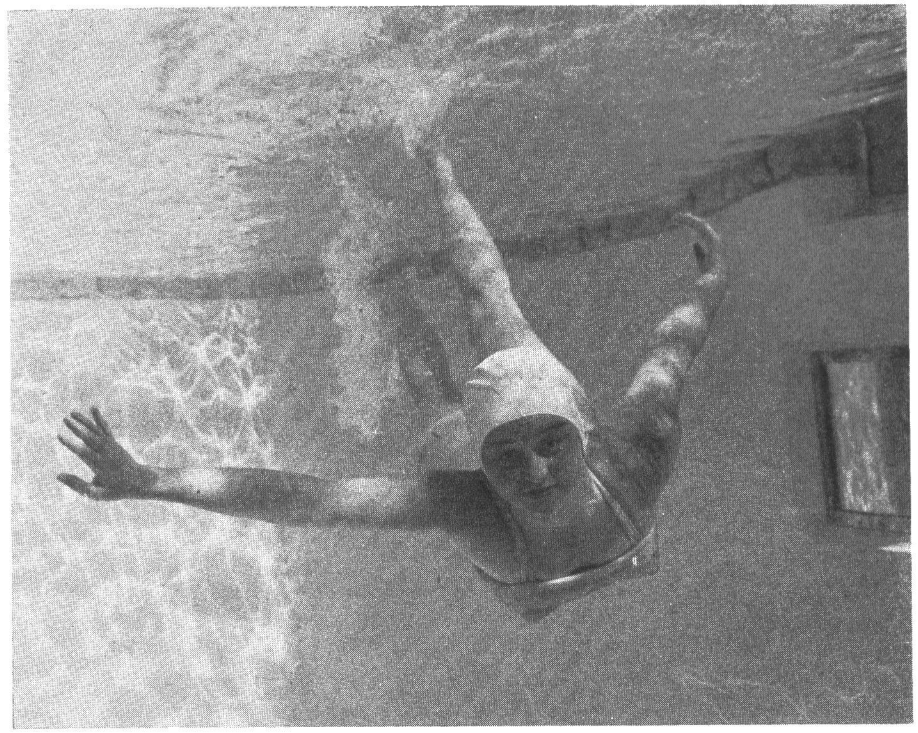
a demand regulator. This diving apparatus has been used successfully 228 feet down, and the air supply when used no deeper than 30 feet will last half an hour—plenty of time to shoot 36 exposures before returning to the surface!

Operational Problems • When building my original plastic box I believed it necessary to have enough air space around the camera to make the box return to the surface if it was dropped. This made the box unnecessarily bulky. Later I discovered that I was expending too much energy in pushing the box down to the scene to be photographed. Using the Aqua-Lung and a belt with 2 pounds of lead, together with the 9-pound underwater box, seems to make the ideal ballast to counterbalance my own buoyancy. Nine pounds doesn't feel very heavy underwater. The use of a neck strap or a wrist strap secured in the tripod hole is sufficient to keep the camera from dropping.

Moisture due to condensation inside the box is no longer a problem. I have found that it is good practice never to load the camera into the box in sunlight, where the metal might get warm before being immersed in the colder water. The use of moisture-absorbing agents, such as silica gel, in small containers at either end of the camera is important. Still another discovery I have found of value is the application of undiluted Arisol paste rubbed on the inner surface of the optical flat and the diving face plate. Wipe this off with lens tissue and no condensation can occur.



3. Pressure gauge is strapped to wrist for checking depth when making photographs underwater



4. Closeup of swimmer with the Leica mounted in the special Stackpole underwater box. Note the clear detail of this underwater picture. Leica was focused at 70 percent of actual focus.

So far, the box has but two controls—shutter release and winding knob. A future model will have a focusing mechanism. The Leica wide-angle lenses, such as the Elmar 35mm or the Summaron, have proved to be of the most valuable focal length for underwater work. At Catalina, where some of these pictures were taken, the morning light in summer is sufficient for exposures of 1/100 second at f/8 on a film of 50 Weston exposure rating. Of course the light falls off at greater depths, and you must decrease shutter speeds or widen the f-stop if you are to make deeper pictures or pictures around kelp. You can get an accurate reading of candlepower by placing an exposure meter in a well-tightened fruit jar and going down ahead of time to the scene of the intended picture for a reading. A test I'm anxious to make is one to determine the relationship of exposure to depth, which can be made easily with the wrist-type gauge and an exposure meter in a jar. In the depths the light falls off, due to the quantity of tiny microscopic organisms in the water. Sandy bottoms reflect the most light.

Underwater Focusing • It is sometimes difficult to determine distances while underwater, hence accurate focus becomes a problem. This gives all the more reason for using the 35mm wide-angle lens, with its advantages in depth of field. When larger f-stops are needed, an accurate knowledge of distance becomes increasingly necessary, because focus underwater changes to 70 per cent of actual focal distance. Since the average picture underwater is taken at somewhere between 4 and 15 feet, a camera prefocused at about 5 feet will record in sharp focus most subject matter encountered within this range.

Designing a view finder presented a puzzle. Most wire finders are fine when used on conventional cameras. The eye sighting through a small hole can see the wire frame and the picture clearly. This wasn't true when I sighted through the face plate, which placed the eye farther away. I bent wire frames of many shapes, finally arriving at a large rear sight of the same shape as the front wire finder, but smaller. This type seemed the least confusing. As you follow about the swimmers stalking fish with their spear guns, you have plenty to think about. Clarity of vision and simplicity of control are necessary. It's a heartening experience to hear the faint click of the Leica shutter and then check the glass window by rotating the box and find no water drops, which can be so damaging to a fine camera.

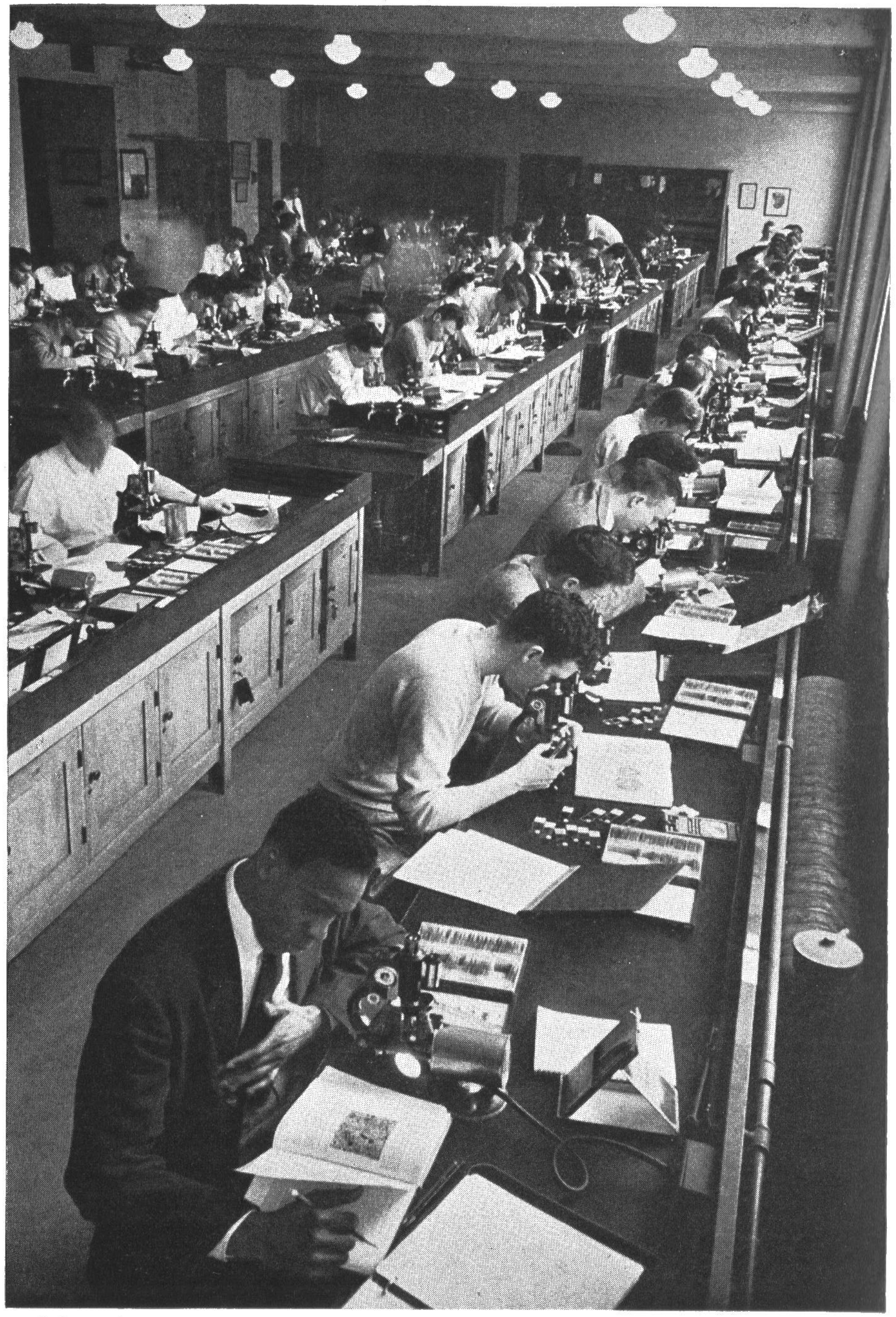
While my experience with various types of film used underwater is limited, in ocean work I have found that the moderately fast films, such as Kodak Plus-X, Ansco Supreme, or Gevaert Panchromosa, do give better contrast than faster films. Since most water you will meet tends toward a murky condition, the subject matter will usually lack contrast. Morning light is usually best, before the afternoon winds come and churn up the surface. You will find the focusing feature handy for suddenly shifting to a close-up at times when you meet a fish. Photographing fish in their natural haunts is a delight after years of aquarium photography. It's surprising how close one can get to a fairly large fish. They seem to get curious, and sometimes linger only a few feet in front of you.

5. Underwater hunter with fish spear below the surface. Photographed at 1/60, f/5.6, Gevaert Panchromosa film. Subject was backlighted by afternoon sun.

6. Complete underwater equipment as used by Stackpole. With this Aqua-Lung, which uses compressed air, it is possible to stay underwater up to half an hour at 20 feet depth.

Here on the Pacific coast there is little to frighten the experienced underwater explorer. Occasionally a sleek leopard shark will make a few passes and look you over, but it's probably the California seal that will give you the greatest jolt as you see its dark form plunge by. It gets curious too, but can usually be frightened off before it gets too playful. The only fellow I have a healthy respect for is the Mauri eel that lurks in crevices of mossy kelp surrounding rocks. Once in a great while one will dart out at a swimmer who ventures too close and bite a sizable chunk out of him. It's good practice never to explore in dark places where you can't see, and it's wiser still to have other swimmers with you at all times.

Having learned about this underwater photography the hard way with much trial and plenty of error, I recommend that even with tried and proven underwater boxes you retest them at the end of a rope without the Leica for several minutes at the maximum anticipated depth for your picture taking. Less than an ounce of salt water left unnoticed can seriously injure or completely ruin your camera.



Pathology Class, School of Medicine, University of Michigan.
A fine example of appropriate use of the wide-angle lens.

Alfred Eisenstaedt
1950 (c) *Time*, Inc.

MEDICAL PHOTOGRAPHY

WAYNE M. HULL, M.D.

From the crude stone carvings of the ancient Egyptians to modern photographic methods, the illustrative art has always been recognized by physicians as an accurate and permanent means of recording their discoveries and observations. It is not surprising that some of them turned artists in order to depict the detail of their work more completely and accurately. The several hundred artistic drawings by Leonardo da Vinci of the muscular, vascular, nervous, and skeletal systems, the Mundinus anatomical drawings, the illustrations by Albinus, the work of Vesalius, the two thousand or more water-color paintings by Carswell, and the universal use of anatomical charts by many others are familiar to most students of medical history. The artistic achievements were in many instances the most important of their contributions to medicine.

Pictures are used freely in medical literature to shorten and emphasize the written information necessary in describing disease. Carefully composed photographs give a more accurate, clear, and lasting conception of the condition presented than that often obtained from pages of descriptive matter. One needs only to glance through a modern textbook of surgery, pathology, dermatology, or one of the current issues of a medical journal to appreciate the extensive use of pictures in presenting important medical conditions and disseminating knowledge concerning their nature. Not less convincing is the enormous display of pictures seen at the larger medical meetings held throughout the country each year in which many of the scientific exhibits consist almost entirely of pictures of patients with various external lesions and deformities, pathological specimens, instruments, and research apparatus.

The fact that so few physicians have availed themselves of this valuable means of case recording is regrettable, and photographs of uncounted scores of rare and unusual conditions have been lost forever. This is accountable for principally by the large, heavy, cumbersome camera equipment available in the

All illustrations in the chapter on Medical Photography, except as otherwise credited, are from photographs by Dr. Wayne M. Hull.

past for this type of work, too bulky to be conveniently or easily transported from office to bedside and frequently entirely unsatisfactory for office use. The time required to set up the equipment and the necessity of a darkroom, film holders, strong lights, and additional office space have made it impractical for the busy physician to consider doing much if any of this work himself. As a result, medical photography has been confined almost entirely to the large hospital, where adequate funds and space for elaborately equipped photographic departments and the full-time employment of professional photographers have been possible. Yet by far the greatest number of patients are seen and treated in the office and the small hospital, where photographic facilities of any kind are exceedingly rare. With the Leica, no longer need the physician with photographic problems be deprived of photographic aid in case recording. Now he can take medical pictures as quickly and easily as he takes his patient's temperature or blood pressure.

Why the Leica Camera in Medical Photography? • It is impractical for many small hospitals and practicing physicians to employ the full-time or part-time services of a clinical photographer, so they must manage to secure clinical photographs by other arrangements. The most satisfactory solution for the physician seems to be to acquire the facilities and learn the technique for doing this work himself. Obviously, the equipment selected must be simple, compact, dependable, economical, quickly assembled, transportable, universal in its applications, and requiring no special training and skill in its operation. The Leica meets these requirements, and because of its small size can be carried in the medical bag with the other instruments to the bedside in the home or the hospital, to the office or the clinic, immediately available for any photographic necessity. With its remarkable precision and accuracy, plus simplicity of operation, the Leica can be relied upon to accomplish the most difficult tasks with the least trouble or confusion. Because of the many advantages of the miniature camera, and the continual improvements in 35mm film and fine-grain processing, clinical photographs can now be made even under the most unfavorable conditions. The numerous Leica accessories offer some satisfactory solution to any photographic problem that may arise.

The ease of operation and the high aperture of the lenses permit exposures with the camera held in the hand, and up to 36 pictures taken without reloading. The great depth of field of the lenses results in sharp, clear pictures even at close range. The proportion of the Leica negative size of 1x1½ is ideally suited to the field of medical photography. The rectangular shape of the negative is ideal for full-length views of patients, making it possible to eliminate more unneeded background than can be done with 2x2, 3¼x4¼, 4x5, or any other size or shape of negative. It is so easy to change the Leica from vertical to horizontal view, such an improvement over the reflex or rear-

focusing-screen camera. In vertical pictures the width of the field is minimized, and in horizontal views vice versa. The adaptability of this camera is remarkable, making it possible to obtain pictures where other equipment fails.

It is most important for the user of this fine equipment to appreciate its high quality and operational capacities in order to avoid mishandling and abuse. The Leica camera is not a plaything, an ornament, a gadget, or a curio, but a scientific instrument in every sense of the word. It is made of fine materials by skilled craftsmen and every part of its construction is held within the most exacting limits of tolerance allowable in manufacture. It deserves the care you would give any piece of scientific apparatus.

Basic Leica Equipment for General Medical Photography • *Leica camera with either, 50mm f/2 Summitar or 50mm f/3.5 Elmar lens.*

Nooky Optical Short Distance Focusing Device.
Focaslide Copying Attachment with a 5x Magnifier.
Extension Tubes: 7mm, 15mm, 30mm, 60mm and 90mm.
Intermediate Focusing Mount for either the Elmar 50mm or the Summitar 50mm lens respectively.
Sliding Arm for supporting Leica camera with the Focaslide upon the upright column of the enlarger.
Photoelectric exposure meter.
Lanternslide projector and screen.
Tripods: A sturdy unit equipped with a Ball-Jointed Tripod Head and a small table-top unit.
Filters: as needed for specific requirements. (see Filter Chapter).

For those who intend to develop their own films:

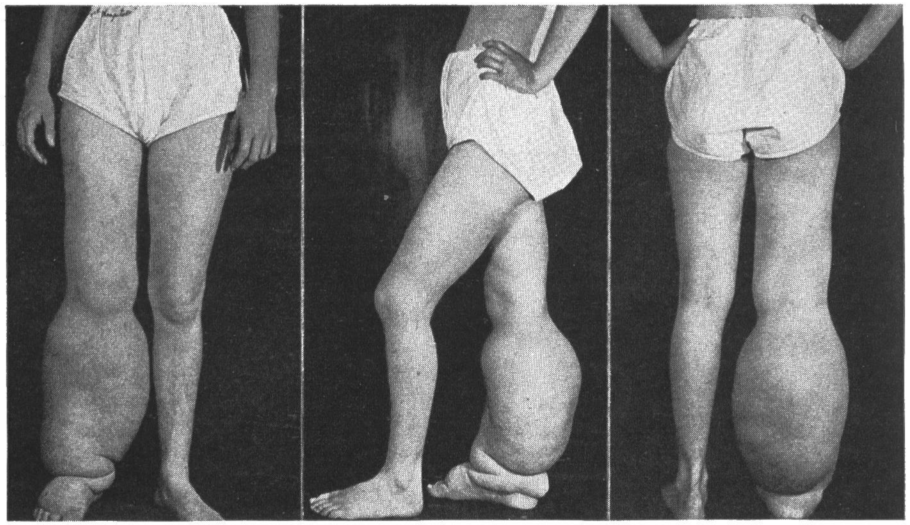
Developing Tank: thermometer, balance scales, timing clock, film hangers, chamois skin or cellulose sponge.

For those wishing to process their own Color Films:

Developing Drum Outfit with trays.

Additional Leica equipment needed for special purposes will be recommended as the various problems will be discussed in this chapter. The beginner is advised to stick to basic equipment until he has gained sufficient experience and understanding to select additional accessories as the need for them becomes apparent.

Medical Photography in General • An attempt should be made to produce medical pictures that are more than merely good snapshots. Acceptable medical photographs represent more than mastery of technicalities in lighting, exposure, film, and print processing. The final picture, whether a print or a transparency, emphasizes the pathology intended to be shown and as little else as possible. In a carefully composed medical photograph the main point of interest occupies a position somewhere in or near the horizontal and



1. A case of lymphedema showing anterior, lateral and posterior views. Note dark, simple background which directs full attention to the subject matter, highlighting important pathological detail.

vertical third of the view. All distracting objects, backgrounds, glaring instruments, dirty towels, and other unnecessary articles are removed from the field to be photographed. Arms, legs, and posture are carefully arranged to avoid diversion of the eye from the center of interest. In general, medical photographs printed on paper or lantern slides show detail clearly and are sharply in focus throughout. They must be accurate and easily interpreted. Crowding is to be avoided; two photographs carefully composed are preferable to one that is overcrowded with detail. Adjustments of the light to emphasize contour or special detail plus attention to careful posing of the subject and correct framing in the view finder are, of course, essential. Posterior, anterior, and lateral views are in most instances taken as a matter of routine (Fig. 1).

The Negative • It must be emphasized that relatively thin negatives are essential for good work with 35mm film. Most workers have a strong tendency to overexpose their negatives, a mistake that must be corrected. The photographer accustomed to using sheet film in the larger negative sizes must realize that the densities normally correct for large negatives are entirely too dense for 35mm film. The film experts tell us that a gamma of 0.6 to 0.8 is correct for Leica negatives and a gamma of 0.7 best for all-round purposes. This gamma business seems confusing. How do we know when we have a negative properly developed to a gamma 0.7?

The subject will probably be pursued vigorously by the curious worker, and he will learn on further investigation that gamma can be determined only by densitometer readings. He is bewildered further when he finds this to be a very

expensive instrument that can be used for nothing else but the determination of gammas. However,there is an easy way to develop any of your negatives reasonably close to the proper gamma. All you need is a Time-Gamma-Temperature Developing Chart for the particular film and developing agent you are using. (I recommend that you obtain the PHOTO-LAB-INDEX, where charts for all films and most developers are readily available, together with an abundance of other photographic data and information.) Following such a chart, the correct developing time for various temperatures will easily result in the desired contrast. After some experience, you will be able to look at the negative directly and know whether the proper density has been secured. A practical and simple rule is this: By reflected light you should be able to read fine print through the darkest areas of the negative easily. The constant use of and dependence upon a good photoelectric exposure meter is especially necessary for making consistently good color transparencies.

The Print • Ferrotyped 5x7 prints on glossy, singleweight paper of good contrast are standard in most clinical photographic work. Prints of this size take up little space in the hospital chart or filing cabinet and this size is preferred by publishers of medical journals and books. Considerable leeway in enlarging the Leica negative is permissible, since controlled printing is allowable, and you can dodge or intensify certain areas to obtain the ultimate in reproducing the subject. You can also select and enlarge only a section of the negative area and still have a 5x7 print. You can modify an undesirable background or eliminate it entirely. In fact, the control possibilities in the enlargement of Leica negatives are almost unlimited. If the negatives are of correct density, print them on either No. 2 or No. 3 grade of paper. Many prefer the No. 3 grade, to give a more contrasty print. Those intending to make their own enlargements should consult the chapter on Enlarging and Printing for detailed information on how to secure consistently uniform prints.

With Leica negatives it is very easy to contact-print them on paper strips for filing in the photographic laboratory and later make 5x7 enlargements when staff members require them. This considerably reduces cost in the photographic laboratory, and for reference purposes or for going through a series of certain types of cases, the contact prints can be viewed with a magnifying glass in selecting just those wanted.

Lighting • Good medical negatives result from proper lighting, correct exposure, and, of course, careful development. Correct exposure presents no great problem provided a good exposure meter is acquired and the instructions of the manufacturer are studied and followed closely. Selection of a fine-grain developer that is dependable and constant in its developing characteristics can be made from the many formulas available for 35mm film. (See the Film chapter.) For proper lighting, unfortunately there are no standard formulas, and you must depend to a large extent upon your own ingenuity for the proper illumination of your subjects, which comes only with experience and careful study of day-to-day results.

Special-purpose lighting · Usually improvised, or special systems to meet some particular purpose in clinical photography are not easily obtained from standard equipment. Special-purpose lighting is used to provide either shadowless light, such as obtained from polarizing or baffled systems, or in other cases very harsh lighting. Often in oral photography it is necessary to design a special unit to illuminate effectively the various regions within the mouth cavity. Generally, an intense light source is selected and the lamp is mounted in a deep spherical or parabolic type of reflector. In photographing the eye, the ideal source is an incandescent-filament lamp with clear-glass globe of high intensity operated through a high-low switch. The filament should be as small as possible to reduce the size of the mirrored image it forms on the surface of the eyeball.

Backgrounds · The alert clinical photographer will devote particular attention to the type of background in all of his work. Consideration must be given to texture, color, reflective characteristics, and the distance from the subject. A smooth, plain background free of pattern or design is generally best. It should be large enough to fill the entire negative area, even though unmounted portions can be eliminated during the enlarging process. For the office or the photographic laboratory of the hospital, roller-screen backgrounds are desirable. They should measure about 5x8 feet and be attached to window-shade rollers held in a case secured to the ceiling, or to a wall of sufficient height so that when fully extended it accommodates a full-length photograph of an adult. At least three of these should be available, black, medium gray, and pure white. When not in use, roll them back out of the way into the case for protection against dust and discoloration. Window-shade material is ideal, since the texture is fine and when coated with paint leaving a dull non-reflective surface offers an excellent background that is not expensive.

The choice of color depends on whether you use panchromatic or color film, and of course on the type of subject to be recorded. To render the best contrast with panchromatic film a black or dark-gray background is the choice for white subjects. With dark-skinned patients white or light gray is better. For color film, a plain white background is probably superior to any other, as you will observe when the transparencies are projected, although many prefer a black background for color work. Whether you use black or white for color transparencies is pretty much a matter of personal choice, as both serve the purpose quite well. Glare from projected color transparencies causing eyestrain and fatigue is frequently voiced as the main objection to the white background. One important point about the background in color work is to keep it close to the subject, to prevent degraded color shades where the intensity of the

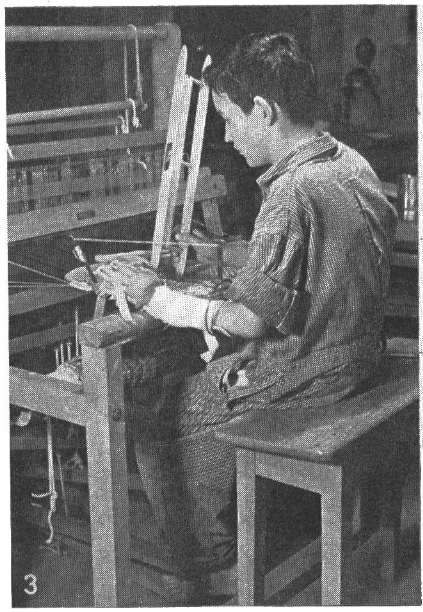
illumination falls off. For really good results additional lighting of the background, especially a white one, is usually indicated. Brilliantly colored backgrounds, such as red, green, blue, yellow, although striking, are entirely too distracting, and are out of place in medical photography.

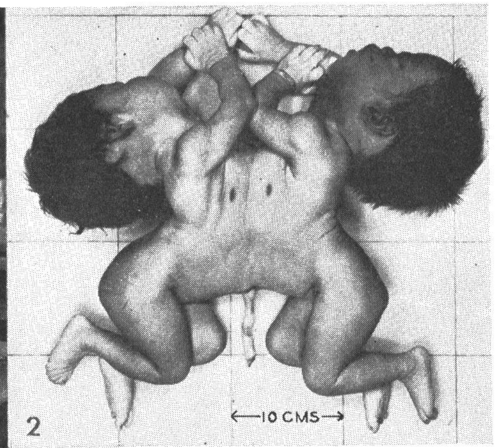
Brilliant illumination of the subject with strong front or side lighting will cast hard shadows on the background if it is gray or white. Colored, light-toned, or gray backgrounds are affected by this trouble too. The least difficulty is encountered with a pure-black background, and if shadows occur at all, they are generally too mild to show on the final print. If the background is moved further back, the shadows become larger and the tonal rendition of the background is darker. The general method of removing objectionable background shadows is simply by brilliant illumination of all areas with side, top, or bottom lights, often positioned behind the subject.

In the home and often in the small hospital, it is necessary to improvise a background. A clean bed sheet will generally suffice and is usually available. Hold it far enough back of the patient to keep wrinkles and creases out of focus. Ordinary ward bed screens can be used satisfactorily as backgrounds in full-length views of children and sitting postures of adults. The outer thirds of the screens can be set at an angle where they will function as reflectors, since a good picture can be obtained perhaps with the aid of a single light source.

Photography in the Hospital · Hospitals are required to preserve complete case records of all patients examined and treated in order to remain approved health and teaching institutions. The case records can be greatly enriched by photographs showing the clinical condition at time of admission, the course of the treatment, and the results obtained. Pictures afford valuable progress records of cases returning frequently for follow-up care and observation. No one can predict when important or rare conditions may suddenly appear requiring a photographic record of the unusual features presented (Fig. 2).

In view of the growing use of x-ray and radium, and the increasing numbers of industrial and accident cases, the hospital constantly faces the possibility of medico-legal entanglements. Only too frequently staff members, nurses, and hospital employees find themselves charged with negligent care or with injury of patients, and in such instances complete records, especially photographs, become of great value. Physicians with considerable industrial practice will find remarkable medico-legal protection in the Leica camera, available at all times in the physician's bag for such emergencies. Most car accident and industrial cases should be photographed as the first clinical record even before treatment of any kind has been instituted, except, of course, in emergency cases where immediate care is indicated. Staff meetings, clinical lectures, medical publications, and health programs can be made more interesting and instructive by the use of photographic records collected and properly cross-filed.





2. Stillborn Siamese twins. The hospital photographic department must be prepared for such rare occurrences. Note background scale.

3. Rehabilitation by occupational therapy, Crippled Children's Hospital. Such pictures are valuable for educational use and gaining public support.

Visual education is rapidly becoming popularized, and all hospitals should take every step possible in the advancement of this effective means of instruction. Not only are pictures of clinical material accurate and impressive, but also knowledge gained from them is retained longer than from most other methods of presentation. Many activities within the hospital lend themselves well to photographic purposes. Pictures of special physiotherapy and occupational therapy for crippled children can be employed to great advantage in showing the value of this work in restoring health, and in some instances prove helpful in obtaining endowments and funds for further support of such facilities (Fig. 3).

Photography of Patients · The patient to be photographed may sit or stand, depending on the nature and the extent of the lesion or the amount of his body to be shown in the picture. The clothing is removed from all parts to appear in the view. When seated, parts of the chair should not be noticeable; a stool is preferable. For the lower extremities and full-length views, the patient should stand on a small black or white platform or a box 12 to 16 inches in height, thus elevating the subject to eliminate the floor design from the photograph. When taking pictures of very ill patients, consideration must be given to the pain and discomfort of moving them around, and straining, tiresome, or uncomfortable positions must be avoided if good co-operation is desired. When respiration is rapid or there are muscle spasms and other unavoidable body

movements, the lighting must be of sufficient intensity to permit very short exposures. Flash lighting is preferred for this type of work. Occasionally, photographs are requested of bedfast patients, particularly children and post-operative cases, requiring the photographer to stand on a chair directing the camera downward, in which case the flash unit provides the least disturbing means of obtaining the picture.

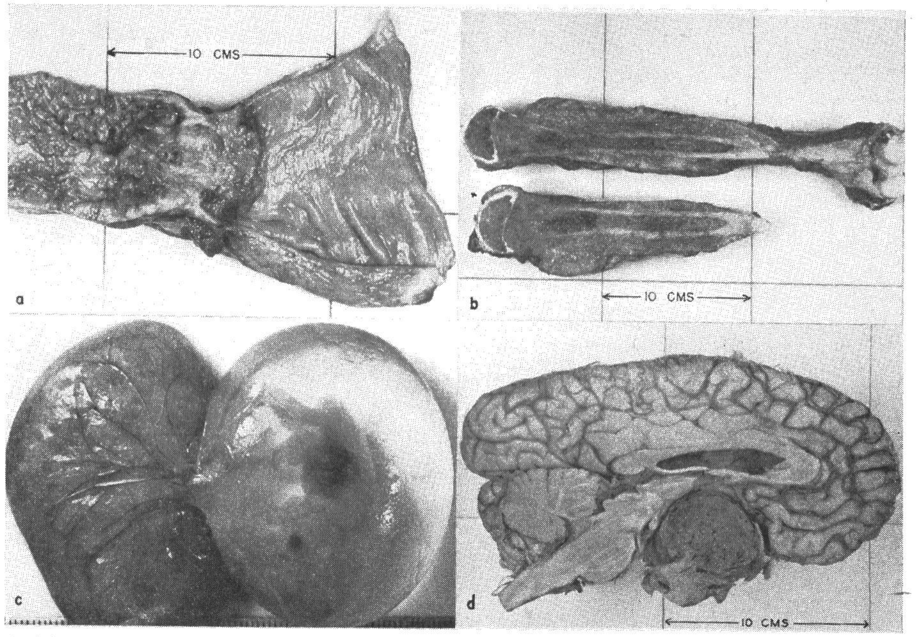
Full-length views of adults require careful arrangement of the lights to illuminate fully and uniformly the entire length of the individual. If the light beams overlap too much, the middle section of the body will be overexposed, the head and feet underexposed. A good arrangement consists of four lights in separate reflectors, two on each side of the subject and positioned to give good contrast and modeling. Set the two lower lights about level with the patient's knees and the upper lights level with the shoulders. Check the uniformity of illumination over head, abdomen, and feet with a light meter to ensure even distribution. An additional light may be added if needed to bring out detail, accentuate contour, or brighten up an area with dark shadows. Tanned skin of the face and arms requires additional illumination. For full-length and half-length views I recommend the 50mm lens, and for close-up detail the use of the Nooky attachment.

The Nooky Optical Short Distance Focusing Device is a valuable accessory, undoubtedly the most useful single item available for the Leica in clinical photography. It permits automatic focusing of the Leica at any distance between 3½ feet and 18 inches, a range particularly suited to the majority of medical subjects. Perhaps its greatest application will be found in photographing patients when only portions of the body are to be recorded. Head, shoulders, back, or chest can be entirely included, or only parts of them, depending upon the nature and the extent of the lesion and the amount of magnification necessary to show the involvement. The largest area covered by the Nooky attachment is approximately 16x25 inches and the smallest about 6x9 inches, permitting fields large enough to identify the anatomical location and relationship and, with a touch of the focusing lever, providing a small field to enlarge the structures for close study. In addition to this important feature, the attachment is suitable for recording instruments and gross specimens quickly when a regular copying stand is not available. Its range is especially adaptable to surgical operations and work at the necropsy table. Of considerable importance is the fact that tripods and focusing screens are eliminated, since the Leica and the Nooky attachment can be held in the hand for most assignments, although admittedly the hand can never be depended upon to steady any camera during exposure as well as the tripod, and the latter should always be used whenever practical. For a more detailed description of the Nooky attachment see Chapter 9 on Copying, page 168.

The Photography of Gross Surgical and Pathological Specimens • Since the photography of gross specimens deals with subjects at close range, you will require, in addition to the Leica, lights, and specimen table, a few other accessories. The Nooky Optical Short Distance Focusing Device can be used, but the work can be accomplished much better with the Leica Focaslide outfit and the Intermediate Focusing Mount. It is also advisable to have available a full set of extension tubes to provide complete coverage for specimens of various sizes. You will also require a 5x Magnifier (preferably the wide-field) for viewing the screen image. The 5x Large Wide-Field Magnifier is strongly recommended for viewing the ground-glass screen of the Focaslide. A 50mm lens, particularly the Elmar, is the choice for most copy work and gross-specimen reproduction. The Valau Slip-on Ring for convenience in operating the iris diaphragm of the Elmar lens is a timesaver and also functions as a lens shade. Finally, you will need the Sliding Arm for attaching the Focaslide to the upright tube. Slow panchromatic films, such as Panatomic-X, and Superior 1, provide a choice selection.

When several organs are to be photographed together, it is preferable to make their arrangement correspond to the anatomical position normally occupied in the body. Generally it is better to photograph specimens separately, especially when some definite or particular type of lesion is to be emphasized. Portions of the specimen should not extend beyond the field unless the purpose is to magnify a small part of it. Magnification must be sufficient to show the pathological detail clearly, and often considerable dissection is required to record the features more distinctly. After preparing the specimen carefully, excess moisture, blood, or mucus is blotted or wiped off with gauze or cotton. Arrange the visible surface in a level plane as far as possible, so that all areas will be within the depth of field of the lens. It is well to measure the thickness of the specimen and its distance from the camera in selecting the diaphragm opening that will render all areas in sharp focus (Fig. 4). Keep depth-of-field tables for both the Nooky and Focaslide attachments close at hand for quick reference. (Read Copying chapter.) Cotton, gauze, or narrow strips of lead can be placed beneath parts of the specimen for props to provide an even top surface. Round or oval solid tumor specimens are more difficult to handle, and the camera may require a position farther away to obtain sharpness over the entire field. Later the negative can be enlarged to give the desired magnification. The projected image of color transparencies will be large enough on the screen to show all the detail.

In the photography of gross specimens, proper illumination is important. Various methods have been devised and recommended, all dependent on the principle of eliminating specular reflections. For a long time the common practice has been to place them in water. The photography of pathological speci-



4. (a) Gross specimen: carcinoma, ileocecal junction. (b) Gross specimen: bone tumor. (c) Fetus in amniotic sac, and placenta. (d) Pituitary tumor. All views made with Focaslide and 50mm Elmar lens.

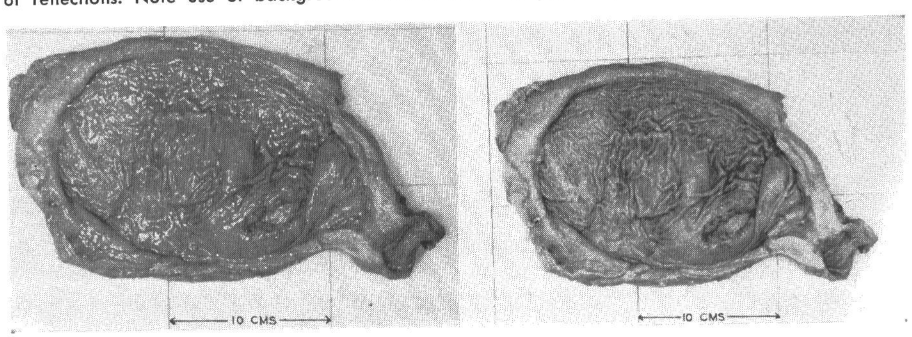
mens under water is not the best way (for optical reasons), even though it does eliminate glare completely. Fresh specimens are hard to wash free of blood, and unless it is removed, the water soon becomes dirty and muddy and flat reproductions result; they are especially objectionable with color film. The color of fresh specimens depends upon the blood remaining in arteries, veins, and tissues, and its removal by overwashing results in loss of structural contrast and natural appearance. Many specimens can be photographed satisfactorily by direct illumination, but too often the pictures are spoiled by the numerous glaring reflections so frequently encountered with fresh specimens, especially mucous membranes. There is a difference between glaring reflections and highlights. The former definitely destroy detail, whereas the latter are seldom objectionable and may actually lend depth, texture, and quality to the pictures. Several lighting systems and methods in common practice for the control of specular reflections are:

1. Immersion in a water tank, the least desirable but most effective method.
2. Subduing glaring points by spotting them with starch or talc.
3. Placing cloth diffusing screens in front of the light source.
4. The Leitz Ring Illuminator for specimens less than 5 inches in diameter.
5. Polarizing screens used over the light source, the camera lens, or both.
6. Baffled lights to provide shadowless illumination.

The last three are the most practical. The Leitz Ring Illuminator merits special mention for small specimens because the system not only removes undesirable reflections from moist surfaces but also gives shadowless light. The illumination is supplied from 12 low-voltage bulbs (8 volts 0.6 amp) connected in series within a circular housing. In the lower part of the housing is secured an annular opal-glass disk in a changing mount with a large opening in the center. The ring illuminator is supported on an adjustable rigid stand close to the camera lens and the light intensity is controlled by a resistance.

The Kodak Pola-Light units offer a very satisfactory method of highlight control in work with pathological specimens. The large bowl-shaped reflector retains the Pola-Screen rotatable through 180°. A built-in bracket and socket centers the RFL-2 Photoflood lamp behind the screen. Two stands should be available, in addition to the Leica polarizing filter to be placed over the lens. Flat or cut sections of specimens can be recorded with complete extinction of all specular reflections and yet the control of the lighting is so effective that round specimens can be illuminated to give excellent relief and modeling of texture and shape. Contrast is easily managed simply by moving one or the other stands a little closer or farther away or tilting the reflector slightly. The Leitz polarizing filter is unique in simplicity of operation. It has a regular ring mount with clamping screw to secure it firmly to the lens and an additional hinged mount securing the pola-filter. In use it is only necessary to swing the mount through 180° and while directly viewing through the filter rotate the polarizing filter to the desired position. The latter mount is then swung back into position. It is not always necessary, of course, to use the polarizing filter over the camera lens, as many specimens can be managed very well with the illumination supplied from the Pola-Lights. Exposure time will have to be increased 50 per cent if a polarizing filter is placed over the camera lens; since the specimens are inanimate, it poses no problems (Figs. 5 and 6).

5. Necropsy specimen of stomach photographed by ordinary light *(left)*, and by polarized light *(right)*. Polarized light preserves detail and shows gradations not visible with ordinary light because of reflections. Note use of background scale in these comparison pictures.

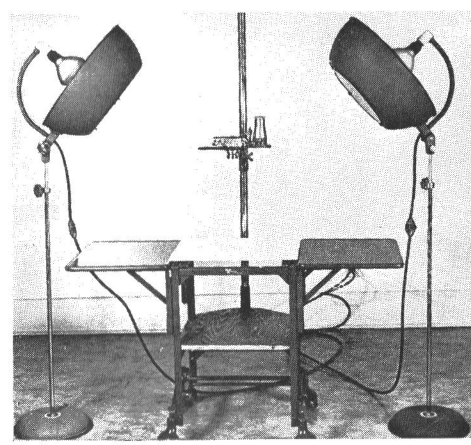


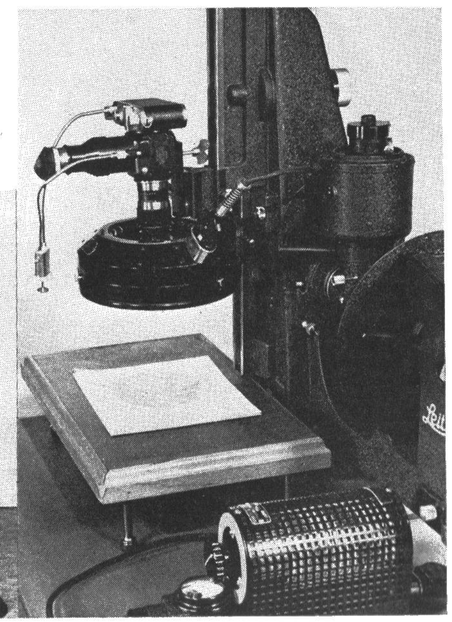
Baffled-light systems can be improvised to afford a very satisfactory method of illuminating pathological specimens to control specular reflections. The essential feature of such a system consists of a large bowl-shaped reflector about two feet in diameter, with mountings near the lower rim to accommodate one or two No. 2 Photoflood lamps and a baffle of tin or aluminum placed in front of the lamps and of sufficient height to prevent any direct flow of light from the lamps onto the specimen. Two of these reflectors, one on each side of the specimen, set at the proper angle (about 45°) provide an intense even source of shadowless light entirely free of reflections and suitable for either color or black-and-white. Since the lights produce a great deal of heat, it is well to have a high-low switch connected in the circuit with the Photofloods to increase their life and prevent excessive heat.

In the busy hospital laboratory where many specimens are handled, some convenient and permanent arrangement of specimen table and lighting system readily accessible should be provided. Since no manufactured units for the photography of gross specimens are available, most laboratories build their own, incorporating whatever features seem to meet their particular requirements. The base and upright of the Leitz enlargers equipped with a Sliding Arm to secure the Leica firmly can be used satisfactorily. Many dislike to use this fine piece of equipment for such a messy procedure, since there is always present the risk of splashing blood, mucus, pus, or other debris onto the unit. A specimen stand can be readily assembled to withstand laboratory hazards.

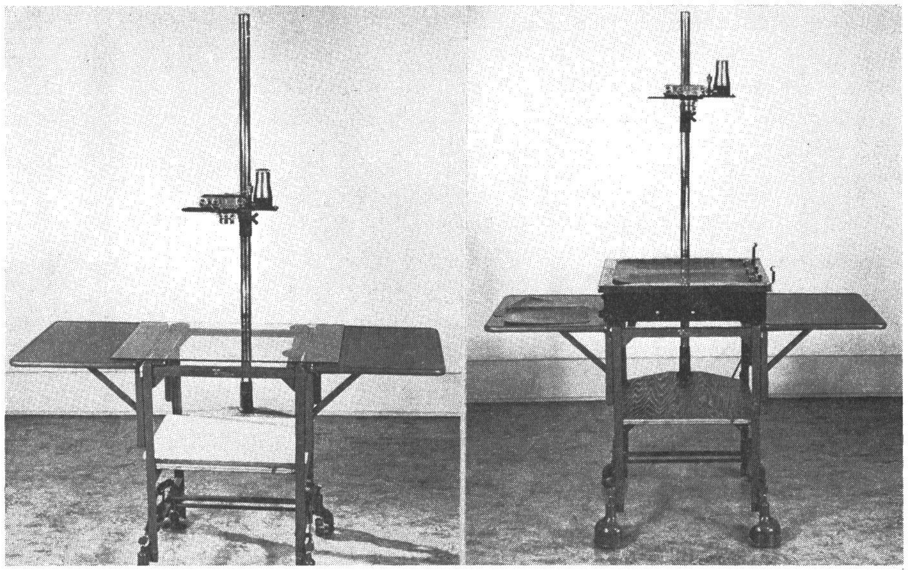
6. *(Right)* Leitz Ring Illuminator used on Panphot for photographing small objects. Leica with Elmar 90mm lens in Mirror Reflex Housing.

(Below) Kodak Pola-Lights with stand for photographing gross specimens and other laboratory exhibits.





The Leitz firm now supply a baseboard with a rigid upright as a separate unit for copy work of all kinds, but without the enlarger head wiring and the usual cutout grooves over the surface of the baseboard. The unit does not require much space, and the only additional accessories needed for operation are the Sliding Arm for the camera and of course whatever lighting facilities you choose. Cover the wooden base with a removable clear-glass plate for protection from specimen fluids and ease of cleaning. A piece of white cloth or paper



7. *(Left)* Leitz enlarger upright with base mounted in typewriter stand. Gross specimen is placed on upper clear plate glass; white paper background on base. *(Right)* Copying x-ray films using same stand for gross specimens together with a conventional x-ray viewing box.

placed below the plate makes a very satisfactory background, although mirror reflections from the uncovered sections of the plate glass may require additional attention to prevent their reproduction on the negative or the color transparency. A better way is to have the upper surface ground to make it frosted, or it may be etched with fluorine to produce the same effect of eliminating mirror reflections. On completion of the photography always clean the glass plate with soap and water, rinse, and then mop thoroughly with alcohol or diluted formalin to destroy infectious material that may have resulted from autopsy or surgical cases containing pus.

A popular arrangement for gross pathological subjects consists of a table with two levels, an upper to support the specimen and the lower to provide the background. The supporting medium is a piece of clear, flawless plate glass, removable, of course, for cleaning and supported by legs or a frame about 12 inches above the lower level. The sides are open and it is convenient to intro-

duce various shades of black, white, or colored paper for numerous background effects, yet any design or structural detail of the background will be out of focus. Some place tilting mirrors at the ends to give additional lighting to the shadow areas and special effects. Space should be sufficient to accommodate a standard x-ray view box to reproduce x-ray films (Fig. 7).

A more elaborate system can be constructed to provide facilities for various applications in copying as well as in photography of gross specimens. Such a unit could be assembled, for instance, from the remains of a discarded oxygen tent, and will offer portability combined with adaptability to various uses.

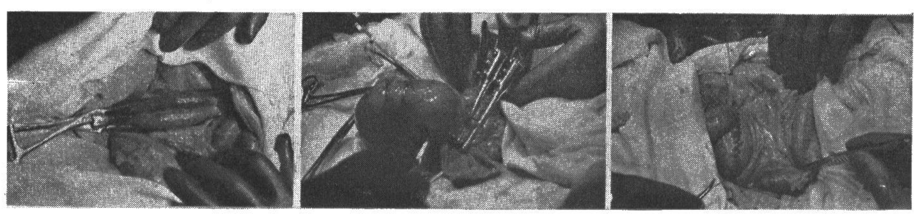
The Photography of Surgical Operations • The photography of surgical operations imposes certain limitations upon the photographer's freedom not applicable in other fields of medical picture taking. He cannot set up his tripod and light stands in positions most favorable for his work, so must compromise with conditions he cannot readily improve.

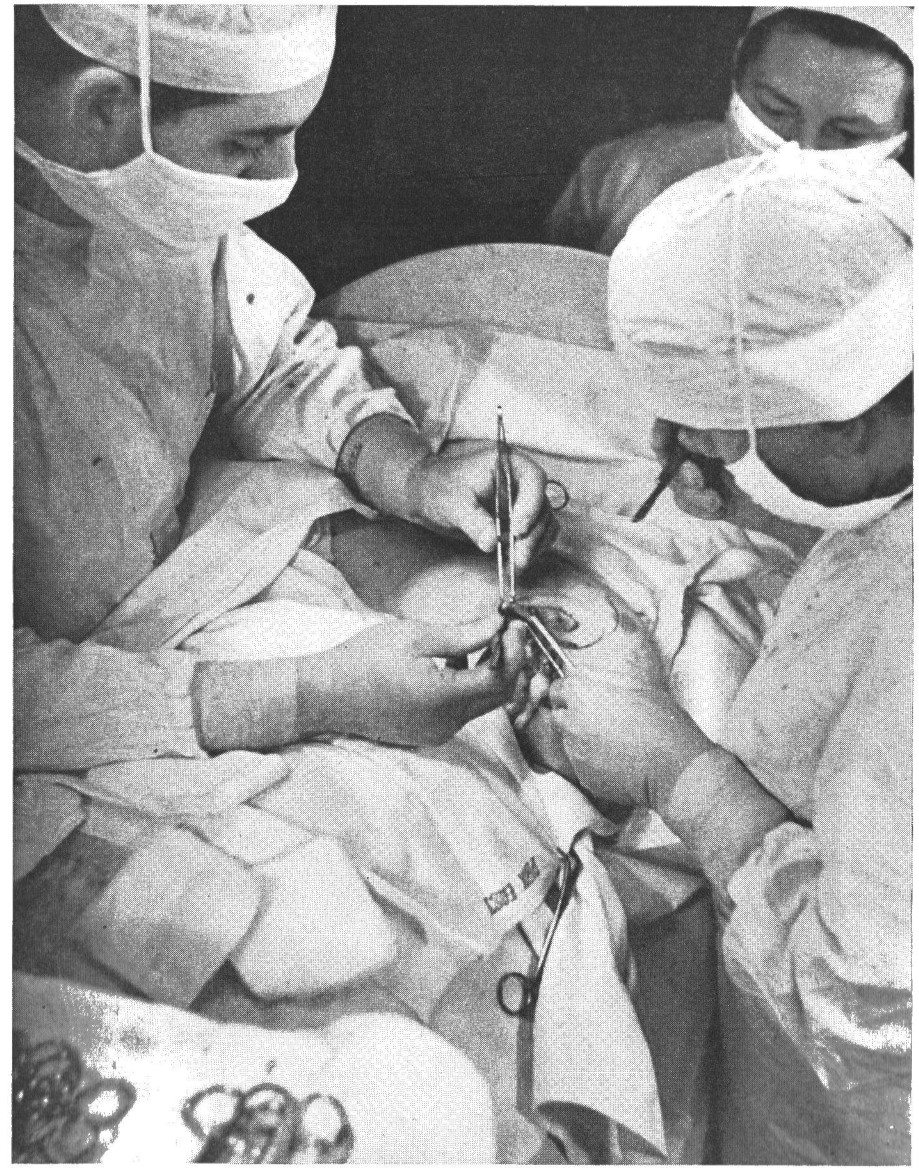
In many pictures of surgical procedures entirely too much of the surrounding atmosphere is recorded, giving the impression that they have been made from curiosity or because they are impressive or sensational. It is obvious that pictures showing the surgeon, his assistants, the anesthetist, and the instrument nurses contribute nothing of scientific importance to the picture. Film is often wasted on insignificant details, such as making or closing the incision. All medical men know that any approach to organs within the abdomen is made through an incision and that the latter is sewed back on completion of the operation. It isn't necessary to photograph it; the healed scar will be sufficient proof. Another common mistake arises from an attempt to photograph a field that cannot be seen clearly. For example, it is futile to attempt photography of an abdominal operation with the camera stationed at the head or the foot of the operating table. The greater part of the operation actually takes place within the abdominal cavity, which can be viewed satisfactorily only from above. Still another mistake is the use of view cameras with tripods that require a good deal of manipulation, adjustments, and time for each exposure. The operation simply cannot be delayed as a convenience to the photographer focusing on the ground-glass screen, or yield time for changing his film holders while all motion is stopped for the long exposure required. Such mistakes reflect doubt as to the photographer's knowledge and understanding of the real purpose of making the pictures. It is indeed fortunate when they can be taken by one familiar not only with the use of his camera but also with the anatomy, pathology, and surgical nature of the operation, for then the entire procedure can be recorded step by step, selecting only the essential features that are necessary to record as it progresses (Fig. 8).

The equipment should include, besides the Leica camera, a rapid winder, a Nooky attachment, and either Elmar or Summitar 50mm lenses. There is need for a lens of longer focus occasionally, such as the Elmar 90mm or 135mm, when the camera has to be stationed several feet from the surgical field. The Elmar 90mm is an excellent supplementary lens in the operating room, for in addition to its relatively high aperture of f/4 it can be focused on subjects as near as 3½ feet, an unusual feat of semi- telephoto lenses. Slow panchromatic film is preferable when lighting conditions permit, because good contrast is obtained and the fine-grained negatives allow enlargements of considerable size. Under conditions of poor illumination a fast panchromatic film, such as Super-XX will be required, and of course development in some one of the many fine-grain developers available. When color photographs are desired, the level of illumination will have to be raised substantially. If this be impossible or impractical on an over-all basis, arrangements will have to be made to step up the level of illumination falling upon the operative area.

Lighting in the operating room is most important. It has been intimated that the less equipment the clinical photographer drags into the operating room, the more welcome is his presence. It is well to get along with the overhead lighting already installed, if at all possible. These highly efficient and specially designed operating lights usually supply sufficient illumination for work with the Leica and panchromatic film. If the assignment calls for color film, it is necessary to investigate the illuminating source more critically in order to determine its temperature and color characteristics. Those who expect much color work should avail themselves of a reliable color-temperature meter now on the market that gives the correct color temperature of any light source within a few Kelvin degrees. An accessory scale indicates the type of correction filter to be used. If neither is practical, your only recourse is to make a few exposures of the existing light source with a dependable exposure meter and study the results. When additional supplemental lights have to be added, use the floodlights and spotlights providing controlled lighting. Connect the cables to a spider box in an adjoining room or hall where an assistant can operate the switches outside the operating room, to prevent possible catastrophies from explosive gases. Should extension cables be required, tape their connections adequately. No lighting equipment that has been used in the necropsy room should ever be taken into the surgical department. In case

8. Successive views of gastro-enterostomy. 50mm Elmar lens used with Nooky attachment. Note that field is carefully composed to eliminate distracting background details and direct attention to center of interest. Each picture shows a salient point in the procedure.





9. BREAST OPERATION — Alfred Eisenstaedt

A pictorial record of a surgical procedure, intended for presentation to lay readers. Normal operating room light, intensified by surrounding area of white drapes, records surgical team at work. 35mm Elmar lens, f/6.3, 1/8 second. Reproduced from a Kodachrome original.

floodlight and spotlight units are not available, you will have to get along with No. 2 Photofloods in separate reflectors of deep conical or parabolic design, mounted conveniently on heavy adjustable stands. Factors that determine how much additional lighting must be supplied are: the type of film in the camera, the diaphragm stop required to provide the necessary depth of field, and the shutter speed that will be needed to prevent motion of the hand-held camera. The use of photoflash bulbs in the operating room is to be thoroughly discouraged. Their flashing is distracting to all and very annoying to the surgeon, and they sometimes burst—a most dangerous accident in rooms saturated with the explosive gases used in modern anesthesiology.

You can photograph abdominal and chest operations to the best advantage by standing on a footstool directly behind the surgeon or his first assistant. In this position you will find it easy to aim the camera directly downward over the surgeon's shoulder toward the operative field. From this station you are entirely out of the way and yet close enough to record every detail as the operation progresses. It is fortunate for the Leica photographer that the "Nooky" Optical Short-Distance Focusing Device and the Rapid Winder are available for his camera, enabling him to follow the entire operation through the view finder, making exposures in rapid sequence and instantly focusing the lens whenever a change in position is required.

For brain operations you will probably select a semi-telephoto lens such as the Elmar 90mm, since these views are usually made from a horizontal plane rather than from an overhead position. The Hektor 135mm lens is a good one for this work, but should always be used on a tripod, and this is one type of operation where tripod and spotlight can be used advantageously.

Obstetrical cases are perhaps the easiest of all to photograph, since the photographer will not find it difficult to locate himself conveniently for good views. The field occupies a position in the horizontal plane, and arrangements described above for brain operations are also applicable here. (Exception: Caesarean section.) In addition, the Leica with the Nooky attachment provides a satisfactory combination if the photographer is permitted to work at close quarters.

Orthopedic operations and plastic surgery lend themselves well to photography, even though movement into different positions is frequently required during the procedure. Experience has proved that the Leica and the Nooky attachment are all that is needed for this work. Excellent reproductions are almost invariably obtained of muscle, tendon, and bone transplantations as well as other types of reconstruction work.

Gynecological procedures are normally managed with much the same technique as described for obstetrical cases when the operation deals with reparative work of the perineum. Since most gynecological surgery involves

laparotomies, the photography should be planned as for abdominal operations. However, many gynecologists prefer the patient in the Trendelenburg position for abdominal work, which considerably complicates the photographer's problem. In such a position the operative field is oblique from both the overhead and horizontal plane, thus requiring you to aim the camera at an angle. Two courses can be pursued; in one you can use a telephoto lens (Hektor 135mm) mounted high on a tripod behind the anesthetist, in the other you can use the 50mm lens with the Nooky focusing device behind the surgeon or his assistant. For hysterectomies or large ovarian tumors the telephoto serves the purpose fairly well, but not always completely. For suspensions, tubal resections, or other procedures completed for the most part within the abdominal cavity the 50mm lens with close focusing device is best. These operations are extremely hard to photograph, since the opening is relatively small and most of the time is filled with the surgeon's hands, so that it is practically impossible to see, let alone photograph, the operative details.

Finally, the photographer must plan ahead for whatever assignment he is called upon to undertake in the operating room. This should begin with a previously arranged conference with the surgeon at which a clear understanding is arrived at as to the essential features of the case or the operative technique. In some operations the main point of interest is the pathology present, in others it is the surgeon's individual or special technique that is to be emphasized. If the photographer is a medical man, he should review the operative procedure thoroughly from a textbook. If he is not, then the surgeon or one of his assistants should give the cues for the steps to be recorded. The nonmedical photographer must develop a sense of "aseptic technique" to guard against any possibility of contamination resulting from his equipment or his work.

Always come provided with several extra magazines of film, for there is no way of estimating the number of exposures necessary to cover any operation fully. Attach the Leica to the neck strap and keep it there until the job is completed. There must be positively no danger of the lens shade's falling from the camera into the operative field; tie it to the lens mount with a piece of catgut as a further precaution—such an accident just must not happen, not even once! When working from above, you can do without the lens shade, as the overhead lighting produces no undesirable reflections except those from the instruments and drapes, which are not correctable by the lens shade anyway. Use the exposure meter with all lights turned on to determine the approximate shutter speeds required. Take a direct reading just as soon as the patient has been arranged on the operating table and before the application of the prep solutions. Readings taken on the patient's white skin are usually too high, but they give you a reliable evaluation of the illumination intensity available. From that you must calculate the shutter settings required for colored organs, shadow areas, and so on. Usually the exposure should be increased the equivalent of one f-stop for abdominal operations where there are deep shadows, and in some cases even more. The shutter speeds can be decreased up to a certain limit (your ability to hold the camera steadily), but when more than 1/60 second is required, open the diaphragm. A picture that is slightly out of focus in some areas is preferable to one showing motion.

Rules to Observe in the Operating Room

1. Inspect Leica, lens, and accessories for dust, operation, and settings.
2. Be sure the Leica contains film and that extra loaded magazines are available.
3. Safety all lighting equipment used.
4. Wash hands, clean nails, put on cap, mask, and sterile gown.
5. Be certain that nothing can possibly fall from the camera.
6. Take meter readings with lights on, with the meter held 10 to 15 inches from the patient's skin.
7. Do not allow the camera or your person to touch the sterile drapes.
8. Do not talk or cause unnecessary motions.
9. Do not use flashlamps.
10. Keep your undivided attention on the operative procedure.

Orthopedic Photography • The photography of orthopedic patients entails problems additional to those of general medical or surgical cases. For such patients interest is usually centered on deformity records that show the original involvement, the corrective procedures instituted, and the resulting periodic changes over a duration of perhaps several years. You will be required to photograph the area of pathology to show its location and extent, motion limitations of limbs, joints, spine, and in many cases the weight-bearing or functional effects. Follow-up records of reconstructive surgery are very necessary to demonstrate the effectiveness of treatment, and these photographs should always be made of the same areas, positions, and scale as the originals, for comparison. As a result, there have evolved several special procedures not customarily applied to other fields of medical photography.

I strongly recommend that a special room be equipped with platform, dull-black background, and good lighting facilities. Systems providing controlled illumination should be selected to handle the many special lighting arrangements required. Full-length views are requested more often in orthopedic work, and since critical analysis of the prints will be made from time to time, a system of scaling should be worked out. A simple and effective method of scaling with the Leica is as follows: On a sheet of pure white draftsman's paper 12x18 inches, draw a grid of squares with the borders exactly 1 inch apart. Use India ink and make the lines very fine and uniform with a drafts-

man's pen. This grid corresponds exactly with the rectangular shape of the 1x1½ Leica negative. Photograph it on Kodak High Contrast Positive film and process it in D-11 developer. Make a contact print on the same positive material and develop in the same solution. Leave about 3 inches of filmstrip on each end for easy manipulation in the enlarger. To print the scale you need only place it in the enlarger in contact above the negative being enlarged. Always record the degree of enlargement, so that the grid can be used by those concerned to measure any part of the photographic reproduction accurately. This arrangement gives white lines on a dark background. If black lines on a white background are desired, photograph the grid on a piece of 5x7 contrast film to be placed over the print after the enlargement is exposed and with the negative out of the enlarger print in the grid. To do this, be certain the film with grid is in good contact with the paper, laying a piece of heavy clear glass on it or placing both in a 5x7 contact printer.

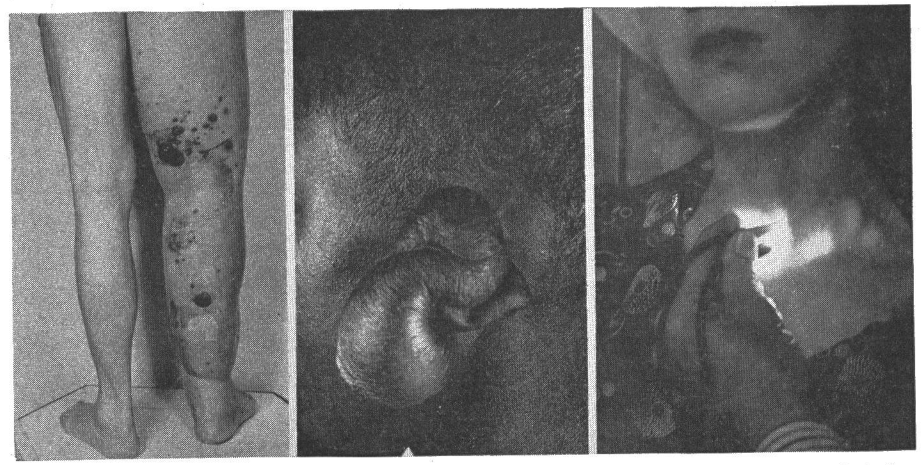
Many orthopedic surgeons request phantom reproductions (double exposures on a single negative) of cases involving limitations of function, especially of hands, wrist, forearm, arm, shoulder, and the corresponding regions of the lower extremities and the back. Scale the phantom photographs and show the full limits of flexion, extension, and rotation before and after treatment. These records are of great importance in industrial accidents, state and insurance compensation, legal entanglements, and of course in rehabilitation programs. The proximal section of the limb or body should be firmly immobilized to prevent shifting while making the two exposures. Although the Leica is intentionally constructed to prevent double exposures by accident, it is possible to make them without difficulty. To do this, secure the Leica on a rigid tripod and after making the first exposure set the Advance-Reverse indicator lever to R, then wind the shutter by turning the shutter-speed indicator dial counterclockwise until it stops. Trip the shutter-release button for the exposure, reset the film direction setter to A (Advance). Wind the negative to the next position in the usual way.

Another method is as follows: Make the first exposure in the usual manner, then hold the shutter-release button in the down position while turning the top shutter-speed dial counterclockwise as far as it will go and, still holding it in this position against its tension, let go of the shutter-release button. Then remove your fingers from the top shutter dial and make the second exposure.

Photographs of special orthopedic instruments and appliances are many times required as a matter of record, and also because some of this equipment is complicated and pictures showing its assemblage and use are helpful. Prints of special appliances are necessary for publications concerning new developments and when possible, photographs of therapeutic applications in actual use should be shown. Very little photographic equipment is required for orthopedic applications of the Leica. Most of this work can be accomplished with the aid of a 50mm lens and the Nooky attachment. Lighting arrangements will test the photographer's skill in orthopedic work more than will camera applications. When photographs of chrome-plated instruments are to be recorded, use diffusers over the available light sources or make use of polarizing methods to overcome the strong reflections from the shining surfaces. As a final word, you are warned to stick closely to scaling methods wherever they can be applied. I even recommend that distances from camera to patient be written down, as well as other data, in the event of later legal questioning.

Dermatological Photography • The dermatologists have probably applied photography to their work more enthusiastically than other specialists, as is indicated by the wide display of pictures throughout their books and journals on the subject. Skin diseases lend themselves well to photographic interpretations; they are easy to record and require no special equipment or skill. As most of these cases visit the specialist's office, he can make provisions for doing this work himself regardless of restricted space with very little inconvenience or delay in regular office routine. The Leica with one of the 50mm lenses and a Nooky device will adequately cover all needs, from full-length views to close-ups, except the occasional need for pictures of mouth lesions. For oral photographs greater magnification must be provided, and the operator will require the Focaslide and one or two extensions tubes. The dermatologist-photographer is urged to make routine use of the tripod whenever he can, and to apply intense illumination and keep the shutter speeds above 1/60 second. Camera motion is the most common cause of fuzzy pictures that fail to show detail sharply. This fact is often overlooked regardless of the type and quality of the equipment used.

From the standpoint of photographic recording, skin diseases are usually manifested by pigmentation, macules, papules, vesicles, ulcerations, or eczematous patches. To record macular eruptions in black-and-white, a flat lighting is sufficient to show the lesions satisfactorily and is obtained by keeping the lights an equal distance in front of the patient. For pictures of other types of skin lesions, adjust the key light 2 to 3 feet in front and a little to one side of the photographic field and use a fill-in light on the opposite side and slightly further away to brighten up the shadow areas. This modeling effect of the lighting arrangement will bring out the elevated papular or vesicular structures as well as show ulcerated areas. The orthochromatic film so popular a few years ago for dermatological work is regrettably no longer available in 35mm size. You can simulate the excellent rendering afforded by ortho film of erythematous and pigmented skin lesions fairly well with panchromatic film by use of a light or a medium-green filter such as the Wratten No. 66. For color film, always set up the lights for flat illumination (Fig. 10).



10. The use of orthochromatic film is very desirable for showing details of skin lesions and similar conditions. *Left to right:* Sarcoid condition, with both limbs included in view for comparison; Keloid condition, an isolated view showing detail and texture of growth; Transillumination of multiple congenital neck cysts. Soft, even illumination aids in bringing out such conditions in maximum detail.

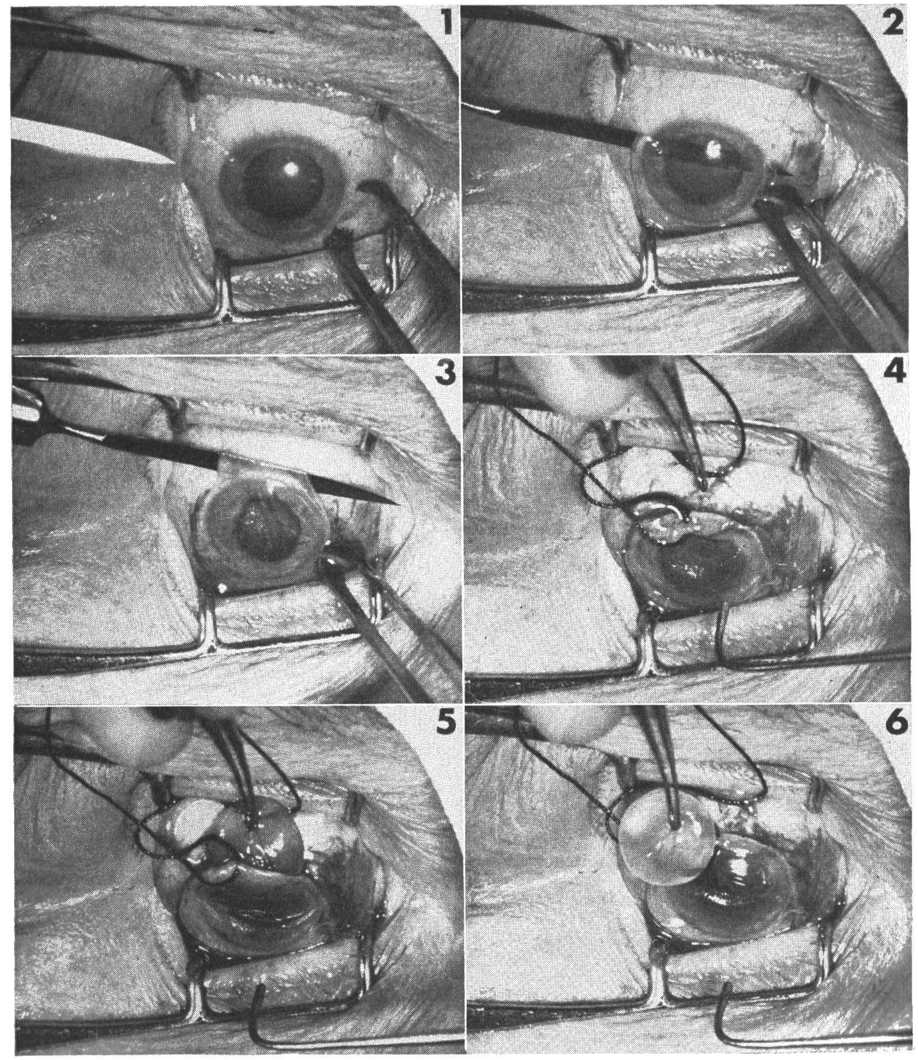
Oral Photography • The Leica, the Focaslide copying attachment, and a 30mm extension tube provide a very satisfactory setup for oral photography. It is essential that a rigid support be available to secure the camera and accessories. A heavy tripod stand will generally suffice, but if you expect much of this work, it will be better to improvise a permanent rigid system with three-dimensional and rotating adjustments. Such a unit can be made cheaply from a discarded tripod type of x-ray tube stand, usually obtainable from a local dealer in x-ray equipment. You should take time and effort to make this piece of equipment fully adaptable to the purpose, keeping in mind that photographs of the oral cavity necessitate angulation of the camera for lesions of the palate, gums, buccal surfaces, and the floor of the mouth. The patient must be comfortably seated, preferably in a specialist's chair, with a headrest to position the head firmly to prevent possible motion. For views of lesions involving palate and upper gums, it is better to tilt the head slightly back until the main weight of the head is supported by the headrest of the chair. For views of tongue, lower gums and floor, a chin rest and a head loup to support the forehead prevent lateral, anterior, or posterior motion. Remember that the slightest change in position may throw the field of interest out of focus. The patient must hold his breath during the time of exposure, and avoid blowing his breath onto the camera lens, to prevent fogging by the moist air on the cold surface of the lens. Good exposure of the field of interest is essential, necessitating the help of retractors to pull back the lips. In some cases a mouth gag can be used to advantage for patients who do not or cannot co-operate well. The retractors can be held by the patient if an assistant is not available.

An adjustable spotlight set close to the camera provides sufficient illumination for short exposures, even for color film. Flashlamps are used by many and may be considered satisfactory for this work after the distance, shutter speed, and diaphragm stop settings have been accurately correlated. For oral photography many use a single No. 2 Photoflood in a small tubular or parabolic type of reflector, and this source of illumination produces good reproductions on both panchromatic and color film. For very high magnifications of oral lesions where the lens must occupy a position adjacent to the oral orifice, good lighting results can be obtained from use of the Cameron right-angled surgi-lights, but the exposure time must be increased considerably, especially with color film.

Ophthalmic Photography • This phase of clinical photography includes a few applications with the slit lamps and corneal microscope. The instrument is designed for binocular study by microscopical visualization of the conjunctiva, cornea, iris, lens, ciliary body, circumlental space, and anterior portion of the vitreous. The manipulation of the slit lamp requires considerable study and experience before proficiency in its use and interpretation of its findings can be expected. The illumination from the slit lamp can be adjusted to provide a broad or a narrow beam of light directed into the eye from almost any horizontal angle. The broad beam allows visualization and photography of the anterior and posterior surfaces of the cornea, Descemet's membrane, anterior and posterior membranous capsules of the lens, and occasionally a small portion of the retina. The narrow beam permits examination and photography of the eye in optical section, particularly location and depth of foreign bodies and structural changes.

The most practical way of obtaining pictures with the equipment is to secure the Leica with Micro-Ibso Attachment into one side of the binocular body, utilizing the opposite side for direct visual inspection. For black-and-white negatives select one of the fast films, such as Super-XX or Superior 3, in order to give full rendering with short shutter speeds. Color film is applicable in a few cases when the patient is able to control eye movements to permit long exposure.

Industrial Medicine and Public Health • The importance of photographic records in the field of industrial medicine is evident in view of the large number of industrial, insurance, and compensation cases and the tremendous increase in car accidents each year. Physicians encountering this kind of practice will find considerable legal protection for themselves and the firms concerned in photographic records of all their cases, even years later, as many have learned. All accident cases, regardless of how trivial at the time, should



11. Consecutive views of eye surgery (cataract extraction) made with Short Bellows Focusing Device, Mirror Reflex Housing and 135mm Hektor lens. The Short Bellows Focusing Device allows continuously varying magnification and working distance, simplifying the photographer's task (see page 408). By careful isolation of field, disturbing elements such as surgeon's hands and surgical drapes are eliminated. Photo from E. Leitz, Wetzlar.

be photographed immediately on arrival at plant, office, or hospital, except those with severe injuries where emergency treatment receives first attention. Pictures to show location and extent of wounds afford indisputable records of the original injury, and when supplemented by later views during treatment and after recovery may settle arguments without reaching a jury. In factories and commercial industries it should be routine procedure to photograph place of accident, machinery involved, and simulated reconstruction to show how it happened, for careful study to establish with reasonable certainty whether the accident was due to carelessness or safeguards of machinery were insufficiently provided. Many of these cases appear later for disability compensation, usually with exaggerated claims of total loss of ability to earn a gainful living, testing the skill of the experts in reaching a settlement agreeable to both claimant and defendant. The medical experts rely to a great extent upon radiographs and photographs on which to base their opinions. Pictures to show limitations or extent of function may prove invaluable in presenting a clear conception of the case to the jury or the Compensation Board.

Industrial medicine reaches deeply into the field of public health, as the hazards of occupational diseases are closely connected with the Public Health Department. Safeguards for health of the workers in industry require intensive study, and nowhere will the services of photography render greater aid for improving conditions in the interests of all. Since public health is a highly educational service, the adaptability of the Leica assumes a place of special significance. Much of the field work can be photographed for reproduction on slides, filmstrips, and color films to be extensively used in public-health programs, lectures, school instruction, and general promotion of healthful conditions in the community.

Equipment for industrial and public-health work need not be elaborate. In addition to the Leica and the Nooky attachment, you should also possess a 35mm lens for work under crowded conditions in the factory, where a large field at close range is sometimes required. A photoflash gun synchronized accurately is an essential accessory for many assignments in the field. When slides are required for instructional purposes, the Focaslide with extension tube offers a time-conserving means of reproductions.

Leica Photography in the Laboratory • Hospitals not equipped with a photographic department often provide this service from the clinical laboratory, and even though this arrangement may not exist, there are nevertheless numerous applications of the Leica in the hospital laboratory, especially where teaching responsibilities are required of the laboratory staff. In no other department of the hospital will there be found a more abundant supply of photographic subjects, and the very nature of the work here is associated closely with picture processing, a laboratory procedure. The progressive pathologist or

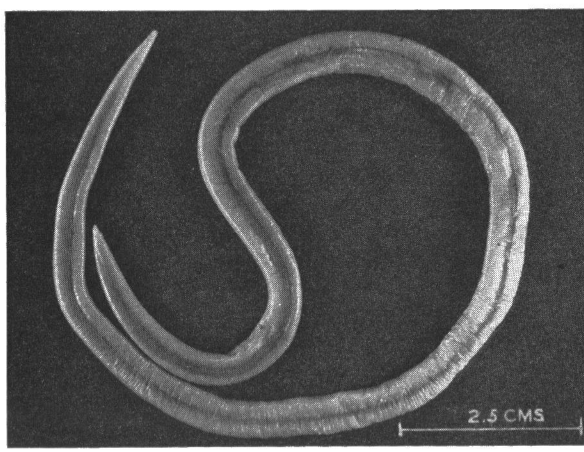
laboratory director is in a position to accumulate a valuable, carefully selected photographic collection of clinical material for departmental and clinical-society meetings, postgraduate work, and his own teaching obligations. Photographs of general laboratory and special apparatus are always in demand for medical publications. Then there are numerous demands for slides to show normal and abnormal clinical features of the multitude of laboratory tests performed in the course of daily routine.

The interpretation of many laboratory procedures depends entirely upon color changes, and practically all these are recordable on color film. Many clinicians prefer color transparencies to supplement their lectures to setups in test tubes in cumbersome racks to be passed from one student to the other while the clinician talks. Repeated requests for these impose additional work, and usually it is impossible to provide them every time. It is much more practical to photograph the color changes representing a normal colloidal gold curve, for immediate comparison of typical curves for various diseases. The same applies to specimens demonstrating pregnancy tests, spectroscopic bands, bacterial colonies on culture media, especially the pigment-producing organisms or those producing color changes in the media, mold and fungi cultures in Petri plates, the Neufeld reaction, blood typing, the rH factor, serological reactions, and so on. Since the clinical laboratory cannot be expected to have at hand all of this material set up for demonstration purposes, a collection of color transparencies showing these features and variations of normal and abnormal changes is obviously a distinct advance in laboratory management and service. Still more significant is the recording of gross surgical and autopsy specimens routinely sent to the clinical laboratory for gross and microscopic interpretation by the pathologist. The Leica and its copying accessories will be found very useful in copying charts and tables from textbooks and journals for quick reference in laboratory calculations that are ordinarily very time-consuming when copied on the typewriter. Once the Leica has been introduced into the laboratory, numerous applications rapidly develop to make it an indispensable scientific instrument. The enthusiast could not possibly find a better place to develop his skill in lighting arrangements, close-up photography, photomicrography, color, infrared work, copying, recording of difficult subjects both gross and macroscopic—in fact, in every phase of photographic application (Fig. 12).

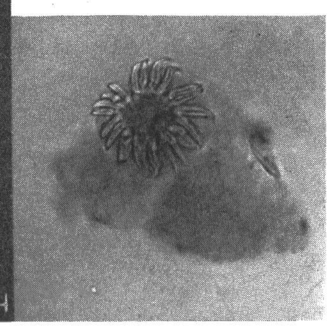
Color Photography • In the centuries-old medical teachings of the cardinal symptoms of inflammation and disease *"dolore, calore, tumore et colore,"* at least one (color) is recordable. The physician's dependence and unconscious reliance on existing color changes seems to be a most important one. Even in the clinical laboratory he depends upon color changes for positive confirmation of numerous qualitative and quantitative chemical procedures. The pathologist describes his gross and microscopic specimens with special emphasis on size, shape, and color. In the routine examinations of patients, many contagious and other diseases, even some malignancies, provide characteristic color features on which diagnostic opinions are based. Today, medical men even depend upon color for identification of the pills they prescribe; in fact, it seems that color is an indispensable factor in diagnostic medicine. The advent of Kodachrome film in the mid-thirties probably contributed more than anything else to make the profession "color-conscious."

Of the two types of Kodachrome and Ansco Color film available, those intended for artificial light are the most suitable for medical purposes. The emulsion speed (Weston 12), while somewhat slower than that of panchromatic film, is sufficient for the majority of subjects except for those few occasions in which supersensitive panchromatic films offer the only means of getting the picture. Since Kodachrome Type A film is very sensitive to blue, in using it exclude all daylight. You cannot photograph subjects illuminated by a mixture of artificial and daylight with either type of Kodachrome or Ansco Color. This problem is frequently encountered in the operating room, which as a rule is well illuminated by daylight from large windows in wall or roof, in addition to strong artificial lighting from the ceiling above the operating table. Little can be done to correct the situation except to increase the intensity of the artificial illumination by additional Photofloods of proper color temperature, permitting very short exposures and thus reducing the effective time the blue light (day-

12. Round worm from intestinal tract, an example of routine close-up copying work in the clinical laboratory. Photograph made with 50mm lens and Focaslide Copying Attachment for critical sharpness in subject matter.



***(Below)* Echinococcus parasite from hydatid cyst of the liver. This is a photomicrograph of an unstained smear showing the characteristic multiple hooks.**



light) acts upon the film. On all other occasions you must plan to use color film in rooms where daylight, if any, can be shut out completely.

Another disturbance is caused by colored walls. Reflected light from these mixes with the illumination on the subject, rendering transparencies that show an overcast of unwanted color that is neither natural nor true. It is advisable, therefore, to use a room with white walls and ceiling to achieve the ultimate in color reproductions. If you are accustomed to the rather wide latitude permitted in black-and-white film, you will discover the need for a good photoelectric exposure meter in all color work, and when properly handled this produces results superior to any other means of determining this vital factor. Having thoroughly studied and digested the detailed instructions for the use of this instrument, you should experience very little difficulty in turning out work of high quality and perfection. As might be expected, meters vary sometimes in their sensitivity, and it may be necessary to calibrate yours with another meter of known accuracy. Detailed records of all exposures, camera settings, lighting arrangements, and distances combine to furnish you a useful guide for future reference in perfecting correct exposure proficiency. It has been the experience of many that the Weston rating of 12 for Kodachrome Type A does not always produce correctly exposed transparencies and that the meter set for a rating of 10 or 8 produces more satisfactory results. For medical subjects, hold the meter about 18 inches away to obtain the most accurate readings, and remember that black objects produce readings that are generally too low (resulting in overexposure) and white highly reflecting subjects give readings that are too high (resulting in underexposure). Dull-white or light-gray subjects produce readings that are more nearly correct.

The reader is referred to the chapter on Color Photography in this volume for additional information on how to secure consistently good color reproduction with various films and light sources.

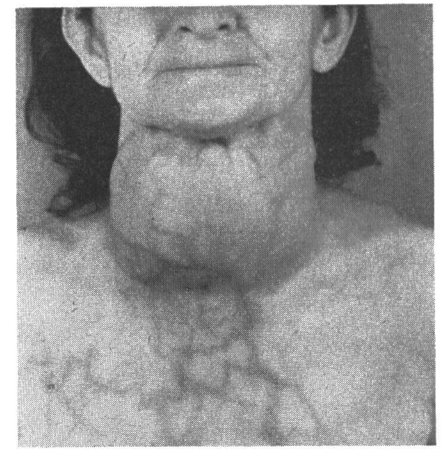
On receipt of the color film from the processing laboratory, mount the individual frames between 2x2 inch clean and flawless cover glasses. This not only permits projection of the transparencies in any desired order but protects them permanently from scratches, dust, and finger marks. The cover glasses also prevent the buckling of the transparencies (due to heat) so evident in the regular cardboard mounts within a few seconds after placing them in the projector, necessitating refocusing of each slide. After mounting them, label the slides, classify them, and cross-index them in accordance with the prevailing system for other specimens in the department. It is best to store the color slides in a cool, dark place.

Infrared Photography • The use of infrared film in clinical photography for special purposes is possible because of the peculiar ability of some tissues, especially the epidermis, to transmit light of the infrared (invisible) region of the spectrum. Subcutaneous blood vessels show up distinctly on infrared sensitive film, because the blood vessels absorb most of the visible light, whereas the surrounding tissues absorb the infrared. This characteristic of infrared absorption provides a method of obtaining pictures of clinical conditions not otherwise recordable. The blood vessels of the mammary gland during pregnancy, varicose veins, distended vessels over the abdomen from portal obstruction—all these make interesting studies. Infrared film has been used successfully in dermatological photography to eliminate superficial obstruction to underlying details when only the latter are desired in the picture. Scales, exudative crusts, and the redness of inflammation can be penetrated by infrared light, thus preventing a photographic impression of them on the final negative. Infrared film has been recommended for bringing out the gross detail of silicotic deposits in lung tissue in cases of pneumosilicosis of fixed necropsy specimens, although lung tissue gives a rather low transmission of infrared light as compared with skin, muscle, kidney, brain, and liver.

The scientific and diagnostic value of infrared photographs cannot be regarded as great, but the method does provide a means of seeing certain conditions not recordable by other means. Specifically, two applications of infrared photography present possibilities of obtaining information not offered by other clinical methods. One deals with corneal opacities, which readily transmit infrared rays, enabling the ophthalmologist to photograph the underlying structures for foreign bodies and pathological changes unrecognizable by other instrumentation. The second application of infrared rays deals with photomicrography of thick sections not penetrable by indirect or transmitted light, especially embryological and parasitological specimens, affording the investigator a means of studying microscopic structures not otherwise discernible. The transmission of infrared light can be increased by wetting the surface of the skin or the specimen with water or some bland oil, such as cedarwood, olive, sesame, or peanut. Use fresh film, since most infrared materials tend to lose their sensitivity rapidly.

Infrared illumination is suitably supplied by infrared heat lamps, incandescent tungsten-filament lamps, photofloods, and the carbon arc for photomicrography. Arrange the lamps in reflectors for flat lighting and set them close to the field to be recorded. Generally, use two No. 2 photofloods for the illumination and place them on each side of the patient or the specimen at an angle of 45°. Use an infrared filter, such as the Leitz Red No. 3, over the camera lens to exclude all visible light. Secure the Leica on a rigid tripod. Carry out focusing in the usual way and adjust the indicated distance to the infrared setting marked on most Leica lenses with the letter R. Correct exposure will vary from 1/20

to 1 full second or more, and cannot be measured accurately by means of the photoelectric exposure meter. Make several exposures (at least 3) at different shutter speeds to be certain of a good negative, unless you have previously established the correct exposure data from other work with this film-and-lighting arrangement. Do not stop down the iris diaphragm too far; usually from f/3.5 to f/9 is sufficient. The grain of infrared film is very coarse, requiring development in one of the many fine-grain developers available, and even then great enlargement is not possible. Infrared negatives are generally flat, necessitating a more contrasty grade of printing paper.



13. One of the many uses of infra-red illumination is to bring out the detail of underlying blood vessels. Here, photographing a thyroid carcinoma with infra-red reveals a complex pattern of underlying blood vessels not otherwise visible.

Copying X-ray Films • The reproduction of x-ray films occupies in many instances the major part of the clinical photographer's copy work and he should anticipate it in ample time to provide the necessary means of accomplishment. Radiographs are copied with the same equipment and general technique as those applied to other copy work, except for the lighting arrangement, which calls for transmitted illumination. Most photographers copy x-ray films directly from the ordinary view box equipped with fluorescent tubes, and the method is generally satisfactory. For those possessing a copying stand, provision for radiographs is usually made, or it can be effected by designing the table top of the unit so that it can be quickly replaced by a sheet of white flash opal glass, on which the x-ray films are placed for copying. Since the largest standard sheets of x-ray film measure 14x17 inches, the opal glass should be cut slightly larger for the copying stand. Arrange the lights below the opal glass so that all parts of the film will receive an equal amount of illumination. You can prevent curling and buckling of the film due to heat from the light source by placing over the radiograph a piece of clear, flawless plate glass to hold the film in a level plane during exposure. Black cardboard masks with a wide border corresponding to the different sizes of x-ray film used will eliminate stray light and greatly improve the appearance of the final reproduction.

Since x-ray films vary greatly in density and possess a long scale range of tones, from black to white, it is impossible to establish an exposure time applicable to all. In practice, the photoelectric exposure meter can be depended upon to indicate the right exposure time when it is properly applied. With the "eye" of the meter in direct contact with the film, take readings of the transmitted light in the densest and lightest areas showing detail, and select an average between the two for the correct exposure time. After some experience, you can determine the correct exposure from a meter reading of a single area representing average density of the particular film copied. When the regular x-ray view box is selected for this work, I suggest that you obtain one containing at least 4 fluorescent tubes, to ensure a more equal distribution of light over the entire film than can be realized with units containing only the usual 2. The standard view box with fluorescent tubes offers some advantages over other systems of illumination in that the tubes produce very little heat to curl or buckle the film. Always include the identification number of the x-ray film when possible. Should it be located beyond the field of view or not legible, take time to print the date and serial number with pen and black ink in some clear section of the film near the outer border. It is sometimes necessary to indicate right or left side by the capital letters R or L.

Medical Lantern Slides • Lantern slides are usually in such great demand by physicians that their production should receive the same skill in preparation and care that is used in other work, but in spite of the universal popularity of slides for projection, the quality of those seen at many medical meetings is often below par. Not infrequently the lecture is interrupted by the speaker to apologize for the poor quality of slides presented. Failure in photographic technique, however, is not the usual cause for complaint, since in the majority of instances there is little indication that any care whatever has been taken in the preparation and arrangement of the original copy matter. Few physicians understand the photographic procedures involved in the production of a good lantern slide, and the clinical photographer will have to assume most of the responsibility for turning out acceptable work. The copy material is usually presented in the form of graphs, charts, line drawings, or diagrams, and many times as typewritten tabulations. These will require sorting into 2 groups; (1) only specimens that are satisfactory for reproduction, and (2) those which cannot be made into good lantern slides. If you analyze the unsatisfactory group, you generally find one or more of the following faults: too much material on a single slide, making it impossible for those in the back of the room to read it clearly, if at all; dark, colored, or even faded paper; lines drawn with a lead pencil or with pale, off-shade ink; too wide a scale ratio; paper showing texture or grain and often other defects; the copy material not well proportioned to make full use of the entire field of the slide; defective typing of tabulations; poor selection of graphs for presentation of the clinical data clearly; poor photographic technique.

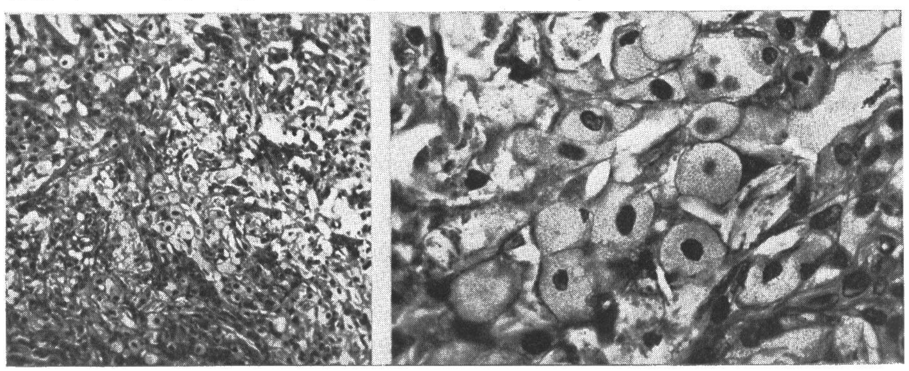
To make good lantern slides, you must consider the original copy itself. The paper selected should be clear white of very fine texture, either dull or glossy, preferably the latter for typewritten data. All graphs, drawings, and diagrams — in fact, any line work — should be made with black India ink on high-grade white draftsman's paper. I recommend that you obtain a draftsman's pen, a T square, and whatever other equipment you desire to have immediately available for remaking the submitted copy. The usual grades of typewriting paper are not the best, since ink from the ribbon tends to spread from the type impressions and when enlarged on the screen has a messy, blurred appearance. The Krompate No. 108 used by the printing industry I recommend highly for preparing copy with the typewriter. It has a very glossy surface and extremely fine texture and the ink does not spread from the type border. Use a typewriter with large, sharp, and distinct type in perfect alignment, and of course keep the type clean at all times and install a new black ribbon at intervals to ensure good impressions. The recently introduced electric typewriter offers the photographer and the physician a perfect means of preparing copy for lantern slides. A machine such as the IBM Executive model with boldface type provides even alignment of the letters, automatic word expansion, and perfect uniformity of type impression regardless of how lightly or how hard the typist strikes the keys. A special dry carbon paper ribbon feeds through the machine only once, replacing advantageously the usual ink ribbons of ordinary typewriters. The boldface type of the machine produces copy that closely approximates the printing of high-quality journals and textbooks.

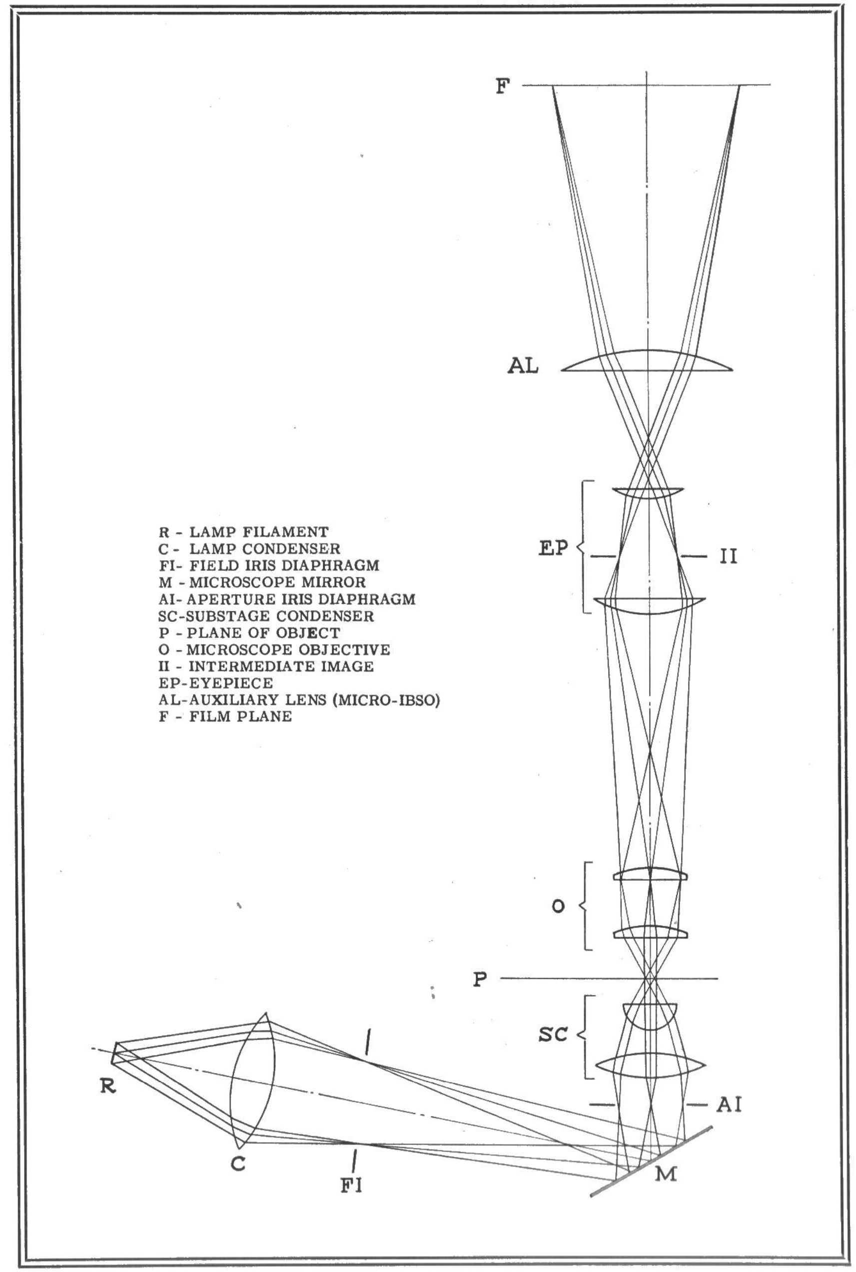
It is well to remember that lantern slides, whether standard 3¼x4 or Leica 2x2, present a greater horizontal than vertical diameter, and the copy material must conform to this proportion. Of course the Leica slides can be projected in either plane, allowing greater freedom in preparation of the copy, but the standard 3¼x4 slides can be inserted into the projector only in the horizontal position. Always arrange the typing to conform to the shape of the slide, and plan to lengthen, shorten, and space the printing to fill as much of the slide field as possible. A narrow black-line border should enclose the copy matter (except photographs) and beyond this a narrow margin of pure white should balance and improve the general over-all appearance of the projected slide. Lantern slides should always be made as positives. A frequent objection to black-and-white positive slides is the glare from the unused white sections of the field, causing eyestrain and fatigue. A common practice among clinical photographers is to tone the slides with toning solutions, such a sepia, blue, green, gold, and so on. I recommend this especially for lectures in which a large number of slides are projected without interruption. Eye fatigue is a trivial matter, even with black-and-white reproductions, provided the field is occupied by black type and the borders are masked to prevent excessive reflection of light from the projection screen.

If you are responsible for the preparation of lantern slides, you must also consider other factors closely related to the successful effectiveness of your efforts — the size of the projection screen, the distance from the screen to the rear row of seats, and the distance from the projector to the screen. Obviously, these items are extremely variable, and you simply cannot make a slide to satisfy fully all the conditions under which it will be used. Since these factors are frequently unknown, a safe procedure is to prepare the slides for the average conditions of an auditorium 50 feet deep with a seating capacity of from 50 to 100 persons. Assume that the screen is 8x8 feet and the projector is placed 50 feet from it and provided with a lens of sufficient focal length to cover the screen fully. Legibility for an observer seated in the back row of such a room requires a slide of approximately 20 single-spaced lines(standard pica type) for the best results. Under the same projecting conditions in a room from 50 to 100 feet deep with a seating capacity of from 200 to 300, the slide should not contain more than 10 lines (enlarged, of course) to fill the entire surface of the slide. In larger auditoriums a 12-foot screen is a practical necessity; otherwise the number of lines requires further reduction, with a corresponding increase in magnification. Most photographers limit the copy to the 20 single-spaced typewriter lines.

Photomicrography • Contrary to general opinion, the production of good photomicrographs is neither a difficult undertaking nor one requiring expensive, bulky, and complicated equipment involving great skill in assembly, adjustment, and operation. Disregarding the few exceptions when such elaborate equipment does have certain advantages, you can obtain equal results

14. Photomicrographs of Xanthoma. *(Left)* 265x. Ortholux, 16mm apochromat, Leica and Micro-Ibso. At this magnification the general overall pattern is visible.
(Right) For greater magnification allowing study of individual cells, the same set-up is used with a 45mm apochromat, yielding a 750x magnification on film.





15. Path of light and image formation in Koehler illumination. (Diagram courtesy of H. W. Zieler)

with simpler and less expensive apparatus — the Leica and the Micro-Ibso Attachment. For general purposes in clinical photomicrography you will find this combination entirely adequate, even providing a means of recording such difficult subjects as motile organisms; this is not possible with the larger units. The low cost of 35mm film, including color, simplicity of operation, and convenience of 20 to 36 exposures with a single loading, are other features recommending the Leica for this special type of photography. These characteristics, combined with the high quality of results, greatly encourage its use, and before long the microscopist finds himself making photomicrographs of numerous specimens formerly disregarded.

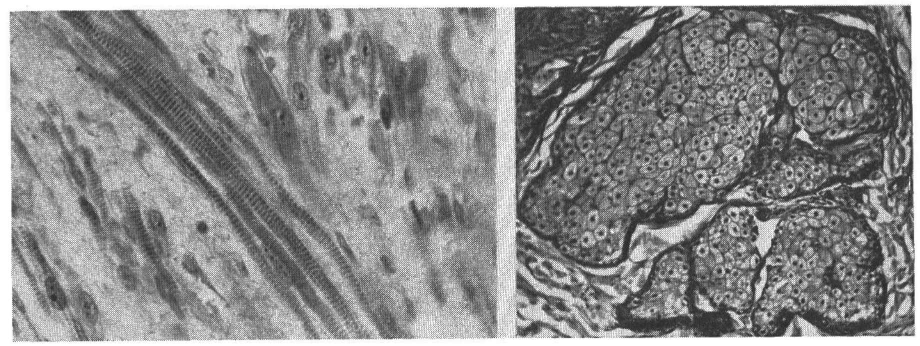
Only fine-grained films, such as Panatomic-X, and Microfile, can be relied upon to yield the ultimate in resolution so important in micro specimens, and these require development in fine-grain developers, such as Microdol. Since most medical sections are stained with eosin-hemotoxylin, experience indicates Panatomic-X, as probably the most satisfactory for high-quality photomicrographs with the Leica-Micro-Ibso combination. Although films such as Microfile provide extremely fine grain, the contrast is generally too great, and reproductions show a definite loss of intracellular detail. The blue nuclei of the stained section show up black with loss of detail on the final print, and too often a loss of cytoplasmic structure results in the same picture because of underexposure. Generally speaking, select the extremely fine-grained films for special stains with nerve tissue, collagen, muscle, and connective tissue, but for glandular and neoplastic tissues stained with eosin-hemotoxylin, you will find Panatomic-X satisfactory.

For panchromatic film, a yellow-green filter possessing a spectral transmission of about 480 mu to 620 mu gives the best results for tissues stained in eosin-hemotoxylin. This range is also most suitable for the color correction of the microscope objectives, particularly the achromats. Generally, you can determine by visual inspection which filters or combination of filters render the best contrast. For many unstained sections filters are not required. It is desirable to have at hand a complete set of high-quality filters of solid glass with individual absorption curves, such as the Duracolor filter set.

Successful photomicrography entails more than careful selection of film, filters, illumination, and apparatus, for in spite of these and a thorough knowledge of the use of the equipment, failure is often experienced because of inferior microscopic specimens. You hear and read much about lighting, apparatus, theory, and so on — in fact, several textbooks on the subject tell you everything you need to know — and then the beginner is surprised with the poor quality of his photomicrographs. At this point I emphasize the importance of

skillful preparation of the stained tissue sections, for unless you have a good slide to begin with, it is simply impossible to make a good photomicrograph. Only flawless, clean, clear glass slides of uniform thickness, free of scratches and corrosion, will suffice. Use No. 1 cover glass that complies with the same quality of standards, as thicker cover glass interferes with the optical performance of the various micro objectives, particularly the high dry apochromats.

Paraffin (also proprietary modifications of paraffin such as Tissuemat) provides the most satisfactory embedding media, as thinner sections can be cut than with celloidin. Fixing, clearing, and staining, especially the latter, are very important steps that require strict attention to each technical procedure involved. Since eosin-hemotoxylin is the method of choice for routine staining in most pathological laboratories, the technician responsible should be well grounded in the fundamentals of the whole process by the pathologist in charge.



16. *(Left)* Photomicrograph of Rhabdomyomyxoma, made with the Ortholux, 45mm apochromat, Leica and Micro-Ibso, yielding a magnification of 750x. This magnification gives great clarity of detail in the muscle striation.
(Right) Photomicrograph of a section through a benign sebaceous gland tumor. The same equipment was used with a 16mm apochromat, since a lower magnification was preferable.

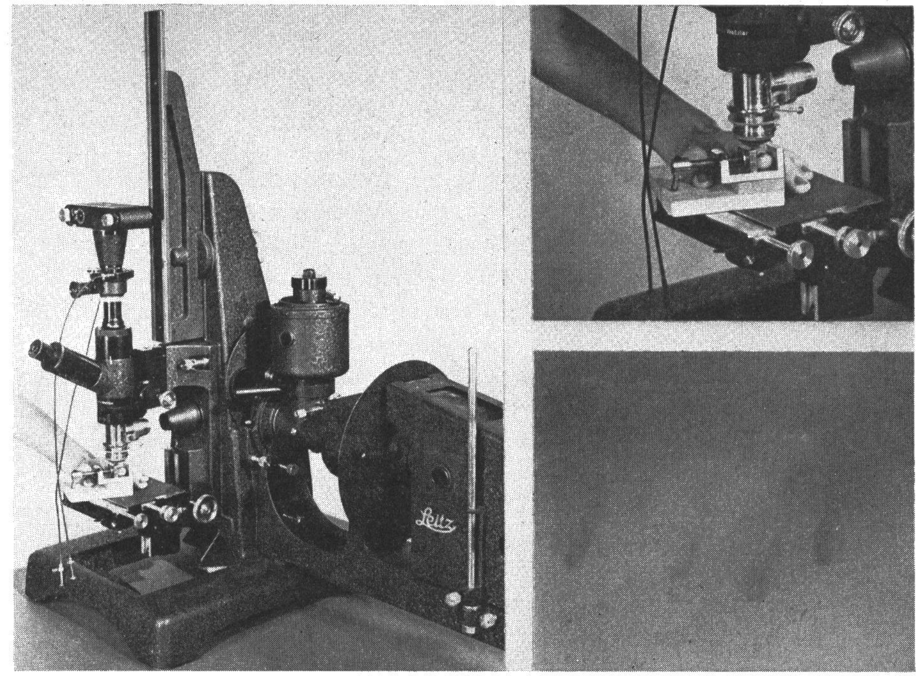
Overworked solutions cannot be expected to yield the kind of slides needed for good photomicrographs, and fresh ones should always be prepared to replace those indicating age.

Frequent inspection of sections under the microscope as they are transferred through the various staining baths is the best way of ensuring correct and balanced staining of the different cellular elements. In all sections stained by eosin-hemotoxylin the cells should show a dark pink or red cytoplasm and light-blue nuclei in which the color contrast is sharp and brilliant. Overstaining with either color requires bleaching and further differentiation with the appropriate solutions, to balance the colors and increase contrast. Tissue sections about 7 microns in thickness are best suited for photomicrography and certainly they should never exceed 10 microns, although these are allowable for very low power reproduction.

Poor slides result more often from careless mechanical handling than from staining failure. Frequently the sections are wavy, broken, or irregular in thickness (indicating a loose microtome blade or paraffin block holder), making it impossible to secure sharp focus over the entire field of any part of the stained section. This defect can be remedied by careful cutting of the paraffin sections with a good heavy microtome of rigid construction in which the knife preferably cuts in an oblique direction. In removing the individual sections from the ribbon, great care must be exercised to prevent tearing the tissues or allowing the edges to fold over and broken pieces to be superimposed on parts of the main sections. These correctable mistakes indicate rough handling and ruin the sections for photomicrography. The final step in preparation of the slide involves permanent mounting, usually with neutral balsam. The section must lie flat and be covered with enough balsam (thin out with xylol) to secure the cover slip.

The choice of a microscope depends largely on the nature and the extent of the photomicrography to be undertaken. When the budget permits, a permanently aligned and rigid setup conserves time and effort in making the necessary adjustments each time the apparatus is used. Although perfectly good work can be produced from almost any standard type of microscope, the larger, heavier research models are distinctly better. The Micro-Ibso Attachment is equipped with a periplan-10x eyepiece, which should be used with all apochromatic objectives. It is a "compensating" eyepiece that compensates not only for the chromatical difference of magnification (a characteristic of apochromats) but also for curvature of the field, which is most pronounced with the apochromats. The apochromats also have a shorter working distance, because of their increased numerical aperture, but in spite of these characteristics, the serious worker is advised to acquire apochromatic objectives for the microscope he intends to use for high-quality photomicrographic performance.

When achromats are used, particularly those of low magnification, it is better to replace the periplan with a Huyghenian 10x eyepiece. The achromats perform quite well with panchromatic film and a green filter, although the apochromats are superior for color film and definitely indicated for subjects requiring maximum resolution and color correction. The two-diaphragm "Berek" or aplanatic-achromatic substage condenser is superior to the usual Abbe two-lens system for all purposes in photomicrography, especially color. It is advisable to have the substage condenser supplied with a centering adapter ring for easy manipulation in centering the condenser into the optical axis. A mechanical stage is a necessity for all photomicrographic work with microslides. It facilitates free movement of the specimen under the objective while looking for the area sought and, by noting its position against the vernier of the micrometer, it makes it possible to re-position the specimen when needed.



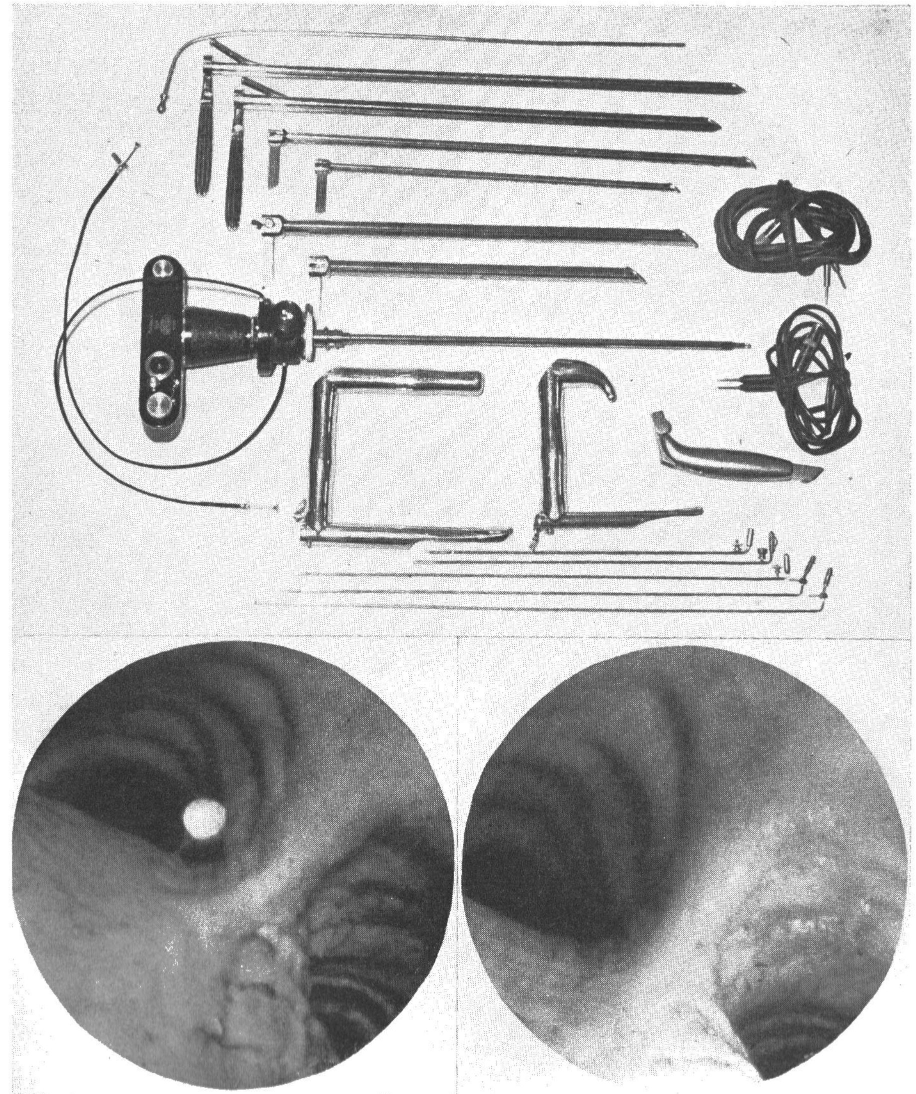
17. *(Left)* Arrangement for photomicrography of nail-bed capillaries using Ultropak on Panphot, with carbon arc. *(Top right)* Close-up method used to immobilize finger. *(Bottom right)* Photomicrograph of the nail-bed capillaries. Ultropak, 22x "UO" objective, Leica and Micro-Ibso.

Presumably the physician or the clinical photographer extending his interests into photomicrography will build up his equipment around an existing microscope; he may on the other hand decide to invest in something more elaborate. What do some of these modern research microscopes offer? One of these which offers special advantages for photomicrographic work is the Ortholux research microscope. This instrument presents a wide departure in design, but can be considered a modern achievement in microscope perfection, providing remarkable utility and numerous applications to satisfy the most exacting requirements of the critical user. One feature of photomicrographic importance is the built-in, permanently aligned, adjustable light system, offering both transmitted light for normal use and reflected light for applications with the Ultropak microscope attachment. Another feature with special appeal is the combination monocular-binocular tube, which permits observation of the micro image with binocular vision, and then by finger-tip shifting of a sliding internal prism, the image is projected upward through the monocular tube for photomicrographs.

At the beginning of the day's work, the Leica is loaded and the Micro-Ibso Attachment secured in place on the monocular tube in readiness for photomicrographs as the pathologist or the research worker runs through his series of slides, making exposures as he proceeds with the work. Hardly a day passes for the pathologist without recognition of many pathological changes he would like to record, but he passes them up because he must transfer the slide to another setup for photomicrographs. With this arrangement he can reproduce them leisurely and without interruption as he goes along with the day's run. The Ortholux also offers another favorable advancement, which concerns the substage condenser. The Berek two-diaphragm bright-field condenser represents an entirely new departure in microscope condensers, particularly for photomicrography. The upper lens of this condenser is provided with a special mount with a lever to swing it quickly out of position when you desire to use very low power objectives. For all objectives from 16mm (10x) to higher powers, the upper lens component is left in the optical axis. In the Berek substage condenser the lower iris diaphragm has a double function. With the lower element alone (the upper lens swung out) the lower iris functions as an aperture stop. When both elements are used in the light path for high magnification (16mm upward), the upper iris diaphragm serves as an aperture stop and the lower iris as a field stop. In this capacity the lower iris functions with greater effectiveness not only in controlling the light admitted but also in eliminating external reflections more completely. The main purpose of the aperture stop is the regulation of the light intensity within the field of view (by variation of the numerical aperture of the illumination). The increase in the depth of sharp focus and flatness of the field is incidental.

It is easy to use different filters with the Ortholux simply by laying them flat above the spherical window located above the substage mirror. There is a swing-down lens in the base of the instrument located in front of the substage fixed mirror; this lens remains in the up position for all work except with the dark-field condenser when it is swung into the down position. The permanently aligned light source consists of an adjustable condenser lens system, filter slots, centerable 6-volt (3 to 6 amp) lamp with controllable transformer and ammeter.

For the purpose of clarification, a few general facts are amplified here for the benefit of those unfamiliar with them. For reference purposes it is customary in photomicrography to indicate a scale of magnification of the micro image recorded by the film negative based on the following facts. If you hold a sheet of ground glass 10 inches above the eyepiece in the path of the projected image, you see the size relationship of cellular detail to be the same as when viewed by the normal eye close to the ocular. The magnification as given under standard conditions at 10 inches is obtained by multiplying the magnifying power of



18. *(Top)* Micro-Ibso Attachment and Leica connected to the foroblique telescope for bronchoscopic work. In similar manner the Micro-Ibso Attachment is used with endoscopic, cystoscopic, gastroscopic, peritoneoscopic, and thoracoscopic instruments.

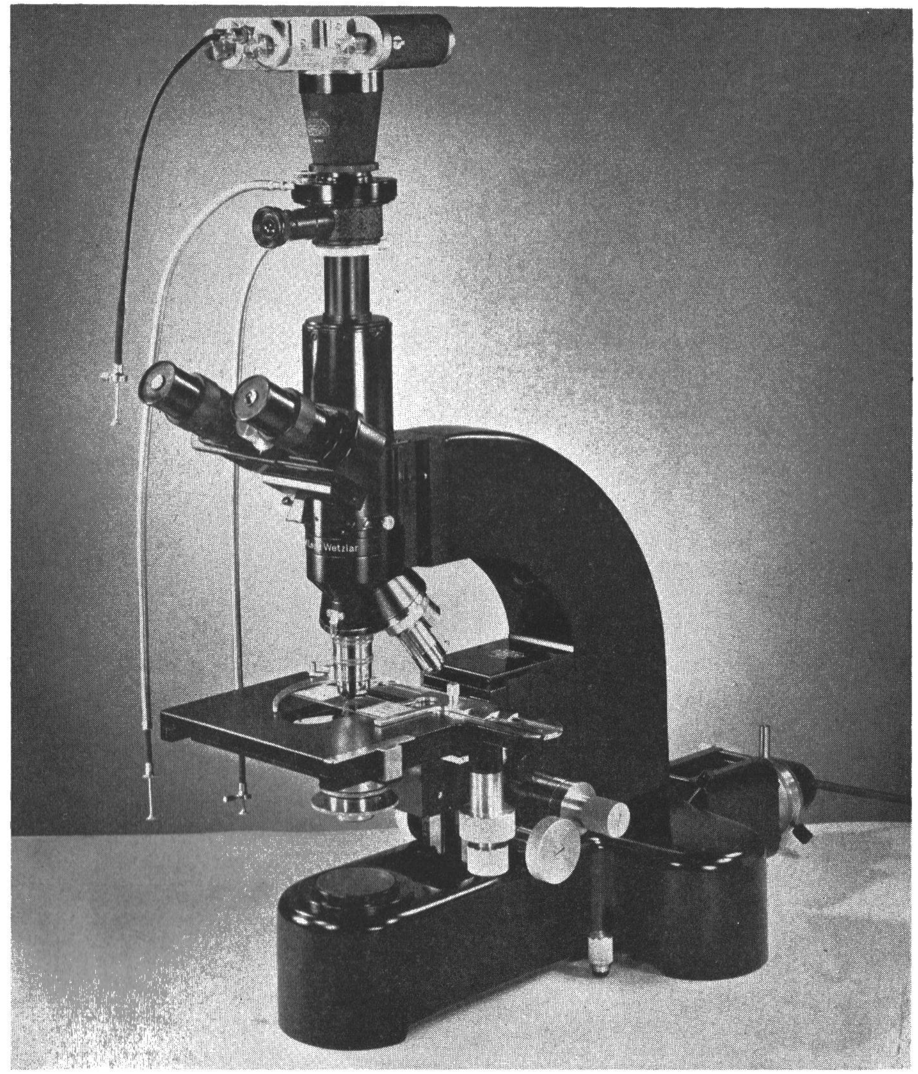
(Bottom left) Ordinary pin lodged in the proximal left major bronchus. *(Bottom right)* Bifurcation of the right and left major bronchi.

the objective by the magnifying power of the ocular. Suppose the 16mm objective of 10x and the 10x ocular are used, the magnification obtained at 10 inches (the plane of the negative) is 10x10 or 100x. If the film plane is nearer the ocular than 10 inches, the relative magnification is less, and if further than 10 inches, it is more. Now consider the Micro-Ibso Attachment with 1/3x conical adapter and notice that the film plane is considerably less than 10 inches when the attachment is secured to the microscope.

In the case of the ⅓x conical adapter the magnification of the projected image in the film plane is only ⅓ the size of the image at 10 inches, and is obtained by the formula, 10x10x⅓ or 33⅓, and you will have to enlarge it 3⅓ times on the print to obtain the same magnification as that of a larger negative located 10 inches from the ocular. The magnification for the ½x conical adapter follows—10x10x½ or 50x—but in the case of the 1x adapter, the scale is 10x10x1, or 100x. Now the diameter of the projected image at 10 inches is approximately 6 inches (10x objective and 10x ocular), necessitating a sheet of cut film approximately 4x5 for full coverage. The ⅓x conical adapter records very nearly the same field, only the magnified detail is ⅓ less, and of course requires a much shorter exposure.

The conical adapter of ⅓x is sufficient for most photomicrographic purposes, the two others are selected only when there is need for greater enlargement of a particular small field, such as is required by the cytologist for critical study of individual cells or small groups of cells. The lens in the base of the conical adapter is achromatic, and suitable for color film. Since the semisilvered beam-splitting prism located in the main housing of the Micro-Ibso reflects approximately 40 per cent of the light into the lateral viewing telescope, the prism can be shifted out of the optical path by means of the actuating cable release, for shorter exposure. For continuous observation, as in the case of motile objects, the prism remains in the optical path.

The matter of magnification deserves a few words of comment at this point, since a distinction must be made between magnification and enlargement as far as resolution is concerned. The initial image produced by any microscope objective of a certain magnification resolves all the detail consistent with its construction, and no more, regardless of how much we enlarge this image. The eyepiece or ocular can only "enlarge" this initial image, enabling the human eye to see it better, but can never increase the resolution, regardless of how much it is capable of magnifying. For very definite reasons an ocular greater than 10x should not be used, and when greater magnification is desired, the microscopist must use an objective of greater power. If you wish to enlarge the initial image more than that provided by the 10x ocular and the highest power objective at hand, you will have to move the film plane of the camera farther away from the eyepiece. For the Micro-Ibso attachment there are



19. Ortholux Research Microscope equipped with objective nosepiece, binocular-monocular tube, Leica and Micro-Ibso Attachment. With its built-in light source, this outfit provides the photomicrographer with a constantly aligned set-up of adjustable intensity for photography or visual observation.

available 2 conical adapters of ½x and 1x (in addition to the 1/3x adapter usually supplied), providing images of greater enlargement on the negative. You can, of course, enlarge the negative image still further by projection enlargement on printing paper, and on the screen in the case of color transparencies, where the size will depend upon the distance to the screen.

Now let us consider the problems of light sources connected with photomicrography and microscopes not equipped with permanent built-in systems of illumination. Many workers produce good photomicrographs by the very simple means of diffused light such as is obtained from a frosted lamp or the insertion of a ground-glass screen somewhere between the light source and the microscope. Although such a method ensures uniform illumination of the objective field and is quite satisfactory for low and medium power magnification, it presents certain difficulties in the high-power objectives for optical reasons. Whether you use frosted bulbs, such as Photofloods or ground glass, to diffuse the light, tungsten filament lamps, or the carbon arc, you should always select the proper lamphousing equipped with adjustable condenser lens, iris diaphragm, and water or filter cell to absorb excessive heat from high-intensity sources. To standardize the entire procedure, the conscientious worker is advised to select a good type of illuminating source suitable to all degrees of magnification, film, and type of objectives, and set it up in such a way that future applications require very little time and adjustment for immediate use. Assuming that you select one of the more commonly used incandescent filament lamps or carbon arc, your success or failure will be determined by your manipulation of both the illuminating and the micro systems. Proper control of the illumination commands special attention, as it is a frequent cause of trouble and a widely debated subject. The cytologist requires from his microscope the ultimate in resolution demanding some type of critical illumination. The majority of medical photomicrographs, however, are made to show cellular arrangement characteristic of various pathological processes in which contrast rather than resolution is the main objective, for which different methods of illuminating sources are applicable and all produce good results when properly handled.

There are two methods of illumination for photomicrography described in standard textbooks on the subject. One deals with a "system of critical illumination," and other Koehler illumination. The term "critical illumination" is often applied to both, and has no significant meaning other than the correct alignment and adjustment of all participating optical components from light source to film plane, and all fully conditioned for the maximum operating efficiency the equipment is capable of producing. What is the difference, then, between the "system of critical illumination" and the more popular method of Koehler? Referring to the books of the authorities, you will find that in order to set up a system of critical illumination you focus an image of the light source in the object plane. Obviously, the filament will have to be absolutely uniform and large enough to produce an image in the object plane free of design, and slightly larger than the field of view revealed by the objective used. Unfortunately, there are today very few light sources that can fulfill this

requirement. Theoretically, the system is good, but it is not as practical as the more popular and widely used Koehler method that most photomicrographers use today. In the Koehler method of illumination you focus a magnified image of the light source in the lower focal plane of the substage condenser by means of the lamp condenser. The microscope condenser throws this image into infinity, but it is picked up by the objective so that another image of the light source—together with an image of the substage iris diaphragm—is formed in the rear focal plane of the objective. Obviously, almost any type of light source can be used for Koehler illumination, because in the plane of the object its image is completely "out of focus" and filament structure is entirely obliterated. Aside from permanently aligned built-in lighting arrangements, the customary practice is to focus the image of the light source in the plane of the substage iris diaphragm. The iris should be partly closed. The eyepiece is then removed so that the rear lens of the objective can be observed by looking into the tube of the microscope. If the substage condenser is not centered, the image of the iris diaphragm will not be centered in respect to the rear lens of the objective. This can be corrected by adjustment of the substage centering mount. The filament of the lamp is also imaged in the plane of the rear lens, and since lack of uniformity of the intensity in this plane is objectionable, the lens of the Monla lamp is especially treated to provide a slight diffusing effect that obliterates the coiled windings of the filament.

For the purpose of illustration take a popular microscope lamp much used for photomicrography, the Leitz Monla with low-voltage coiled filament bulb (6 volts, 5 amp), with centering mount. Although the directions given here pertain to this particular lamp, other types of filaments, including the carbon arc, may be used without affecting the outline from a practical standpoint. To begin with, set the lamp filament in the optical axis of the condensing lens of the lamphousing (a three-dimensional adjustment) and then adjust the cone of light to the optical system of the microscope. When possible, place the light in front of the microscope, determining the correct distance by trial, moving the lamp stand back and forward until its sharply focused image is slightly larger than the aperture of the lowest-power objective to be used on the microscope. This distance has been found to be about 12 to 14 inches for the 10x objective, and this position of the lamp is maintained for all other objectives of higher magnification. Now close the field diaphragm of the lamp condenser FI (Fig. 15). Its image should appear in sharp focus simultaneously with that of the object. Possibly slight refocusing of the substage condenser (SC) will be required. If the image of the substage iris diaphragm AI is not centered, tilt the plane mirror (M) back and forth or sideways to center the image of AI. The entire beam of the illumination must of course be centered in respect to the surface of the mirror (M). When the field stop (FI) is centered in respect to the field of view, open it just far enough to ensure illumination of the entire field. Further opening of the field stop is not advisable—particularly at high magnifications—because haze and glare will reduce the contrast of the object image. It is easy to follow this procedure of alignment with an objective of medium or high magnification, when the lamp is about 12 to 14 inches from the microscope. However, when you use objectives of long focal lengths and low magnification, the field of view is much larger. The image of the field stop must be correspondingly larger, and if the same substage condenser is used, this can only be accomplished by moving the lamp much closer to the microscope. When the focal length of the objective is much longer than 16mm (for instance, the 24mm achromat), it will be impossible to illuminate the entire field by adhering to the above procedure. In that case, either use a special long-focus lens in the substage mount or obtain uniform illumination by interposing ground-glass screens between lamp and microscope.

When taking the photomicrograph, it is advisable to reduce the numerical aperture of the illumination so that about ½ to 2/3 of the rear lens of the objective is filled with light. The better the correction of the objective, the farther can the substage iris diaphragm be opened without decrease of sharpness. That is why this iris can be opened farther when apochromats are used. When taking photomicrographs of unstained objects, such as diatoms, amoebas, ova, parasites, or other material that differs from the surrounding medium only in regard to its refractive index, close the aperture of the substage iris considerably more than for stained specimens. Now that the entire optical system is adjusted and the light properly conducted through the optical axis, you can satisfy yourself of this fact by examining the real image in the plane of the film (F). For this purpose place a finely ground glass screen in the approximate plane occupied by the film and inspect the image carefully. If you have been successful in effecting the correct adjustments, you will find an equal distribution of the illumination over the entire field, and a very sharply focused image of the micro specimen. If you did not accomplish this, a little manipulation of the substage mirror will usually correct the inequalities as far as the uniformity of illumination is concerned.

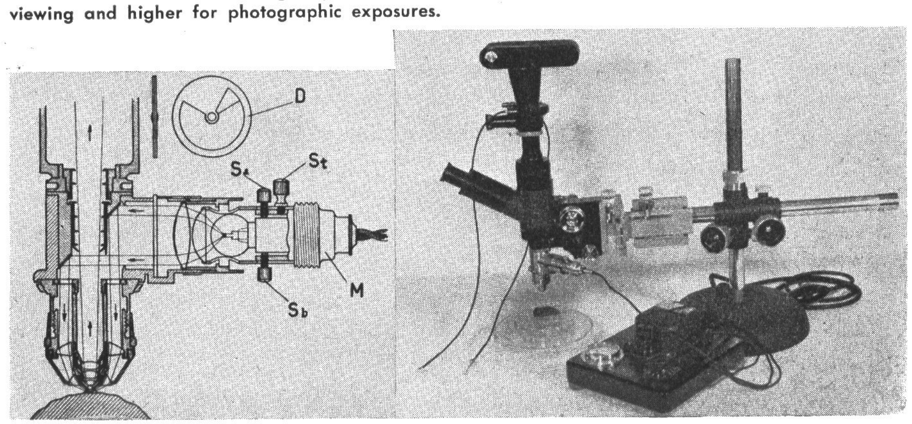
Photomicrography in natural color is rapidly replacing the conventional black-and-white methods of the past, with many justifications. The popular Leica-sized transparencies are easy to make, and when projected they offer many advantages of presenting scientific knowledge comparable only to that furnished by the microscope itself. The physician or research worker selects the important fields in his sections at the time of study, making photomicrographs of the essential features he desires to emphasize and gathering together all this information in a few color transparencies he can easily carry from

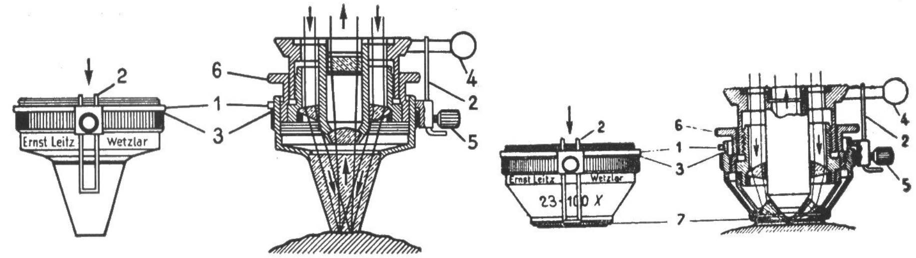
place to place. In many institutions the color transparencies are rapidly replacing the micro-projector, because of portability, saving of time in locating desired fields, and the improved quality of the projected image. With one or two exceptions, the technical applications of photomicrography with color film are practically the same as with black-and-white. Assuming a high-grade microscope equipped with fully corrected optical components, the main requirement for photomicrography in color is a light source of the right color temperature. Photofloods provide the correct color temperature, but their short life, with their constant change of color quality, intense heat, and large size, make them rather undesirable. When you use them, install them in a well-ventilated lamphousing with condenser lens, diaphragm, and water cooling cell. It is more practical to utilize the light source presently available and introduce correction filters obtainable from Eastman or Ansco for the film they offer. The carbon arc is very suitable for color work and although the color temperature is considerably more than needed, it can be corrected with filters to properly adjust it to the color film selected. The availability of a dependable color temperature meter for careful measurements of the color temperature of the light source for photomicrography in color is recommended. Once the color temperature has been determined, compensating filters are introduced to provide the correct illumination acting upon the color film. For the ribbon filament lamp, the Wratten filter No. 78B is used for Kodachrome Type A, since this light tends to produce a slight yellowish color in this film without correction. Coil filament lamps are widely used for photomicrography in color, the common practice being to over-volt them by means of an adjustable auto-transformer with ammeter. Color temperature readings are made with different settings of the ammeter scale (but not exceeding the rated voltage of the lamp employed) and a setting established on the ammeter scale providing a color temperature from the lamp very close to the requirements of the film at hand. It is well to avoid a setting too close to the voltage limitations of the lamp, since the life of the lamp is greatly shortened when continuously burned near its peak, and the color quality decreases with age under these conditions. Voltage fluctuations in the current source (city lines) induce color changes in all high intensity tungsten lamps, suggesting the need for maintaining the transformer-ammeter connections continuously in the circuit for detection and control of these changes. While overloading will shorten the life of the lamp, many exposures are possible if it is overloaded only during the actual exposure, and then immediately turned down to its low operating level.

The problem of correct exposure of color film calls for the use of a reliable exposure meter designed for photomicrographic purposes. An instrument such as the Photovolt offers accurate and consistent means of determining correct exposure for color film.

Photomicrography with the Ultropak • The Ultropak microscope attachment provides a unique illuminating arrangement for opaque subjects with rough surfaces and low reflecting characteristics. In principle it differs from the ordinary opaque illuminators in the manner in which the illumination is transmitted to the specimen. With the opaque illuminator, light is projected through the micro objective onto the specimen and the reflected rays at a similar angle re-enter the same objective, forming the visual image. In the Ultropak the illuminating rays pass (entirely independent of the objective) through a ring condenser that surrounds the objective, allowing the rays of light to reach the specimen with full intensity, eliminating reflections, glare and haze, thus providing use of the full aperture of the objective. A special low-voltage lamp (8 volts, 0.6 amp) provides illumination sufficient for visual observation and photomicrography with the Micro-Ibso. A condensing system within the lamp mounting directs a parallel beam of light rays onto an angular ring-shaped mirror set at 45°, diverting the illumination downward, where it is collected by the ring condenser surrounding the objective and focused on the specimen. The condenser system of the objective is secured to an adjustable ring mounting, which can be raised or lowered in relation to the objective so that the intensity of the illumination can be varied within wide limits to suit the objective used and the specimen under examination. Depending on the nature of the specimen, the illumination may create a great variety of effects; some structures may appear as in a bright field while others may reveal a combined effect of bright and dark fields. The light source is interchangeable with various accessories for other more intense systems, or it may remain intact with the system, as desired. A number of very useful arrangements can be assembled.

20. *(Left)* Diagram of the Ultropak Attachment showing arrangement of its parts and the path of light. *(Right)* Ultropak Attachment connected to the monocular tube, Leica and Micro-Ibso Attachment, on a special heavy stand for photography of specimens in Petri dishes. Note variable transformer and ammeter, allowing adjustment of light intensity required: it can be made lower for viewing and higher for photographic exposures.





21. *(Left)* Diagram showing details of the interior of the Ultropak immersion attachment. *(Right)* Diagram showing details of the interior of the Ultropak immersion cap.

Since the Ultropak images the subject by reflected light, for photographic purposes it may be necessary to employ light sources of greater intensity than those found adequate for work by transmitted light. Incandescent lamps can often be made to emit more light, when used with a variable transformer.

The Ultropak can be adapted to any standard microscope simply by replacing the nosepiece of the microscope with the Ultropak attachment. The Ultropak objectives are corrected for a tube length of 185mm, and since the attachment occupies a position 15mm lower than the regular nosepiece, the correction is automatic for tube length of 170mm, but for microscopes of 160mm it becomes necessary to extend the draw tube another 10mm. Microscope stages equipped with rack-and-pinion movement up and down are preferred, and are especially indicated with the low-power "UO" objectives, since the longer working distance of the latter is such that most microscopes do not permit extension of the tube high enough for focusing the specimen, particularly a thick one.

The outlay of Ultropak equipment should consist of the following: Ultropak attachment, illuminating changing device, illuminating attachment, 3.8x (contains built-in condenser), 6.5x, 11x, 22x, and 50x "UO" objectives, all with their respective ring condensers and immersion attachments. For photomicrography the Micro-Ibso with the Leica may be used. Should you desire to use a strong light source, such as the carbon-arc or high-intensity filament lamps, it is only necessary to unscrew the Mignon lamp mount from the Ultropak body, screw it into the illuminating changing device, secure the illuminating attachment, and direct the path of strong illumination into the latter unit. The changing device is a T-shaped unit providing a swing-out mirror actuated by a cable release to change instantly from carbon-arc to the low-voltage lamp for visual observation when desired.

For satisfactory observation with the Ultropak and immersion attachments, all surfaces of the various elements of the illuminator and observation system must be thoroughly cleaned with lens tissue (dampened with xylol to remove grease smears when present). Even the smallest dust particles and scratches will cause disturbing reflections when you view the specimen against a black background.

Since successful applications of the Ultropak system are closely related to proper adjustment and uses of the various illuminating and optical parts, the detailed procedures outlined in E. Leitz, Inc. literature on the Ultropak should be consulted and carefully followed.

Photomicrographs of bacterial colonies and tissue cultures on opaque media can be made with the 3.8x, 6.5x, or 11x "UO" objectives and 10x periplan ocular with the Micro-Ibso Attachment. For reproductions of individual organisms, the 50x objective is excellent. For rapid biopsy examinations, in many pathological laboratories the Ultropak has replaced the old method of frozen sections. With the polychrome stains it is a very simple and rapid procedure to stain a piece of fresh tissue of any thickness and size for immediate examination. As the majority of tissues stained with polychrome dyes tend to fade in a very short time and are therefore unsatisfactory for permanent mounting, immediate photomicrographs with Ultropak and Micro-Ibso Attachment are used to preserve an accurate record of the microscopic features appearing in the original fresh state. The Ultropak is particularly adaptable to the study and photomicrography of bone sections that otherwise require decalcification and several days' delay before they are conditioned for blocking and microtome sectioning. Bone sections prepared for the Ultropak show a much better preservation of cellular architecture, permitting a more thorough examination and better photographic reproductions.

The Ultropak has special application in connection with the study and photomicrography of the nail-bed capillaries in various diseases that demonstrate early manifestations and structural changes effecting these minute structures. The subject has been extensively investigated by Duryee and Wright, resulting in their recommendation of the Ultropak method of illumination not only for study but also for photomicrography of nail-bed capillaries. Their technique involves gentle cleansing of the finger with soap and water to wash away dead epithelium and dirt. Grease and oils are removed with xylol, and after drying for 15 minutes the area is covered with some bland oil, such as cedar oil, to diminish the reflections caused by the uneven outer layers of epithelium. A green filter (supplied with the instrument) is inserted into the filter slot of the Ultropak to provide contrast. (An infrared filter may be used with infrared film to produce even better results.) A strong source of illumination, such as the carbon arc, is a practical necessity for photomicrographs even though a fast panchromatic film such as Super-XX is selected. A supporting arrangement to hold the finger firmly from the sides is essential to maintain it in a steady position, for even the heart pulsations transmit sufficient movement to cause blurring of the negative image. Since the capillaries expand and contract with

each pulsation, very short exposures—of 1/20 second or less—are required. It is very desirable to make separate exposures of the capillaries during systole and diastole, as a better interpretation of vascular status is afforded by photomicrographs showing the appearance of the vessels under these conditions. The effects of drugs such as vasodilators or vasoconstrictors may yield additional information about the capillaries, especially in hypertensive conditions where the drug responses are observed to be more sluggish than those from normal nail-bed capillaries. Photomicrographs of the capillaries made at a later date for comparison may prove helpful in determining effectiveness of treatment or progress of the disease (See Fig. 17).

PHOTOMICROGRAPHY and MACROPHOTOGRAPHY at VARIABLE MAGNIFICATION

by E. G. Keller

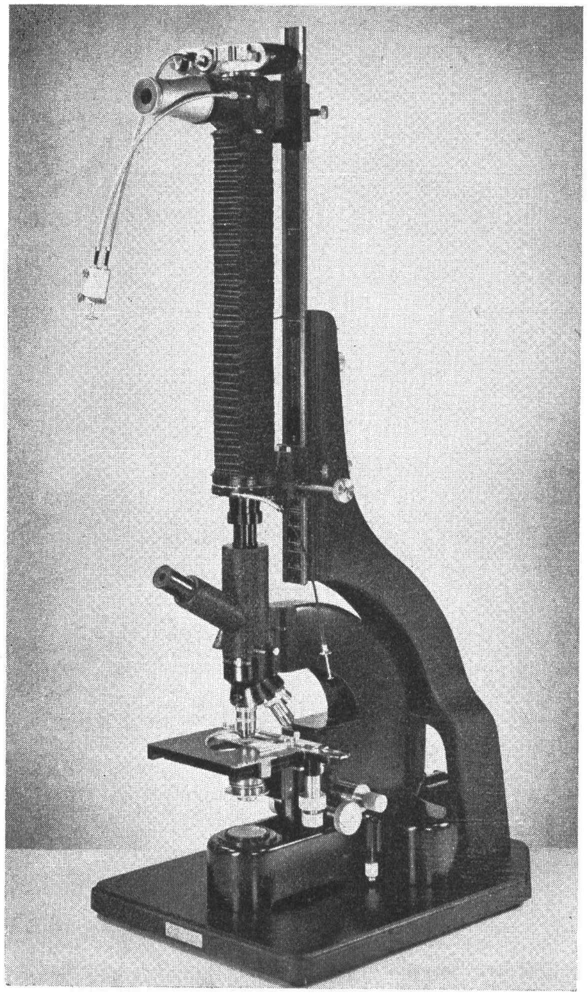
Traditionally, whenever photography with the Leica involved reproduction at high, medium or low magnification, it was necessary to use extension tubes of fixed lengths to provide the required greater than normal lens-to-image distance. Available in a considerable variety of appropriate lengths, these extension tubes could be combined into a total length which more or less provided the desired relationship between the lens and the plane of the film. The inflexibility of such a setup was quite obvious to those who found that any modification of a once established lens-to-image distance required either the addition, removal or substitution of some of the extension tubes.

The Aristophot • The addition of the Aristophot to the list of Leitz photomicrographic accessories helps to overcome this drawback and increases the scope of application of the Leica to the varied needs of the medical, dental and scientific photographer. This instrument, shown in Figures 22 and 23, gives the Leica user the convenience and flexibility of bellows extension, continuously adjustable by a rack-and-pinion mechanism. This arrangement introduces the much needed *variable magnification,* an important feature heretofore available only in larger and much more elaborate outfits.

The Aristophot consists of a rigid base supporting an upright column equipped with rack-and-pinion movements for the bellows, both ends of which ride on dovetailed sliders. The lower end of the bellows is connected to a lens board supporting a compur-type shutter, which will accept either a photographic lens or a light-trapping collar for connecting the bellows to a microscope. The upper end of the bellows accepts either a Focaslide device or a Mirror Reflex Housing, making visual observation or focusing a simple matter.

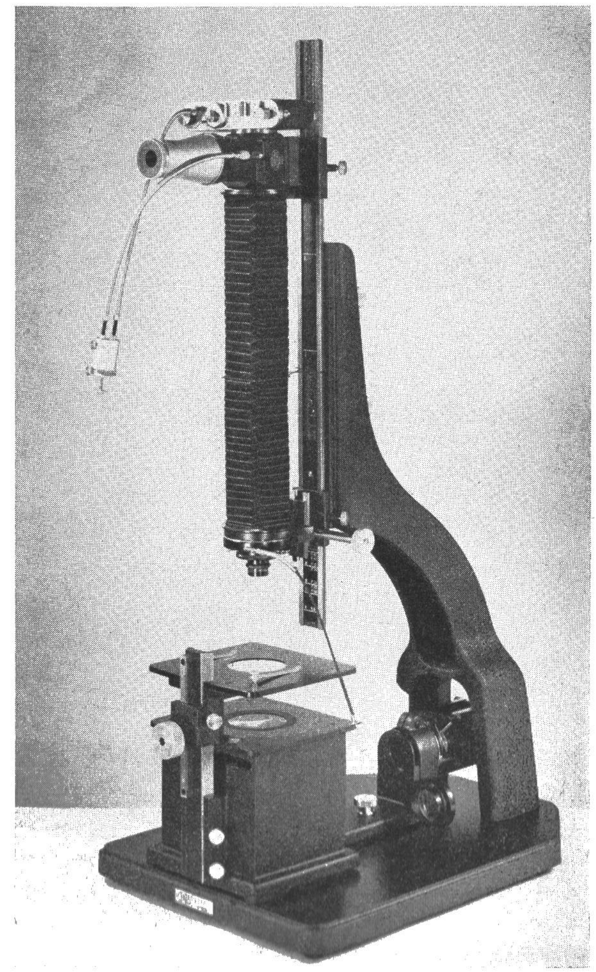
Focusing through the Mirror Reflex Housing is the most efficient and dependable method of arriving at critically sharp focus, regardless of whether the initial magnification of the microscope objective is of low or high order. The microscope image can be observed through a focusing magnifier, or directly on the ground glass exactly as it will appear on the Leica negative. These two methods of image inspection are very helpful: the entire ground glass can be examined for subject arrangement, evenness of illumination and proper exposure determination; or a portion of the ground glass image can be viewed through the focusing magnifier to assure critical sharpness.

The bellows of the Aristophot is actually an extension tube of variable



22. Aristophot with Ortholux Research Microscope, Mirror Reflex Housing and Leica. A rigid upright column supports the camera and bellows, allowing them to slide up and down as a unit for instantly variable focusing.

length. As such, it does not replace any of the Leica photomicrographic accessories, but rather extends and amplifies their usefulness. Thus, for instance, the Aristophot can be used with or without the adapter cone of the Micro-Ibso Attachment. When the latter is used, it offers the advantage of viewing and focusing the subject on both the ground glass of the Mirror Reflex Housing and through the viewing telescope. The bellows extension is capable of producing a magnification on film at least twice that obtainable visually through the telescope. Fixed intermediate adapter cones are available in varying reproduction ratios of 1:3, 1:2, 1:1, and 2:1. Each of these is equipped with its own shutter mechanism and focusing-viewing telescope.



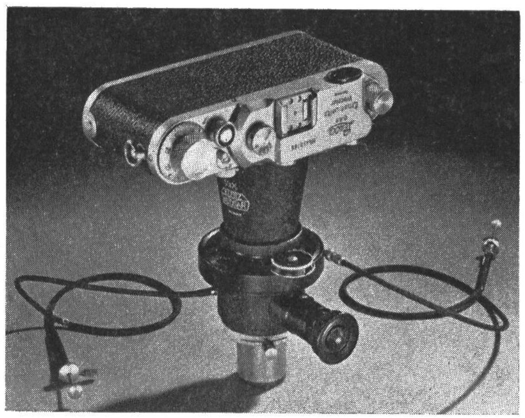
23. Aristophot with stage for macrophotography, Mirror Reflex Housing and Leica. The stage moves up and down by rack-and-pinion to accommodate specimens of varying sizes, and the light source is built in.

Figure 23 shows the Aristophot set up for macrophotography. Here the microscope is replaced by a special stage for photography of large pathological sections and general anatomical views in transmitted light. The stage housing has a built-in 45° reflecting mirror, a stage which accepts interchangeable illuminating condensers to be used with lenses of different focal lengths, and a second stage for supporting the object to be photographed. This stage will accept a variety of interchangeable diaphragms of different diameters corresponding to the different fields of view of the photographic lenses.

The most suitable photographic objectives for this work are the Summar and Milar. Both types are corrected for photography at close range to the subject. The Summar lenses are particularly recommended for color photography, being highly color-corrected objectives ranging in focal lengths from 24mm to 120mm, all having apertures of f/4.5. The Milar lenses, currently available in focal lengths of 65mm and 100mm, also having apertures of f/4.5, are most suitable for general black-and-white photography.

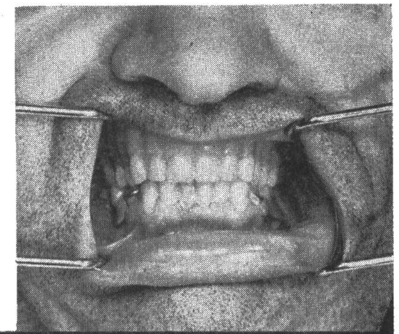
Since the light source of the Aristophot macrophotographic setup is part of the unit, once it is well aligned and centered, it will require no further attention. Survey pictures can be made of objects measuring up to 95mm in diameter, with the proper combination of optical elements and a suitable bellows extension. The object stage can be raised or lowered through a convenient rack-and-pinion movement. This is a great convenience when used with the variable bellows extension, which can be raised or lowered at both top and bottom, since it permits arriving at the point of critical focus by the movement of either the ground glass (focal plane), the lens, the subject, or all of them when dimensional accuracy is of importance.

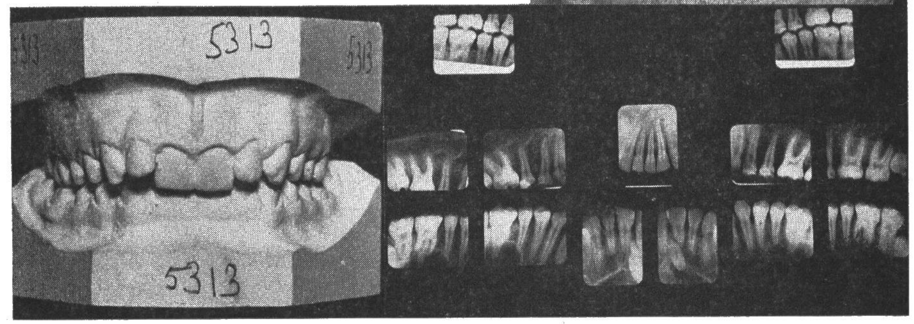
Markings on the column of the Aristophot are useful in positioning the camera and lens for macrophotography, and are important for pre-positioning these components of the setup in photography of subjects of various sizes.



24. Leica and Micro-Ibso Attachment. Side telescope used for visual observation of microscope image. Cable releases activate built-in light-deflecting prism and compur-type shutter which makes actual exposure.

25. Documenting dental case histories with the Short Bellows Focusing Device. The variable magnification feature makes it possible to choose the most advantageous working distance between the camera and the subject matter. Photos by Julius Huisgen.





E. Leitz, Inc. will supply on request a table of lenses, bellows extensions, camera and lens settings for the wide range of reproduction ratios obtainable with the Aristophot.

For those who prefer to determine their own object-to-image distances for macrophotography, the following simple relationships help to establish them approximately:

At a Ratio of Reduction such as 1:5 to 1:2, the *object distance* from the plane of the lens diaphragm is found by adding to the focal length of the lens the product of the focal length multiplied by the reduction factor.

Example: Focal length: 8cm; ratio of reduction: 1:3

$$8 + (8 \times 3) = 8 + 24 = 32 \text{ cm}$$

If the *image distance* from the plane of the lens diaphragm is sought, the focal length is added to the quotient of the focal length divided by the factor of reduction.

Example: $8 + (8 \div 3) = 8 + 2.7 = 10.7$ cm

Where the image is greater than the object, as in ratios 2:1 to 30:1, the *object distance* from the plane of the lens diaphragm is found by adding to the focal length of the lens the quotient of the focal length divided by the magnification factor.

Example: Focal length: 4cm; magnification: 5x (5:1)

$$4 + (4 \div 5) = 4 + 0.8 = 4.8 \text{ cm}$$

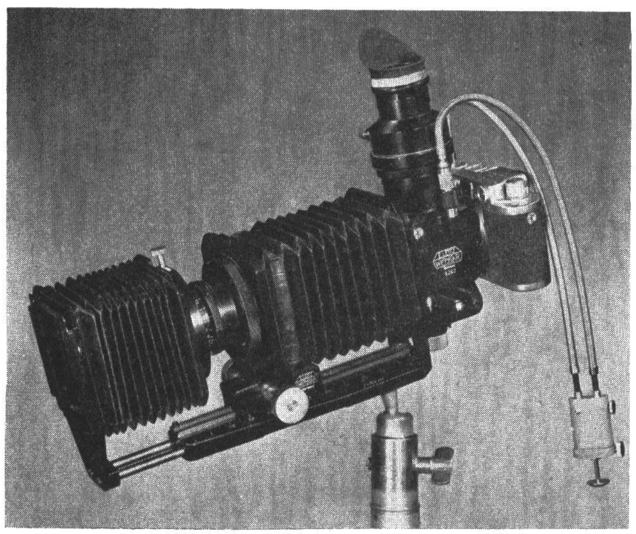
If the *image distance* from the plane of the lens diaphragm is sought in the same example, the focal length is added to the product of the focal length by the magnification factor.

Example: $4 + (4 \times 5) = 4 + 20 = 24$ cm

When the image is the same size as the object (1:1 reproduction ratio), the plane of the lens diaphragm is halfway between them: 2 focal lengths from the image, and 2 focal lengths from the object.

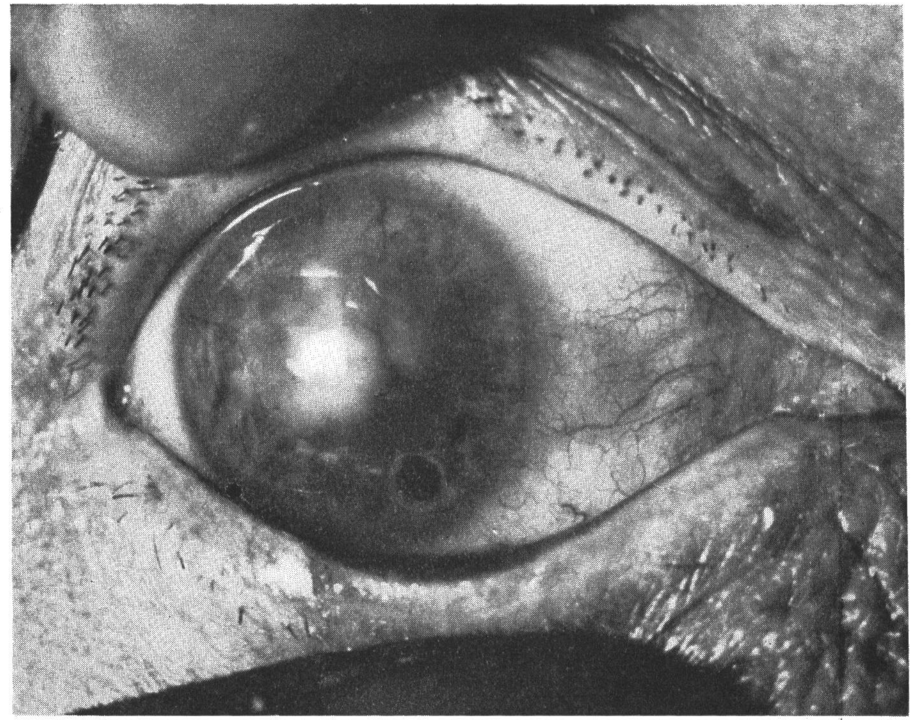
In practice, it will be found that the actual distances will vary slightly from those calculated by the above method, its usefulness being greatest in offering immediate guidance to the approximate placement of all components (the film plane, the lens and the plane of the object) in their relative positions, from which it is simple to bring them into final sharp focus.

Short Bellows Focusing Device • Though similar in principle to the Aristophot, the Short Bellows Focusing Device is intended for different applications. Extending to a maximum length of 6 inches, the bellows is mounted on a metal "foot," and can be smoothly extended or contracted through a rack-and-pinion movement. Again it offers the advantages of an extension tube of readily adjustable length. The Short Bellows Focusing Device can be used with either the Mirror Reflex Housing or with the Focaslide. Optically, it will accommodate either the complete lens unit of the 135mm Hektor Leica lens (which can be readily unscrewed as a unit from its regular mount) or any of the Leica 50mm lenses, the 50mm Elmar f/3.5 being the preferred choice.* With the complete lens unit of the 135mm Hektor, the range of the ratio of reproduction is from infinity to 1:1. When a 50mm lens is used, the ratio of



*All other interchangeable Leica lenses can be used within certain limits.

26. Short Bellows Focusing Device connected to a Leica through a Mirror Reflex Housing. Lens hood and filter holder used with Hektor 135mm lens.



27. Anterior view of a pathological eye condition. Photographed with the Short Bellows Focusing Device and Mirror Reflex Housing for ease and simplicity. Photo from E. Leitz, Wetzlar.

reproduction can be extended from 1:2 to 2.5:1. Numerical designations for the various bellows extension settings for either of the two focal lengths of lenses are conveniently marked on the foot of the device, and are easily read against an index mark engraved upon the slider supporting the front of the bellows. The device is equipped for use with a bellows-like hood and filter holder, and is provided with a threaded base socket for use on a tripod or the ball-jointed tripod head.

These convenient features, combined with the advantages of variable focusing, make it unnecessary to establish or to maintain fixed working distances between the subject and the camera — an inflexible requirement of rigid extension tubes. The Short Bellows Focusing Device is thus particularly suitable for dental and oral photography, dermatological and ophthalmic pictures, and for other branches of medical and surgical photography, where comparatively small areas or small objects are to be photographed "in situ."

For photography of inanimate subjects, such as dental models or casts, moulages, small or large gross specimens, special surgical or therapeutic setups, or for copying of charts, graphs and such, the Focaslide attachment is very convenient when used with the Short Bellows Focusing Device. Though it requires sliding the camera from viewing to taking position and back again, the Focaslide permits more leisurely and frequently more accurate work, especially when exact measurements to definite scale are needed: these can be conveniently carried out on the ground glass screen of the Focaslide.

Complete tables offering detailed data on the various settings of the bellows and the ratios of reproduction obtainable with the two focal lengths of lenses, are available on request from E. Leitz, Inc.

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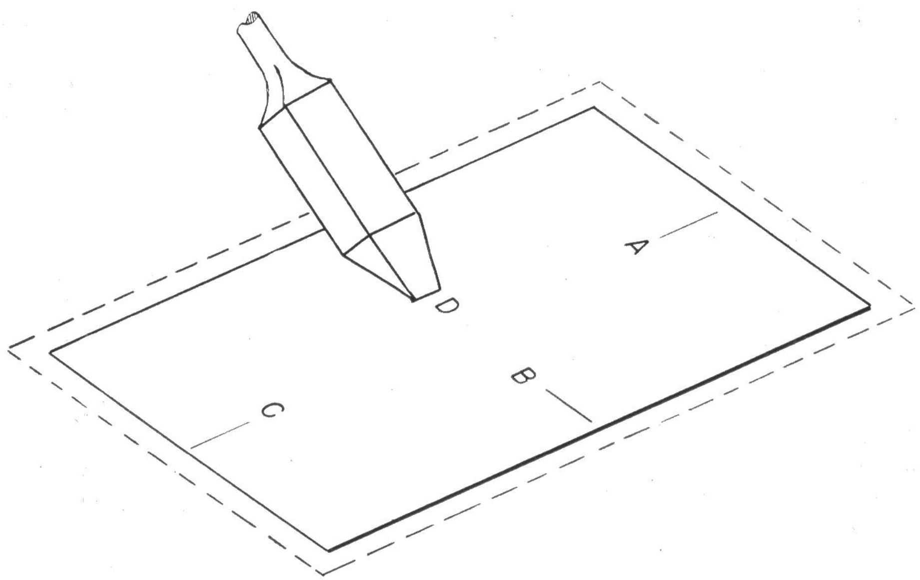


1. Tacking iron used for attaching dry mounting tissue to back of photograph before placing on mounting board. The electrically heated iron is drawn across the tissue at A, B, C, and D. See page 414.

PRESENTING THE PRINT

Spotting, Trimming, Mounting and Display

KONRAD CRAMER

There is a great difference between the appearance of a photograph just out of the dryer, curled up on the table, and the finished print, perfectly spotted and mounted for exhibition. No matter how good the original photographic conception is, the final print will lose impact, or even be a failure, if it is carelessly finished and sloppily presented.

You have washed and dried your print, and must now proceed to correct certain unavoidable blemishes caused by the photographic process. But remember, the cleaner your working habits in making the negative and the print, the less spotting and retouching you will have to do afterward.

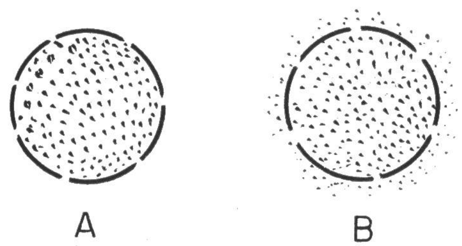
There are generally two types of blemishes. The well-known small white specks are one type — caused by dust particles or scratches and blisters on the negative. These are defects that occur during the developing process. The other type is a kind of disfiguring image that occurred during the taking of the photograph: unavoidable pinpoints of light, or any other visually disturbing object that could not be eliminated from the picture field during the process of exposing the negative. We have all met up with negatives that would have been "perfect" but for telephone wires, stray light bulb reflections, or any one of the many "eye disturbers" that are so easily overlooked during picture taking, and can become so annoying in the finished print. These small imperfections can be readily repaired on the print with the right kind of tools and a certain amount of patience.

Spotting • Spotting tools should be kept very simple — basically a good sable brush and proper ink with a handy receptacle. Most people make the basic mistake of using a very small brush in the belief that a smaller brush will make make a finer point. A good quality sable brush of medium size, such as a No. 6, has just as fine a point as a small No. 2 or 3, and in addition has the great advantage of holding a larger reservoir of ink. I feel that no less than the best round red sable brush you can buy is good enough, and I use a Winsor & Newton No. 6, Series 7.

The great trick in spotting is to condition your brush: it should be neither too wet nor too dry. Once in the proper state of moistness, one filling of the brush will spot many prints. If the brush is too full of moisture, it will deposit little round domes of wet ink that are difficult to manage. If the brush is too dry you will stipple in vain, as the semi-dry pigment cannot make a mark on the paper.

For the actual spotting medium I use the best available Chinese ink in stick form, ground in a small slate receptacle. For spotting matte prints the ink should be ground into water; and to spot glossy prints more readily, a small addition of gun arabic to the water is very helpful. Often in order to match certain tone qualities of a print, small cakes of water-color burnt umber or raw umber can be added to the mixture to produce warmer tones. There are, of course, various prepared spotting inks on the market in black and colors for toned prints. But I feel that the real craftsman or artist will not find them as rewarding as his own carefully mixed medium. I use the thumbnail of my left hand for a palette, a convenient place to recharge the brush with additional ink occasionally.

To charge the brush, fill it two-thirds full with the spotting ink and then on a piece of paper, or on the back of an old print, make long linear brush marks, revolving the brush in your fingers as you make the marks, thus giving an excellent point to the brush. When the excess ink has been worked out of the brush you are ready for spotting.



2. (A) Incorrect way to spot a print. (B) Correct method of spotting a print. See text below for full description.

The ideal form of spotting would be an actual imitation of the silver grain in the print. This, however, is physically impossible; the closest approximation is a series of tiny black or gray dots made with the point of the brush. You will find it much easier to make a little white spot disappear if you use the method shown in Fig. 2B. Note that the small dots not only cover the spot itself, but are also scattered in the area surrounding the spot. The beginner usually attempts to fill the white spot with little black dots as though he were putting apples in a bushel basket. This invariably results in a very obvious margin, (Fig. 2A).

In spotting, it is good practice to focus the eye occasionally on the print as a whole, rather than only on the spot that is being repaired. The amount of pigment deposited on the spots should be infinitesimal. Big blobs of heavy pigment will not produce good results. Sometimes it is better to apply two coats of

dots to an area, rather than covering the area with too dark a mixture in one coat.

Carelessly processed 35mm negatives are sometimes infested with long scratchlike parallel lines that appear in the enlargement as long white streaks. These streaks are the most difficult blemishes to remove. Here, as with small specks, the best results are produced by spotting the white lines irregularly here and there, changing the darkness of the ink as the white line passes through various fields of darkness in the print. But it is simpler to prevent such defects through careful processing and handling, rather than trying to correct the faults in the print. If a large number of prints of a damaged negative have to be made, it is sometimes advisable to spot carefully one master print, from which to make a copy negative. This process is especially indicated when large areas of the print have to be repaired or changed.

Dry Spotting — Etching Out • Occasionally a print will have a number of small dark spots caused by air bells on the negative during development. It is much more difficult to remove the dark spots from a print than the light ones. There are three possible ways of doing this:

1. Remove the silver deposit on the print—carefully—with a very sharp etching knife. Stencil knives or broken pieces of razor blades are ideal tools for this purpose. Your main concern must be to stay on the emulsion surface of the print and not dig into the paper base itself.
2. Mix an opaque white with your spotting color to produce a matching gray. As in all retouching, avoid heavy application of the pigment.
3. When making the print on the enlarger easel, locate the dark spot (which of course in projection will be a light spot) and cover the spot with graphite from a very soft 3B pencil. This shields the emulsion from the light, and the developed print will have a light spot, and be more easily corrected.

Trimming and Mounting • As the print comes from the enlarger, it is surrounded by the white margin left by the enlarger easel. This is usually trimmed off before mounting. It is assumed, of course, that cropping the print for composition has already been done in the enlarging process and will not be done on the trimming board.

The best means of mounting a print on another surface is with dry-mounting tissue, a very thin tissue paper impregnated with shellac-like substance that melts under heat and, under pressure, makes a perfect bond between the two surfaces. There are four steps in the process of attaching the print to the mat with dry-mounting tissue:

1. Attach tissue to back of print with a tacking iron (Fig. 1, p. 410).
2. Trim the print and the attached tissue on the cutting board.
3. With the tacking iron, attach the print with its tissues to the mat.
4. Place print and mat in a hot mounting press.

In step 1 the tacking iron is brought into contact with the tissue in four spots, A, B, C, D (Fig. 1), as the tissue lies on the back of the print. Next, step 2, trim off the overhanging tissue on the cutting board.

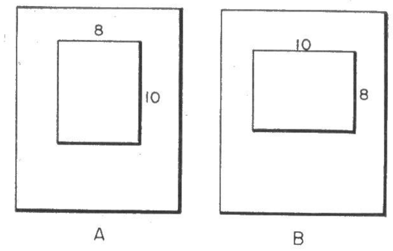
To speed up the work of mounting the print on the mat, cut yourself a number of templates as shown in Figure 3. Take a sheet of medium-weight cardboard, the same size as your mat. With ruler and pencil, carefully lay out the area the print is to occupy, and cut out this area with a sharp knife and a steel straight-edge. You now place one of these templates on top of your mounting board and center your 8x10 print in the opening of the template. This is a quick and accurate method of placing your prints on the mat. (For other print sizes, additional templates will be necessary).

To facilitate the work further, I use a piece of composition board which has a narrow strip of molding attached to two of its sides. (See Figure 4) On this aligning board, two or three mats at a time, together with the templates, are easily aligned against the molding. This prevents shifting of the templates with respect to the mats. Place a small flat weight on your print as it rests in the template.

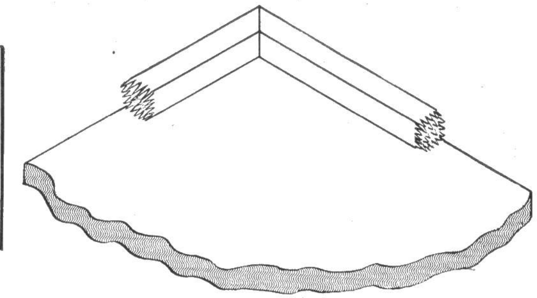
Now we are ready for step 3, tacking the print to the mat. With your left hand, raise one of the corners of the print, leaving the mounting tissue in contact with the mat. Place the hot mounting iron on the tissue, which will then adhere to the mat. Do this in the remaining corners, and the print will be attached sufficiently well to be placed in the hot mounting press.

The hot mounting press is indispensable whenever many prints are to be mounted. It consists of two electrically heated metal platens that are brought together under pressure by means of a lever. Most hot presses have automatic heat control. Where a hot mounting press is not available, prints may be mounted with an electric flatiron. In using a flatiron, several layers of paper must be placed between the face of the print and the iron. If the iron is too hot, the print will not adhere to the mat. If it is too cold, it will also fail to adhere. Do not use the iron as in ironing clothes — that is, going back and forth rapidly — but press the iron down for a few seconds in one spot, beginning in the center of the print. If on bending the mount slightly the edges of the print become loose, apply additional heat and pressure.

Rubber cement can be used in mounting photographs. However, its bonding power is not as strong as dry mounting tissue, and eventually the print may come loose from the mat. There is also a possibility that certain chemicals in the rubber cement will in time discolor the print. However, rubber cement is the cleanest of the mucilage-type adhesives. It must be applied in very thin layers to the back of the print and the face of the mat. Least desirable of the adhesives are the so-called library pastes. They are messy to manipulate, and in time may produce discoloration.



3. Cardboard templates are useful for mounting photographs.



4. A special aligning board is made by attaching strips on a piece of composition board.

Mounting Boards — Mats • We must realize that the basic purpose of a mat is to separate — visually — the field of the photograph from its accidental background. Without the restful border of the mat, the photograph is at the mercy of all the disturbing elements of the background. The mat is like the moment of silence before the orchestra begins to play.

There are two main types of mounting board. The one most widely used, but least desirable, is made of a wood-pulp filler covered on either side with a thin layer of paper. This wood-pulp filler will yellow and become brittle in a very short time and corners of the mat will break off easily. The thickness of the mounting board itself is no guarantee of its quality. For years I have used a rather lightweight but pure rag stock of art Bristol board. Its light weight is not a disadvantage because it is very strong and it does not create nearly the storage problem of the heavier boards.

The surface of the mat should be as plain and smooth as possible. All pebbly finishes, as well as imitations of water-color paper, seem esthetically out of place. As to color, a pure white or slightly off-white is the best choice. Pronounced color in a mat distracts from the quality of the photograph. Simplicity should be the keynote at all times in the selection of your photographic mount. All fancy borders and ornaments are but indications of poor taste.

Undoubtedly, the safest course for the beginner will be to confine himself to a mounting board with a smooth, white, dull finish. The standard exhibition mat size is 16x20 inches. But this demand from "salons" for uniform sizes is more for the convenience of the hanging committee than for esthetic reasons. Some more modern exhibitions have proved that beautiful photographic displays can be arranged with pictures and mounts of various sizes; 4x5 contact prints have been effectively displayed in the same room with nearly life-size enlargements.

Use of the slide-in mount, or double mat, is another way of displaying prints. In this case the print must be mounted firmly on the inside of the mat with an adhesive. Unfastened prints that buckle give an untidy appearance and are not very effective. A handy, commercially available double-mount is called the Redi-Matte, and comes already folded and ruled on the inside for easy cutting.

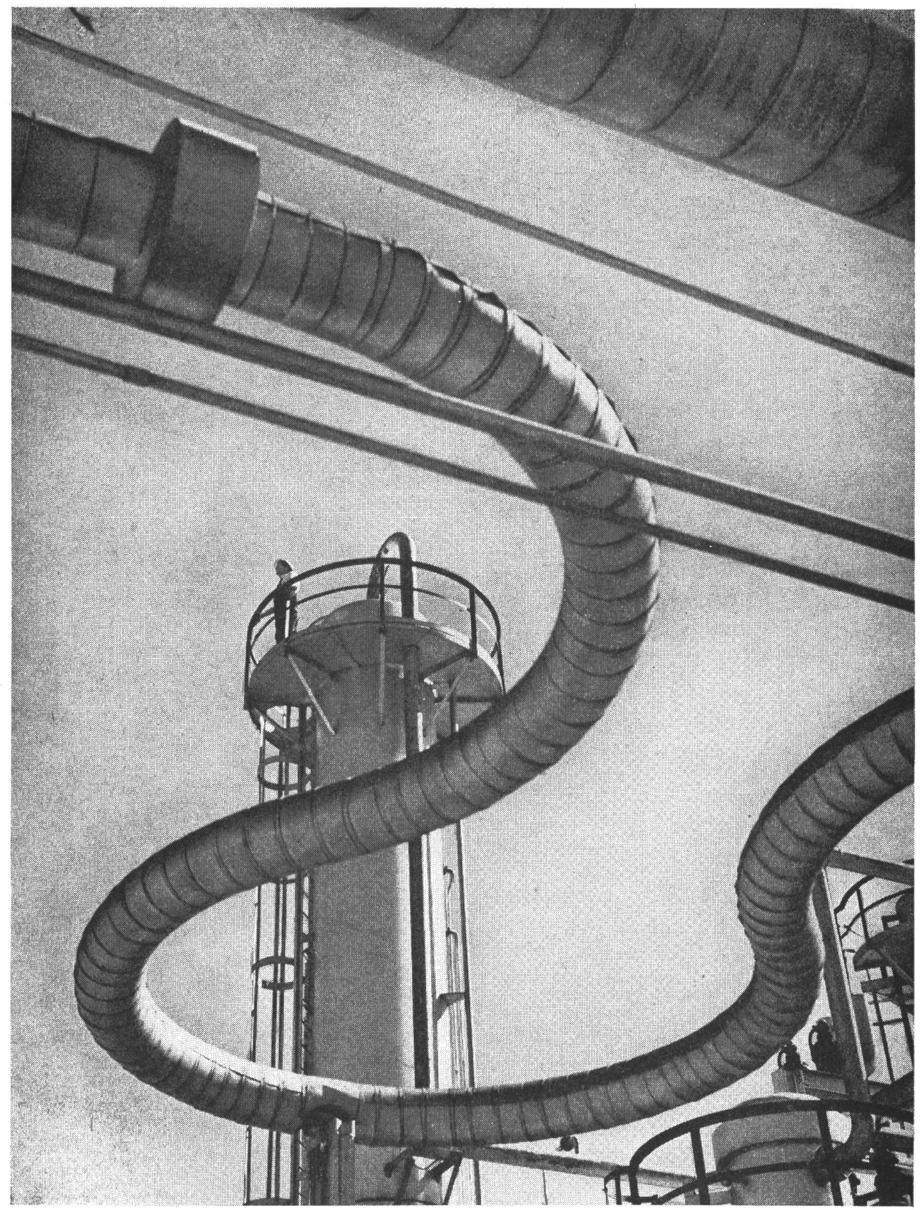
An effect similar to double mounting can be achieved by producing a black margin around the print. This can be done during the enlarging, or by the following mechanical method. The point of a pen with a three section nib (Speedball C-1) is heated over a flame to take the temper out of the steel. With a long-nosed plier, the tip of the right outside section of the nib is bent at right angles. This bent-down portion of the nib serves as the margin guide for the pen. Place the trimmed print over the edge of a table or a book. Fill the pen with India ink, place the two straight nibs on top of the edge of the print and let the third bent-down nib slide along the side of the print. After a few trials this system provides an easy means of placing a black border around a print, even after the print has left the enlarger easel.

Display • Up to now our concern has been mainly with the preparation of the finished and mounted print. But of no less importance are the esthetic factors in the display of a photograph. Some of these factors we have already touched upon. The foremost problem is the proportional balance, *first,* between the size of the print and the size of the mat; *second,* between the print and the margins; and *last,* the balance of the margins themselves. You may choose to mount a strong 4x5 print on a 16x20 mat and it may look wonderful. Another, more delicate print, mounted in the same manner may shrink into insignificance under the weight of the large mat.

Some photographers favor three even margins around a print, with a base margin considerably wider. In the case of a horizontal print mounted on a vertical mat, the bottom margin becomes a problem. If one chooses to leave the three margins at top and sides all the same width, the horizontal print has the effect of floating rather high on the mat. These are purely esthetic problems and definite rules cannot and should not be set up, even by exhibition committees. The picture, and the picture alone, should determine the proportion and the character of its display.

An extension of the idea of mounting the photograph on mat board is framing and mounting the mat under glass. If a photograph is displayed continuously, the protection of a sheet of glass is very desirable. On the other hand, light reflections caught by the glass are sometimes disturbing. In selecting a frame, the same principle of simplicity and genuineness of material should be followed. A light, narrow molding of either white, black or unfinished wood seems to be the most effective. For permanent display, the back of the frame should be sealed tightly, to prevent dust from entering between the print and the glass. Singleweight or doubleweight plate glass is the best material to use.

Another effective way of displaying prints in homes or exhibitions is to place them between two parallel horizontal moldings permanently mounted on a



S CURVE — Esther Bubley

Industrial photographs require a keen eye for making the best composition and at the same time producing an accurate report on the subject. From the Standard Oil Co. (N. J.).

wall. These moldings should have a sufficiently rabbeted space so that a mounted print, with its covering of glass, can easily be inserted between the two moldings. A number of mounted prints can be so displayed that the sides of the mats touch each other, or they may be arranged to leave some spaces between the mats.

Finally, all our valiant efforts to show our photograph with its best foot forward may be completely nullified by injudicious titling and signing of the print. The photographer's name, if he cares to display it on the front of the picture, should be neat and legible, and should at no time intrude itself upon the picture. Overlarge and flourishing signatures executed in dark and heavy inks also become overemphatic. The pseudo-artistic practice of placing the signature within the print area is, to me, the greatest of all these sins. A hard, well-sharpened pencil is an ideal tool with which to place a modest signature under the lower right-hand corner of the print.

Too often titles are hackneyed. Don't try to raise the quality of a photograph by the bootstrap of a corny title. Don't be clever, don't be facetious. If you think a title is necessary for the purpose of print identification, place it discreetly on the back of the mat. Let your photograph speak for itself, without the aid of literature. I have known photographers to spend as much time and thought devising a smart title as they spent making the photograph. I have even known some photographers who start out with a title and make the photograph afterward!

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