THE MINOLTA WAY

CLYDE REYNOLDS

THE BOOK AND THE CAMERA

Just to handle a Minolta SLR is a joy; an invitation to go out and take beautiful photographs. Ever since the introduction of the SR-2 in 1958, Minolta's single lens reflex cameras have offered top quality handling and performance.

Today's line-up includes the innovatory XD-7 (XD or XD-11) which offers the choice of shutter speed priority or lens aperture priority as well as full manual control, the simpler automatic XG-2 (XG or XG-7) and the manual match needle metering SR-T 100X. These cameras, and all the earlier models accept the whole of the enormous range of Minolta lenses and accessories.

The Minolta SLR Way describes the choice and use of Minolta equipment for any type of photography, whether it be in a science laboratory or at a power-boat race. After an introduction to the single lens reflex and a brief resumé of the Minolta SLR, the book discusses in detail film and exposure, portrayal of movement and the use of lighting and colour. It then examines the array of Minolta lenses which is unusually vast and diverse because Minolta is one of the few companies to produce their own SLR lenses right from the glass to the final testing. Finally, the author analyses close-ups and macro work, looks at the smaller equipment and then gives his suggestions for choosing and using the Minolta system. Detailed operating instructions for every Minolta SLR make this book the perfect companion for the Minolta enthusiast.

THE AUTHOR

CLYDE REYNOLDS writes on cameras, photography and the life sciences. He has now been an editor with Focal Press for over five years, previously working with Kodak. Long familiar with the single lens reflex, he has been an enthusiastic Minolta user for many years. He has written nine other books on cameras including the *Focalguide to Cameras* and the *Focalguide to Filters.*

THE MINOLTA SLR WAY

The Minolta SLR
Photographer's Companion

CLYDE REYNOLDS

Focal Press . London

Focal/Hastings House . New York

British Library Cataloguing in Publication Data
Reynolds, Clyde
The Minolta SLR way—(Camera way books)
1. Minolta camera
I. Title II. Series
771.3'1 TR263.M47

ISBN (excl USA) 0 240 51023 2
ISBN (USA only) 0 8038 4717 3

Cover picture by Clyde Reynolds. 75–200 mm *f*4.5 MD Zoom Rokkor at 200 mm. No filter. Automatic exposure on XD 7.

ALL ENQUIRIES
relating to this book or to any photographic problem are answered by post to the Focal Press without charge is a stamped addressed envelope is enclosed for reply.

Printed and bound in Great Britain by
A. Wheaton & Co. Ltd.,
Exeter

Acknowledgements

The author would like to thank Japanese Cameras Ltd; the UK Minolta distributors for their assistance in preparing this book, and for an extended loan of a wide range of Minolta equipment. In particular, he would like to mention David Shaw for his invaluable assistance and unfailingly cheerful and helpful response to repeated queries; Bernard Petticrew of Japanese Cameras London showroom for answering more questions, and for lending scarce items for short periods.

We would also like to thank the Minolta Camera Company Ltd. for assistance with preparing the book, and for supplying all the pictures which do not convey a photographer's credit.

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PHOTOGRAPHY WITH THE SINGLE LENS REFLEX

The 35 mm SLR (single-lens reflex) is the heart of an incredibly versatile photographic system. The viewfinder displays the picture you will get on the film, whatever lens or accessory you mount. Scales and lights or needles show you what exposure you need, and electronic controls make sure that this is the exposure the film receives.

You can set a Minolta XM, XD, XE or XG for automatic exposure, choose a moderate lens aperture, and just point and shoot. You will get accurately exposed pictures of any normal subject. Lining up the needles on an SR-T camera has virtually the same effect.

All the Minolta SLRs are excellent for everyday photography with their standard lens. The 110 SLR is particularly ideal, with its simple loading system and built-in zoom lens.

Accurately recording scenery and events, though, is only touching the versatile abilities of the 35 mm SLRs. The range of lenses stretches from a 7.5 mm fisheye that can 'see' all round, to a 1600 mm mirror lens, that lets you photograph objects so far away as to be virtually out of sight. With easily used close-up accessories, you can photograph things so small that you can barely see.

You are not restricted even to these possibilities, though. You can mount a Minolta SLR on a microscope, telescope, or any other optical instrument you want and photograph things you cannot even see with the unaided eye. The viewfinder still shows you just what you will photograph; the built-in exposure meters of the SR-T models allow simple exposure measurement, and the automatic cameras give you automatic exposure control.

The modern SLR

Of course, like all other modern equipment, the single-lens reflex has gradually evolved. The most important elements in the reflex viewing system—the mirror that reflects the image and the ground-glass screen originate with 18th century camera obscura. Some 19th century hand cameras incorporated the same viewing system; the mirror was moved out of the way with a lever just before the picture was taken.

By putting the shutter release just below the mirror lever, manufacturers made the operation easier. The single-lens reflex (although not known by that name) became a popular form of middle-sized camera—quarter plate especially. Naturally, as films improved, smaller formats came into serious use. So, the principle was applied to smaller and smaller cameras. The design evolved through 6 × 9 cm and 6 × 6 cm roll-film models to the VP Exakta of the mid 1930s. This camera, which took 6.5 × 4 cm pictures on size 127 roll film, was the immediate predecessor of the 35 mm SLR. Within a few years the same manufacturers had introduced the 35 mm Kine Exakta.

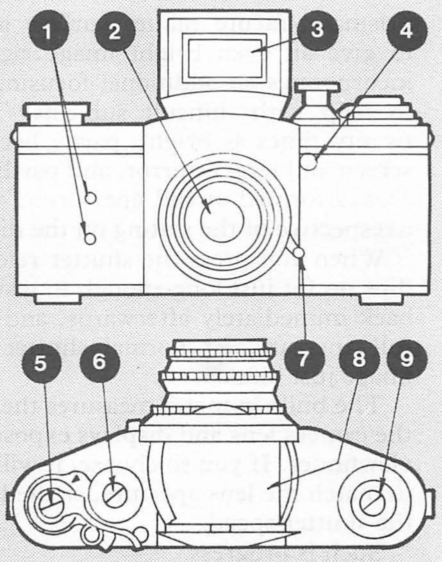
Although taking 35 mm film, and fitted with a focal plane shutter, the Kine Exakta had much more in common with its ancestors than with a modern 35 mm SLR. The tiny image (24 × 36 mm, like the negative) on the plain ground-glass focusing screen was viewed at waist (chest) level for horizontal format pictures; it was reversed left to right, and for vertical format pictures the photographer had to look sideways at an upside-down image. His only aid were a pair of magnifiers; one built in to the focusing screen, and the other in the hood, to make the image appear larger than the film size. The corners of the screen were much less bright than the centre, and the whole image dimmed as the diaphragm ring closed the aperture down directly, just as on an enlarger lens. On pressing the shutter release the mirror flipped up to allow the picture to be taken and stayed up. Winding on the film lowered it again. Until then, the viewfinder was blacked out. Of course, the Kine Exakta had no built-in exposure meter.

Compare that with a modern camera, such as the Minolta XD. A pentaprism on top of the viewing and focusing screen produces an eye-level right-way-round picture for horizontal or vertical shots. The viewing eyepiece enlarges it, so that it appears nearly life-size, with a standard lens on the camera. The screen itself has a

DEVELOPMENT OF THE
35 mm SLR

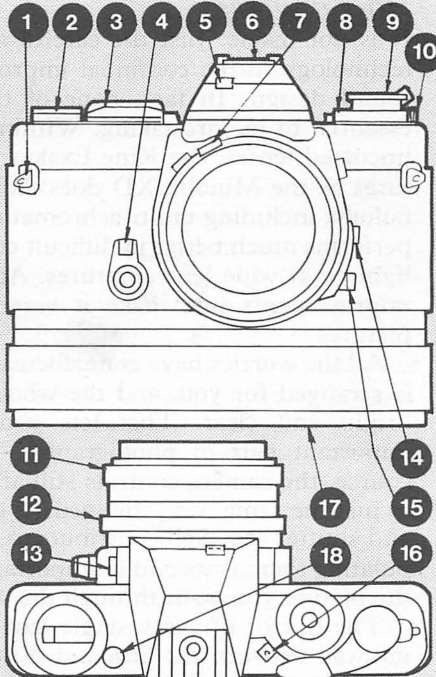
The first 35 mm, the 'Kine' Exakta, derived from the larger format models.

1. Flash contacts.
2. Manual-diaphragm lens.
3. Auxiliary frame view-finder.
4. Shutter release.
5. Film-transport lever.
6. (Shutter speed dial).
7. (Lens release lever).
8. Focusing screen.
9. Rewind knob.



Over the years, the original concept has been refined to produce modern electronic cameras, such as the Minolta XD7.

1. Carry-strap lug.
2. Film-transport lever.
3. Shutter-speed dial.
4. Self-timer.
5. Scale-illumination window.
6. Accessory shoe with flash sync and auto flash contacts.
7. Lens diaphragm coupler (for meter).
8. Film-speed dial.
9. Rewind/back release knob.
10. Exposure-compensation lever.
11. Focus ring.
12. Automatic diaphragm preset ring.
13. Lens-release button.
14. Film flash socket.
15. Stop-down (preview) button.
16. Exposure mode selector.
17. Accessory power winder.
18. Film-speed dial release.



prismatic (acute matte) surface and a condenser lens to give an even bright image right to the corners. It incorporates an additional focusing device in the centre to help with difficult subjects. The image is ten or twenty times as bright, partly because of the improved screen and larger mirror, and partly because the image is always formed at full aperture of the much faster lens, irrespective of the setting on the diaphragm ring.

When you press the shutter release, the reflex mirror flips up for just long enough to take the picture. It drops back immediately afterwards, and the lens opens up to full aperture. At normal shutter speeds, the viewing image just blinks.

The built-in meter measures the light coming through the camera lens and displays exposure information in the viewfinder. If you so choose, it will set the shutter speed to match the lens aperture, *or* the lens aperture to match the shutter speed.

Such is progress.

How it works

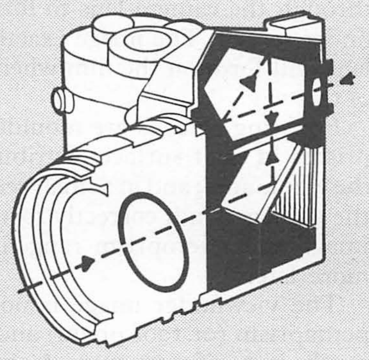
It is not magic. Just the careful application of modern technology to the continual improvement of a basically sound design. In fact, none of the improvements are essential to picture taking. Within the limitations of its uncoated lenses, the Kine Exakta took just as good pictures as the Minolta XD does. With modern lens technology, including multi-achromatic coating, the Minolta performs much better in difficult conditions—against the light or at wide lens apertures. Apart from that, all the improvements just make it very much easier to take pictures.

All the worries have gone, focusing is simple, exposure is arranged for you, and the whole viewfinder image is bright and clear. That lets you concentrate on the important part of photography—creating pictures. Of course, the camera controls still affect your photographs in just the same way; the focused distance, lens aperture and shutter speed all contribute to the final image. Manipulating them is second in importance only to composing the picture you want through the viewfinder.

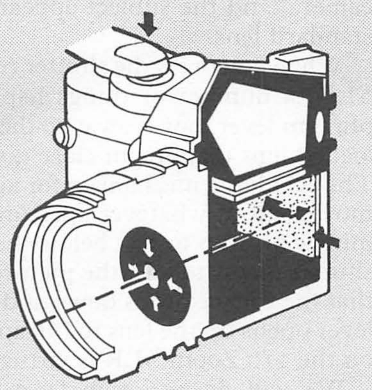
The mirror of every single-lens reflex is sited exactly midway between the film and the focusing screen, at an

HOW THE MINOLTA SLRs WORK

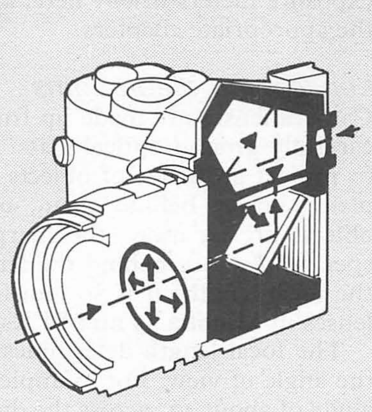
For viewing, the light enters the wide-open lens, and is reflected by the mirror to form an image on the 'ground glass' screen. Above the screen, the pentaprism and eyepiece allows you to see a right-way round and enlarged image of the screen—as if you were working straight through the camera.



To take a picture, the camera closes the lens down to the preset diaphragm setting (or to the required setting with an XD in its shutter-speed priority mode). The mirror moves up, and the shutter allows light to reach the film for a pre-determined time.



Immediately afterwards, whether or not you let go the shutter release, the mirror drops back and the lens diaphragm re-opens. So you regain the viewing image as soon as possible.



angle of 45° to both of them. So it reflects light coming through the camera lens to form an image on the viewfinder screen. The image exactly matches that which the lens will form on the film when the mirror is moved out of the way.

Focusing screens are moulded accurately. Ridges and prisms in their surface distribute the light evenly across the whole area; and in a small central spot, displace it when the subject is not correctly focused. This produces split-image and microprism rangefinders—of which there is more later.

The viewfinder image is normally viewed through a pentaprism (or roof prism) and a suitable eyepiece. The result is as if you were looking straight through the camera, and the subject appears roughly life-size with a standard lens.

When you press the shutter release on a Minolta 35 mm SLR, a number of things happen. The automatic diaphragm lever moves away to the left. This lets the spring-loaded lens diaphragm close down to its preset aperture. The XD has a mechanism for automatically stopping this movement at whatever aperture is needed. The viewing mirror flips up to just below the focusing screen, and the shutter opens to take the picture, then closes again. After that the mirror drops down and the automatic diaphragm lever opens up the lens to full aperture again. The process on the 110 Zoom SLR is virtually the same.

We will discuss each facet of this process, and the exposure meters briefly here, and then in more detail in the appropriate chapters.

Lenses and diaphragms

Camera lenses are made up from a number of pieces of carefully ground optical glass. Their combined effect is to project an image of objects in front of them on to a plain surface behind them, or vice versa. When the objects are far away, the sharpest image is projected a specific distance behind the lens. The distance is called the focal length; it is 50 mm for most current standard lenses in Minolta 35 mm SLRs.

The focal length determines the image size, and thus the angle of view. For example, a 50 mm lens covers an angle of about 47° across the diagonal of the 24 × 36 mm picture format; while a 100 mm lens pictures things from the same standpoint just twice the size, taking in, of course, less—with an angle of 24°.

When the lens is moved further from the film than its focal length, it forms sharp images of nearer subjects. That is why most Minolta lenses are fitted into focusing mounts. You can choose just where you want to focus, down to a preset minimum distance, and see the result on the focusing screen.

If focal length is the primary feature of a lens, its maximum aperture is the next most important. Crudely, it is the size of the hole through which the lens transmits light. To make photographic calculations easier, all ordinary photographic lenses are calibrated in relative apertures, normally called *f*-numbers.

The great significance of them is that at the same *f*-number, any lens, regardless of focal length, transmits to the film exactly the same proportion of light reflected from the subject. This gives you the basis for calculating exposure times with any lens. The aperture setting (*f*-number) ring is connected to an iris diaphragm in the lens. This allows you to choose the size of the hole through which you photograph.

The *f*-number scale runs: 1, 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32. Each one represents a light-passing area of just half the previous number. So, changing say from *f* 5.6 to *f* 8 reduces the light reaching the film by exactly half. Conversely, changing the other way doubles the light passing through the lens. This, of course, is of paramount importance in determining exposures.

Because *f*-numbers are really fractions in disguise, the larger the number, the smaller the hole it represents. No lens has the full scale shown above. The average standard lens has a maximum aperture (smallest *f*-number) somewhere between *f* 1.2 and *f* 2 and a minimum of *f* 16 or *f* 22.

Depth of field

The depth of field is the distance over which you get an acceptably sharp picture. It is of vital importance to your pictures. Sometimes you want it to extend, from a meter or so (a few feet) away to the far distance. At other times you may just want a few centimetres (a few inches) of your subject to be sharp and the rest out of focus.

M.W.—B

The focal length of the lens, its aperture, and the subject distance all affect the depth of field. In simple terms, the longer the focal length, and the closer the subject, the narrower the depth of field. However, the relationship is not entirely straightforward; it is examined in much greater detail in the chapter on *Lenses*.

The lens aperture, though, has a direct effect. From a given distance, with a given lens, reducing (closing down) the lens aperture increases the depth of field. For example, with the 50 mm lens focused on 5 m (17 ft), depth of field at *f*4 stretches from about 4 m (13 ft) to 7 m (25 ft); at *f*16, the depth stretches from about 2.5 m ($8\frac{1}{2}$ ft) to infinity.

Focusing screen

The point of sharp focus is quite easily seen on a 'ground-glass' focusing screen. The lens is normally at full aperture, so its depth of field is at a minimum, and the effect of altering the focus distance is very marked. Despite that, focusing aids are useful, especially in low light, for determining the exact point of sharp focus as quickly as possible.

The standard screen of the more recently introduced Minolta models incorporates a dual focusing aid in the centre. This comprises a split-image rangefinder surrounded by a microprism collar. When a straight edge of an out-of-focus image crosses the split-image wedges, it appears discontinuous. When the subject is exactly focused, the line becomes continuous. The microprism area works in a similar way. Its myriad tiny prisms split the unsharp image in several directions. The result is a shimmer, which stills when the image is focused. Microprism focusing is most useful with mixed subjects, such as trees or fur where there are no obvious straight lines for the split-image wedges to divide.

Instead of a split-image system, the earlier Minoltas have a central microprism spot. The surrounding area is plain etched for fine focusing, unlike most of the screen.

The main area is backed by the concentric rings of a Fresnel condenser which ensures even illumination. On the most recent screens, these are so fine as to be invisible. On older screens, though, they interfere slightly with the most critical focusing.

Shutters

The interchangeable-lens Minolta SLRs have focal plane shutters. The SR and SR-T models have horizontally moving cloth shutters, controlled by a mechanical timing mechanism. The XM has an electronically timed horizontally travelling titanium foil shutter, the XG models have an electronically-timed horizontally-travelling cloth shutter, and the other electronic cameras vertically travelling metal-blade shutters—again electronically controlled.

However they work, camera shutters have the same function: to let the light from the lens reach the film for an exactly measured time.

For all normal photography, these times are small fractions of a second, typically between 1/60 and 1/500. Once again, the nominal speeds are put on a doubling-up (or halving) scale. The commonly available ones are:

1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125, 1/250, 1/500 and 1/1000 second.

As you can see, each is half the preceding one. That conveniently ties in with the aperture scale for calculating exposures.

The automatic Minolta cameras have shutter speeds timed electronically. By coupling the timing mechanism to the exposure meter, the shutter speed is matched automatically to the lens aperture selected appropriately for the brightness of the subject and the sensitivity of the film. The photographic effect, of the shutter speeds, though, is just the same as if they were chosen manually.

Shutter Speeds

To get a completely sharp picture, you need to use a shutter speed fast enough to 'freeze' any movement in your subject. If it is moving at all quickly—traffic perhaps, or an atheltics event, you need short exposures: 1/250 or 1/500 second at least. Normal crowd scenes, slow moving animals, and so forth come out sharp at 1/60 or 1/125 second, and really slow moving things such as snails or still-life scenes, can be shot at really long shutter speeds if necessary.

That raises different problems of movement. If you move *the camera* while the shutter is open, you blur the image. This camera movement blur, commonly called camera shake, ruins millions of pictures a year—mostly those taken with simple cameras, but at least some with sophisticated machines like the Minolta SLRs.

To avoid camera shake with a hand-held camera, keep the shutter on 1/60 second or shorter. For longer exposures, support the camera on a tripod or suitable solid object. Remember, the effect of movement is just the same whether you choose 1/15 second or your electronic miracle sets it for you.

Of course, subject and camera movement can be creative elements in your picture. If they are, well and good; there is a chapter on Movement further on in the book. The thing to avoid is unintentional movement blur.

Exposure

The combination of lens aperture (*f*-number) and shutter speed determines just how much of the light reflected from your subject reaches the film. By adjusting that, you ensure that the film receives just the right amount of light to suit its sensitivity.

Most Minolta SLRs have built-in meters. You adjust them to account for the film's sensitivity (speed), and then they assist you in choosing the correct exposure for the light reflected from your subject.

The add-on meters of the SR models, and the built-in one of the SR-7 tell you what aperture and shutter speed to set. On the SR-T cameras, you adjust the aperture and speed to align a pointer with the meter needle. Either procedure sets the correct combination for the film. It does not, of course, decide on the actual shutter speed and aperture that is set. For example, with normal colour negative film (100 ASA) on a fairly dull day, the film will be correctly exposed at about 1/30 at *f*16, 1/60 at *f*11, 1/125 at *f*8, 1/250 at *f*5.6, 1/500 at *f*4 and 1/1000 at *f*2.8.

It is your selection of the most suitable combination that determines the picture you will get; it is this selection that we discuss at length in this book.

With an automatic camera, you are in just the same position. It makes no difference to the film whether you align two needles, or choose an aperture (or shutter speed) and let the electronics do the rest. All the newer automatic 35 mm Minolta SLRs display the automatically chosen shutter speed in the viewfinder. Most display the

BASIC CAMERA CONTROL

The focal-plane shutter controls the time that light reaches the film. The longer that time, the greater is the blurring if the subject or camera move. The lens diaphragm aperture changes the brightness of the image on the film. It also alters the amount of the subject that is sharply focused (the depth of field).

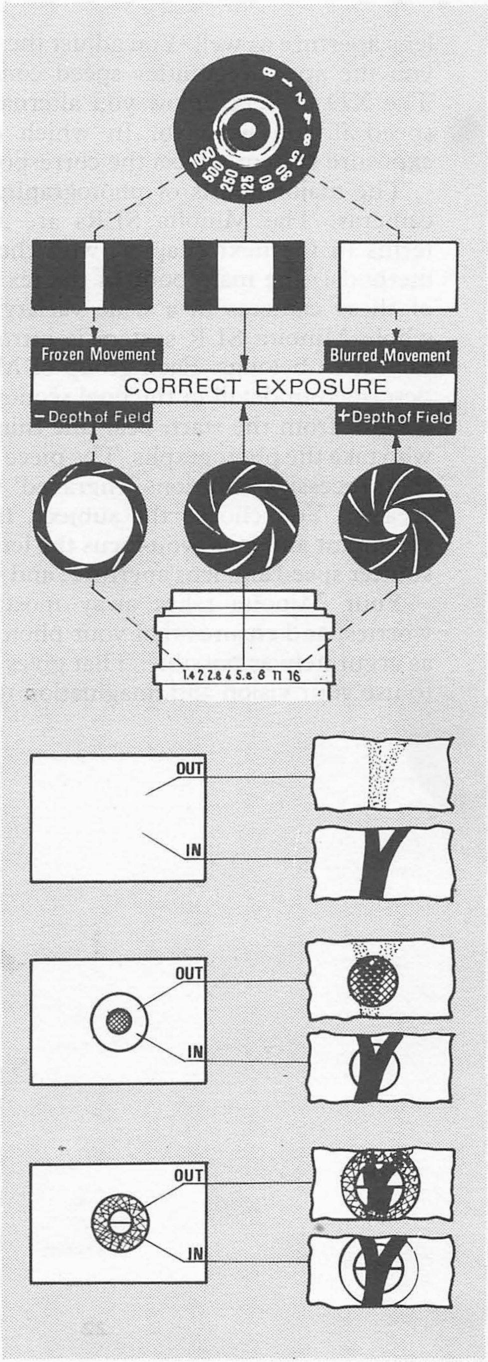
The shutter speed and aperture determine the exposure; but a number of combinations have the same effect on the film. Choose short shutter speeds (and, necessarily wide apertures) if you want to freeze movement. Choose small aperture if depth of field is more important.

The image formed by the lens is displayed on the viewing screen. At full aperture, as it normally is, depth of field is small, so you can see the focus point quite clearly. To speed up operation, though, the Minolta SLRs have focusing aids on most of their screens.

All fine etched and acute matte screens show a sharp or fuzzy image.

The microprism spot makes the out-of-focus image more obvious, and shimmers when the focus is near.

The split-image spot divides the image clearly into two except when it is accurately focused.



lens aperture as well. You adjust the lens aperture to give you the aperture/shutter speed combination you want. The XD cameras allow you alternatively to choose the speed if you want to. In which case, the automatic exposure system selects the corresponding lens aperture.

The major points of photography are common to all cameras. The Minolta SLRs are described in general terms in the next chapter, with their normal operating methods. The main body of the text expands on the use of these cameras in a wide variety of conditions. The whole Minolta SLR system is introduced in the places each item belongs. Each group of Minolta SLRs is then described in detail in the final section.

Right from the start, bear one thing in mind: it is you who take the photographs. The piece of film emerges from the processing solutions 'engraved' with the images you created. You choose the subject, the composition, the viewpoint and lens; you focus the lens; you decide on the shutter speed and lens aperture; and you press the button.

Your Minolta takes away most of the mechanical worries, and ensures that your photographs are recorded as accurately as possible. That gives you the opportunity to use your vision and imagination to create pictures.

MINOLTA CAMERAS

With a few exceptions, the Minolta SLRs have developed in a smooth progression. In this short survey, we note only the new features of each successive model, thus the descriptions are to some extent cumulative. For example, the self-timer is basically the same on all models up to the XE-5; in this case the description relating to the SR-2 applies to them all. Each model is described in more detail at the end of the book.

These final sections on individual cameras show the exact location of each feature, and describe its mode of operation. They also include details of unusual operations—making multiple exposures, shooting through special or different lenses and accessories, and so forth.

The operation and significance of each feature is discussed, too, in the appropriate section of the book. As with any manufactured item, there have been many unheralded changes in Minolta cameras, and some of the new features have been introduced in mid-production run. This is especially so on the SR series cameras.

Since about 1973, Minolta have used different numbers to designate cameras of the same model sold in different parts of the world. Wherever possible, we have devised a single code to denote each type of camera. Thus, the XD-7, XD-11 and XD are covered by the single designation XD. Where this is not possible, we have chosen the 'worldwide' numbering. This is the code used in the largest number of countries including those of Europe, Africa, Asia, South America and Australia, and the one most commonly chosen for English-language publications originating in Japan. For some models, the Japan designation also applies to cameras sold in Hong Kong and Singapore. The numbering is described in detail for each camera in this listing.

Whenever possible throughout the book, information refers to groups of cameras, each of which forms a separate section of the list on the next few pages.

The basic 35 mm SLR features

All the 35 mm Minolta SLR cameras are the same basic shape—a rectangular box with a lens mount on the front, and a more or less pyramid-shaped pentaprism housing on top. The back is hinged to allow loading and unloading. Pulling up the film rewind knob on the left-hand end opens the back.

The film, in normal cassettes, goes in the left-hand end of the camera. It passes across the back and on to the take-up spool. The film transport lever, on the top right of the camera pulls exactly one frame of film across at each full stroke. It is interlocked with the shutter release (which is in the hub of the winder on most models) so that you can take only one picture on each frame of the film; and cannot wind on until you have taken the picture.

After the film is finished, it is wound back into its cassette. To release the transport, you depress the button in the camera base. Then you wind the film back with the rewind knob, folding out its crank to do so.

The top of the cameras also carries the shutter speed dial (between the transport lever and the pentaprism housing) and the frame counter (on the right-hand end in most models). The exposure meter controls, too, are on the camera top. These vary from model to model.

The camera front carries the lens mount. This is the Minolta bayonet.

To remove a lens, you depress the release button which is above the lens on the rewind side of the mount; turn the lens about one-seventh of a turn counter clockwise (looking at the camera) and lift it out. To replace a lens, line up the red dots, or beads, drop the lens into the mount, and turn it clockwise until it clicks into place.

Below the lens lock button are situated one or two flash terminals. At the bottom on the other side of the lens mount, most models have a depth-of-field preview button. Above that on the camera front is the self-timer lever.

Standard lenses

All the Minolta SLRs, equipped with focal-plane shutters, offer full lens interchangeability. Most of them are sold with a 'standard' lens of between 45 and 58 mm. The choice of exact focal length and maximum apertures has varied through the years. Most, though, have been 45, 50, 55, or 58 mm; f 1.2, f 1.4, f 1.7, f 1.8, f 1.9 or f 2.

Until the introduction of through the lens metering (with the SR-T101) the lenses were Auto-Rokkors. These have the facility for fully automatic diaphragm operation. The MC-Rokkor lenses that came next have a meter coupling pin to allow full aperture exposure measurement. These lenses were then superseded by the MD-Rokkors. In addition to the meter coupler, the MD-Rokkors have an extra pin for the shutter speed priority automatic exposure system introduced with the XD-models.

SR-models

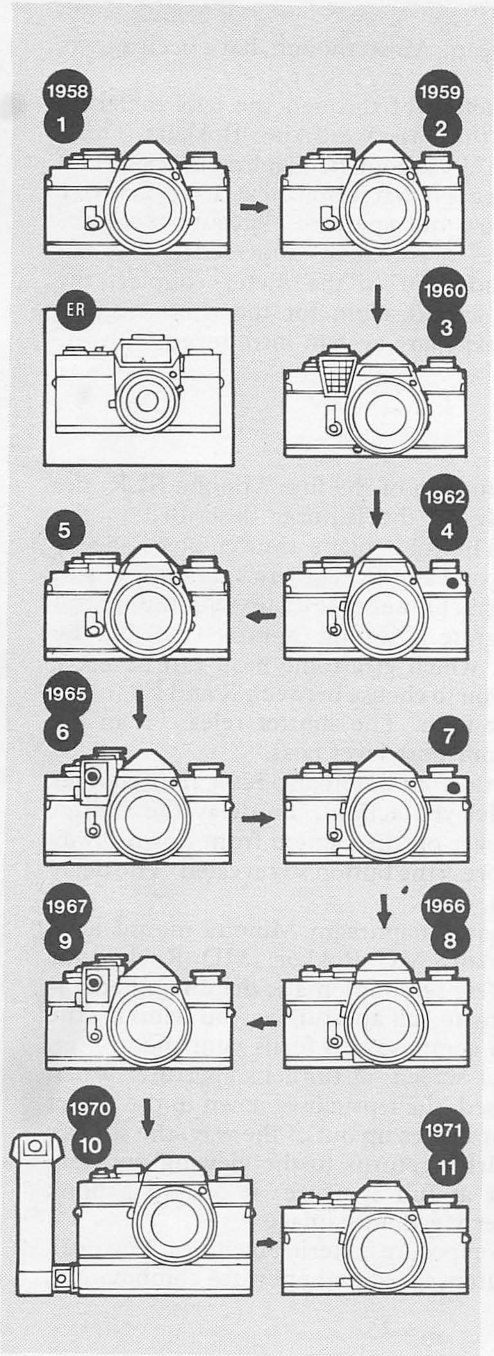
1958 saw the introduction of the first Minolta SLR, the SR-2, with basically all the features described in the previous chapter. The focal plane shutter gives speeds from 1 to 1/1000 second and B, set by raising the dial and turning until the correct number lines up with the central index. It has a separate X setting (approx 1/50) for the maximum speed at which electronic flash can be used. Two sockets allow you to choose between X and FP (bulb) synchronization for flash. The shutter release is in the centre of the film-transport-lever boss.

The camera features an automatic-reset film counter and a self-timer (delayed action). To delay the shutter release, push the lever on the camera front down (away from the lens) and press the button so revealed. The delay is about 10 seconds.

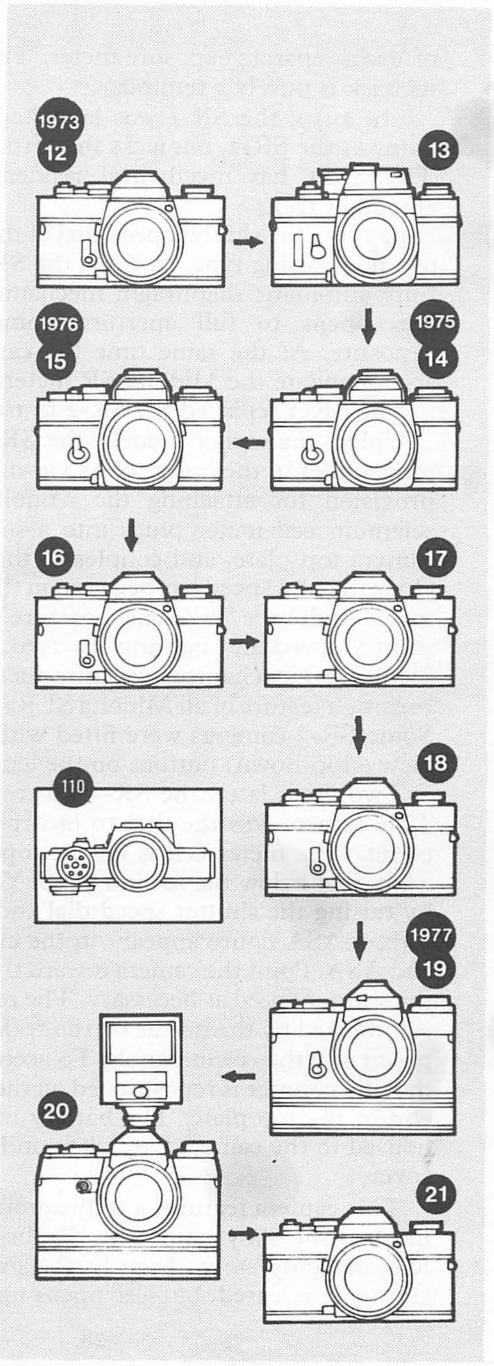
With any automatic diaphragm Minolta mount lens, such as Auto-Rokkor, MC Rokkor, MD Rokkor, or Celtic, the SR-2 offers semi-automatic diaphragm operation. The lens opens to full aperture as you wind on the film. You can then compose and focus your picture (on the plain viewfinder screen) at full lens aperture. When the shutter is released, the lens closes down to the preset aperture, the mirror moves up out of the way, the shutter is fired and the mirror returns to the viewing position. The effect (except at full aperture) is one of a blink followed by a darker viewfinder image.

The SR-2 has no exposure metering facilities. You need to estimate the shutter speed and aperture combination,

THE MINOLTA SLR MODELS



1. SR-2.
2. SR-1.
3. SR-3.
4. SR-7.
5. SR-1.
6. SR-I(V).
7. SR-7(V).
8. SR-T 101.
9. SR-IS.
10. SR-M.
11. SR-T 100.



12. SR-T 303.
13. XM.

14. XE1.
15. XE5.

16. SR-T 303b.
17. SR-T 101b.

18. SR-T 100b.

19. XD-7.

20. XG-2.

21. SR-T 100X.

or use a separate exposure meter. The film speed dial on its back is purely a reminder.

In 1959, the SR-1 was launched. It is basically the same as the SR-2, but lacks the 1/1000 second top speed. The SR-1 has mechanical refinements, leading to a smoother feel.

In 1960, the shutter speed dial of the SR-1 was changed to a non-raising type. In 1961, the SR-1 was fitted with a fully automatic diaphragm mechanism; with which the lens opens to full aperture immediately after each exposure. At the same time the camera was altered to accommodate the Minolta SR meter.

The SR-3 replaced the SR-2 in 1960.

Unlike the earlier models, the SR-3 has a split-image rangefinder in the centre of its viewing screen. It also has provision for attaching the Minolta SR meter. This selenium cell meter plugs into a socket in front of the camera top plate, and couples to the shutter speed dial. Once the film speed has been set on the dial at the side, the meter indicates the lens aperture appropriate to the shutter speed and lighting. In 1961, the fully automatic diaphragm mechanism was introduced to this model, and became a feature of all Minolta SLRs produced thereafter. Some SR-3 cameras were fitted with depth-of-field preview (stop-down) buttons on the lens.

Two years later, the SR-3 was replaced by the SR-7. This camera was the first to incorporate a built-in CdS meter. The meter cell is on the top edge of the camera front, just below the rewind knob. You set the film speed by raising the shutter speed dial and turning it until the correct ASA figure appear in the cut-out between 1000 and ASA. Point the camera toward the subject, and adjust the shutter speed as necessary. The required lens aperture is indicated by the needle on the scale between the pentaprism and the rewind knob. To accommodate the meter, the film counter is repositioned on the extreme right-hand end of the top plate. The battery to power the meter is housed in the camera base plate under a machined screw cover.

This camera features a fully automatic lens diaphragm mechanism. Any automatic diaphragm Minolta mount lens not only stops down to the preset aperture as the shutter is released, but also opens up again to give a fully bright viewing image immediately the shutter closes. The viewfinder incorporates a microprism focusing aid in the centre.

The SR-7 introduced the mirror lock to Minolta cameras. The ridged button on the side of the lens mount turns clockwise to raise the viewing mirror, and counter-clockwise to lower it again. This is essential when using old 21 mm lenses. These lenses protrude too far into the camera to allow the mirror to work normally. They are supplied with a separate viewfinder, which fits into the accessory shoe.

At about the same time the SR-1 was updated. The new model closely resembled the SR-7, with its film counter on the right-hand side. The Minolta SR-Meter 2 is the CdS cell meter that was made for this model. It operates in the same way as the earlier meter, but of course needs a battery.

In 1965 the body shape of the SR-1 and SR-7 was changed. Gone was the slight step at each end of the top plate. The round viewfinder eyepiece was replaced by a rectangular one that accommodates series-V accessories; including an accessory shoe, right-angle finder and critical focusing magnifier. The shutter speed index is at the side of the pentaprism, not in the centre of the dial as on earlier models. The new cameras are called the SR-1 (model V) and SR-7 (model V). The SR-1 (model V) has a mounting shoe for the Minolta SR-Meter V. This works just like the SR-Meter 2, but cannot be interchanged with it. Both the model V cameras have mirror locks. Instead of only at the separate X setting, electronic flash can be used at all shutter speeds up to 1/60 second. Both these cameras closely resemble the following SR-T series cameras.

The last of the conventional SR cameras, the SR-1S was introduced in 1967. This camera is very similar to the SR-1 (model V), and uses SR-T101 components whenever appropriate, and has a top shutter speed of 1/1000 second.

The SR-M is a motorized SR camera, introduced in 1970. The motor is permanently fixed to the camera base. It can be coupled to a battery grip or operated from a remote power source. The SR-M has no meter nor has it provision for attaching one.

SR-T cameras

Developed directly from the SR cameras (model V) in 1966 the SR-T101 introduced through-the-lens metering. Twin CdS cells in the viewing prism measure the light level on the focusing screen, and display it on a needle visible in the viewfinder. Setting the film speed (by raising and turning the shutter speed dial), changing the shutter speed, or altering the aperture of a meter-coupled (MC or MD) lens moves a ring-ended follower which is also visible in the viewfinder. Aligning this with the meter needle sets the camera to the metered exposure. A scale below the viewfinder image shows the shutter speed chosen.

The meter works at full lens aperture with all meter-coupled lenses. It works at the picture taking aperture with non-coupled lenses and accessories without making any change to the camera.

This makes exposure setting a simple operation in most conditions. You simply choose a suitable shutter speed, point your camera toward the subject, and alter the lens aperture to match the follower to the meter needle. The camera measures the light from your picture area, whatever lens you are using. Of course, there are times when a straightforward meter reading is less than ideal. We discuss these in detail in the Chapter on *Exposure*.

Externally, the SR-T101 differs from its predecessors in the shape of its pentaprism housing (to accommodate the meter cells) and in its fixed accessory shoe. The meter switch on the base plate includes a battery check (BC) position.

The SR-T101 remained virtually unchanged in operation for more than 10 years; but cameras since 1975 have no mirror locks.

The SR-T101b differs in that its accessory shoe has a contact for cordless (hot-shoe) flashguns. The SR-T101b is called the SR-T201 in North America, and the SR-101 in Japan. The final production cameras from 1977 have no FP (bulb) flash contacts.

The SR-T100 is a simpler version introduced in 1971. It has a top speed of 1/500, and does not display the shutter speeds in the viewfinder. No SR-T100 cameras have a mirror lock or a self-timer. The SR-T100b (SR-T200 in North America) from 1975 on has 1/1000 second top speed; it is otherwise the same. The SR-T100X has in addition a flash contact in the accessory shoe, but no FP contacts.

The SR-T303 introduced in 1973, has all the SR-T101 features, with the addition of a viewfinder display of the (preselected) lens aperture. In the centre of the focusing screen there is a split-image rangefinder, surrounded by a ring of microprisms. This gives you a choice of focusing method. The SR-T303 has a simple mechanism for making double or multiple exposures, and a 'hot-shoe' flash contact. The SR-T303 is known as the SR-T102 in North America and the SR-T Super in Japan.

The SR-T303b, SR-T202 in North America, SR-505 in Japan, introduced in 1975 has in addition a safe-load indicator to show whether the film is being transported correctly. As with the SR-T101, only those cameras made before 1975 have a mirror lock, and the latest (1977 on) SR-T303b has no FP (bulb) flash contacts.

XM cameras

The XM, XK in North America, and X-1 in Japan, Hong Kong and Singapore, introduced in 1973 uses electronic shutter timing. Combined with a suitable pentaprism (Auto-Electro or AE-S) provides fully automatic shutter speed selection. The XM offers a choice of viewfinders.

The normal fitting is the Auto-Electro Finder, which offers pentaprism viewing coupled with fully automatic shutter speed selection operated by its built-in CdS meter. The shutter speed is displayed by a needle moving against a scale. Of course, the reading takes account of the film speed, lens aperture setting and light from the subject.

When the shutter dial is set to AUTOMATIC that is the speed the camera sets. The prism display indicates this with a grey needle, set on A at the bottom of the shutter-speed scale. When a manual shutter speed is selected, the needle moves to that speed, allowing the camera to be used for match-needle metering as well as fully automatic operation. For a short while a manual-exposure only match-needle prism was also available for XM.

The AE-S finder has the same function as the Auto-Electro finder. The meter cell, though, is silicon, not CdS; and the shutter speed display is by LED on an illuminated set of figures, from 1/2000 to 1/30 second. For slow speeds, a second set of figures are brought into operation. These light up individually to show the automatically set speed. This viewfinder is especially intended for the XM Motor camera because it can respond to changing light fast enough to keep up with the 3.5 frames per second maximum shooting rate. The AE-S finder, though, is perfectly suitable for the ordinary XM.

The fourth pentaprism finder has no built-in meter. The camera with this prism is entirely manual in operation, just like an SR-1. All the prism viewfinders display both the shutter speed selected and the lens aperture beside the viewing screen.

The main advantage of the XM is that it allows you to view the screen directly when you want to. The waist-level finder has a hinged hood. To raise it, pull it up with the button at the back. For critical focusing, press the button to raise the focusing magnifier.

The waist-level viewing is just like a brighter version of the view on one of the original Kine Exakta SLRs. It is, though, particularly good for tripod use, and makes it much easier for spectacle wearers to view the whole composition at a glance. The additional advantages of any low-level or overhead viewing, and convenience on a microscope stand make this a highly desirable piece of equipment.

For really critical focusing, you can use the high magnification finder. This allows you to see the whole screen at a magnification of more than six times. This finder has the same reading characteristics as the waist-level finder (reversed image and bent head viewing) but is not so convenient on a tripod. It is, though, by far the best way of focusing through close-up equipment, microscopes, telescopes and at any time that the focusing image is very dim.

Because the meter prisms are an integral part of the Thus, all the alternative finders have a shutter speed dial. The focusing screen is also interchangeable, so you can choose the focusing aid you like best for any particular job.

The shutter of the XM travels horizontally. Its blinds, though, are not cloth, but titanium foil. It is electronically timed to give speeds between 1/2000 and 16 second. The automatic exposure prisms set the speeds steplessly from 4 seconds (AE finder) or 8 seconds (AE-S finder) to 1/2000 second. The shutter and the meter prisms are powered from batteries in the camera base. The camera is switched on either with the pressure switch on the front panel beside the self-timer or with the switches on the meter prisms. The non-metering viewfinders 'automatically' switch on the camera power when they are fitted. In the absence of battery power, the camera will work on B or X (1/100 second).

The XM-Motor (XK-motor or X-1 motor) is an XM with a built-on motor drive. It can be powered from a screw on battery pack, or from remote power sources.

XE cameras

1974 saw the introduction of the Minolta XE-1, called the XE-7 in North America, and the XE in Japan. This camera differs from all the SR and SR-T models, most dramatically in its shutter which has electronically timed vertically running metal blades instead of the mechanically timed horizontally running cloth blinds of the earlier designs. Thus, the XE uses some, but not all, of the features of the XM with Auto-Electro Finder.

The shutter dial has, as well as the customary 1 to 1/1000 second and B positions an AUTO setting. In this position, the camera automatically sets the shutter speed to suit the light, film speed setting and lens aperture. In place of the follow pointer of the SR-T models is a shutter speed scale. Thus, the meter needle indicates (in the viewfinder) the automatically-set shutter speed. The figures 2S and 4S indicate whole seconds, showing that the shutter speed range is longer than that on an SR or SR-T camera. The automatically-set shutter speeds are not confined to the normal steps. The shutter gives exactly the time determined by the meter, 1/48, or 1/732 second, for example.

For all normal photography, you can focus your camera on the subject, and alter the lens aperture until you have a suitable combination of aperture and shutter speed. Like the SR-T303, the XE-1 displays the selected lens aperture in the viewfinder. The meter works equally well at full aperture with meter-coupled lenses, or stopped down with coupled or uncoupled lenses or accessories.

Naturally, the lens aperture and shutter speed have just the same effect in an automatic camera that they have when you select them manually. If you select too small an aperture for the conditions, you get a long shutter speed. If it is 1/30 second or longer, you are in danger of camera shake, see the chapter on *Movement and the Camera*.If the needle indicates more than 4 seconds, the exposure is unlikely to be correct. If on the other hand you choose so large an aperture that the needle goes beyond 1/1000 second, the exposure will then be wrong also.

The shutter dial can be turned away from AUTO to any of the marked shutter speeds, in which case the chosen speed is indicated in a small window above the focusing screen of XE-1 viewfinder. The meter needle continues to indicate the measured shutter speed. The manually chosen shutter speeds are electronically timed. So the camera needs a battery for manual as well as automatic exposure. Without a battery, you can use only X, the electronic flash speed, which is about 1/90 second, or B. The camera is turned on or off with the switch on the back to the right of the eyepiece.

The main external development on the XE-1 is the removal of the film speed dial to a new position around the rewind knob. To set the film speed, you depress the lock button (between the dial and the pentaprism housing) and align a suitable speed with the white index on the top cover. Combined with the film speed dial is a ±2 stop exposure compensation mechanism. To deliberately give more or less exposure than the meter suggests, you can press a button on the edge of the rim and turn it so that the index aligns with the figures +2, +1, −1 or −2. The +1 or +2 settings give more exposure, as you may need for backlit subjects, and −1 and −2 less, for spotlit subjects. Note that this dial should be set to 0 for all normal subjects, and when adjusting the film speed.

The XE-1 has a multiple exposure switch just in front of the film-transport lever, and the frame counter is combined with the safe-load indicator on the back of the camera, next to the on/off switch. The viewfinder is fitted with a blind to prevent light entering the eyepiece affecting automatically timed exposures when the camera is used away from your eye (with the self-timer, for example).

The blind is moved by the small switch to the left of the viewfinder.

A simple version, the XE-5, was introduced in 1975. This model lacks the multiple exposure mechanism, the lens aperture or manual shutter speed display in the viewfinder, the viewfinder eyepiece blind and the safe-load system. The shutter is X-synchronized for electronic flash only; otherwise it operates like the XE-1.

The XEb sold in Japan only has the XE-5 features. In addition is has the multiple-exposure ability of the XE-1.

XG cameras

The XG-2, XG-7 in North America, XG-E in Japan, introduced in 1977 offers facilities very like those on the XE-5 and is basically similar to use. It is, though, built into an entirely new body, considerably smaller and lighter than any previous Minolta SLR. The XG-1 is a simpler model offering similar facilities.

The film speed setting is on the shutter dial. Raise the rim to set the ASA rating in the cut-out. For automatic exposure, set the A to the white index. To compensate for special conditions you can choose +2, +1, −1 or −2, just as on the XE cameras. On the XG, though, you move the shutter dial until the A is against the compensation factor that you need. To turn the dial, you must press the release button beside it.

Just touching the shutter-button switches on the exposure system when the camera is set for automatic exposure. Then the automatic shutter speed is indicated in the viewfinder by an LED (light-emitting diode) lighting against the scale (not by a needle as in the XE-5). Neither the lens aperture, nor the manually chosen speed is indicated in the viewfinder. For manual exposure, you must read the shutter speed from the viewfinder scale with the camera set to A, and then set the figure you need on the shutter speed dial. The electronically timed, horizontally running cloth shutter offers a range of 1 to 1/1000 second on either manual or automatic exposure. Over or under exposure is indicated by the top or bottom LED lighting. When the top (under-exposure) LED lights, the shutter release locks, preventing wasted film. The camera cannot be used without a battery.

The XG is switched on or off by rotating the dial surrounding the rewind knob. Turning this to BC lights the indicator on the camera front if the batteries are in good condition. Turning it to SELF-TIMER delays the shutter release by about 10 seconds. The same indicator light flashes during the delay period, speeding up about $2\frac{1}{2}$ seconds before exposure. The shutter release is electromagnetic. It needs much less pressure than do the mechanical buttons fitted to SR, SR-T, and XE cameras.

The XG has no depth-of-field preview (stop-down) facility. It has the safe-load indicator, and the hot shoe has a special extra contact for the Minolta Auto-Electroflash 200X. This flashgun automatically sets the shutter speed to 1/60 second and lights a viewfinder indicator when the flash is ready to fire.

The Auto-Winder G fits directly to the XG. It offers powered shooting in single frames or at a continuous rate of up to 2 frames per second.

XD cameras

The XD-7, XD-11 in North America, XD in Japan, is much like the XG in appearance, though it is considerably more versatile. The XD-5 offers the same operation, but is somewhat simplified. The XD meter uses a silicon cell, which reacts virtually instantly—so fast that it can measure as the lens diaphragm stops down, and arrest its movement at a measured light intensity. This allows the basis for a second automatic exposure system—shutter speed priority.

On the XE and XG cameras, the camera sets the shutter speed as you alter the lens aperture. On the XD, that can happen if you wish. Alternatively, you can set the shutter speed, and allow the meter to set the lens aperture. The choice is indicated by a switch between the shutter speed dial and the pentaprism: A for aperture priority, like the new feature; or M for manual control, like all the previous Minolta SLRs.

Set to A, the XD-7 viewfinder displays the chosen lens aperture and a shutter speed scale, just as the XE-1 does. The XD-5 shows just the shutter-speed scale, like the XE-5. The automatically set shutter speed is indicated by a LED lighting against the nearest figure. Set to M, it shows the same meter read-out, the aperture, and the speed selected with the shutter speed dial.

When the camera is set to S with an MD lens fitted, the viewfinder scale changes to show lens apertures. In this mode, you must select the minimum aperture on the MD lens. This shows green in the XD-7 viewfinder, the this mode, you must select the minimum aperture on the MD lens. This shows green in the viewfinder, and the shutter speed is shown, just as with manual operation. This time, though, the LED shows the aperture to which the lens will stop down. Note that the shutter speed priority exposure automation is intended for use only with MD-coupled lenses. With MC-coupled lenses, you can use the normal aperture priority mode. This also works with non-coupled lenses and accessories, but they do not indicate the shutter speed at full lens aperture.

As on the XG, if you go outside the shutter speed range in the aperture priority mode, the top (overexposure) or bottom (underexposure) LED lights, and you get an incorrect exposure. In the shutter speed priority mode, on the other hand, the camera compensates. For example, suppose you have chosen too long a shutter speed for the conditions. The camera will stop down to *f* 16 (or whatever the minimum aperture is). It will then set the appropriate shutter speed, which will be shorter than the one you have set.

The shutter runs vertically, and the maximum speed for electronic flash is 1/100 second. This speed can be timed either electronically by setting the shutter dial to X, or mechanically by setting it to O. The O setting provides 1/100 second even if the camera has no batteries. The batteries are in good condition if any of the LEDs light.

The XD has an electromagnetic shutter release, like the XG, but its self-timer is conventionally placed, and does not have a flashing light. It has a stop-down preview button. Unlike previous models, this is on the left of the lens, the rewind side. Multiple exposures are made simply by pressing the rewind release button.

The Auto-Winder D fits directly to the XD cameras. It provides power winding-on of the film. The camera is also coupled for the Auto-Electroflash 200. This sets the shutter speed to 1/100 and starts a flash-ready signal in the viewfinder.

The Minolta ER

Introduced in 1962, the Minolta ER offered fully automatic exposure at the expense of fully interchangeable lenses.

The ER follows the same basic pattern as the other Minolta SLRs. It has, though, a fixed lens mounted in a diaphragm shutter speeded from 1/30 to 1/500 second (+ B). The film speed (ASA or DIN) is set on a ring round the lens. The shutter speed and lens aperture scales are both on the lens barrel. The aperture scale has an extra A position, for automatic exposure control. Then the selenium meter cell sets the lens aperture to suit the shutter speed chosen. A green light in the viewfinder indicates that the exposure is within the aperture range.

The ER can also be used manually, with no exposure meter. The shutter has a self-timer, labelled V, on the flash synchronization lever. Lens converters (equivalent to 35 mm *f* 5.6 and 85 mm *f* 5.6) were available for the ERs 45 mm *f* 2.8 lens. These cannot be used with automatic exposure control. The viewfinder screen has a split-image rangefinder. Few Minolta ER cameras were made, so we will not refer to this model in the bulk of this book.

The 110 Zoom SLR

The Minolta 110 Zoom SLR is in many ways an equivalent of the ER. It has a fixed lens, and a separate (not through-the-lens) meter giving automatic exposure control.

There are, though, many points of difference. The main is the choice of film size; 110 film comes in easy-load cartridges. You just hinge open the back and drop in a new cartridge. Wind on and you are ready. The film speed is set automatically by the cartridge.

To operate the camera, you focus on your subject in the normal way, and operate the rear (zoom) control to produce just the image size you want as the lens can be varied from 25 to 50 mm, and press the shutter release.

The other main control is the lens aperture. You can choose *f* 4.5, *f* 5.6, *f* 8, *f* 11 or *f* 16 on a dial beside the lens. The combination of aperture and shutter speed has the normal effect. For most outdoor shots, choose *f* 8 or *f* 11.

The viewfinder has a central microprism spot. It also has two warning lights. A red one comes on if the lens aperture is so wide that correct exposure needs less than 1/1000 second; in which case, you need to choose a smaller aperture. The yellow light warns that the shutter speed will be longer than 1/50 second. If it comes on or flashes at first pressure on the shutter release, either choose a wider aperture, or support the camera firmly. The red light also acts as a battery check and an indication that the camera is set on B or X (1/150 second). These are the two shutter settings that still work without a battery.

FILMS

All the Minolta SLRs (except the 110 model) use normal double-perforated 35 mm film in standard cassettes. The normally available loads give 12, 20, 24 or 36 exposures per cassette. The 110 SLR uses film in 110 cartrdges, giving either 12 or 20 pictures per load.

Negative or reversal

On processing, a film yields either a negative or a transparency. The result depends on the process, but films are manufactured to produce either one or the other; and normally are best used as the manufacturer intended.

The characteristics of negative films are designed to give the best possible prints. This is particularly obvious with colour negatives. Each colour of the subject is represented by its complement—blue by yellow, green by magenta, and red by cyan (blue green) and vice versa—in addition, the negative has an overall brown or orange colour. This is the *mask*, which is there to compensate for the imperfect nature of the dyes used. It helps to ensure the accuracy of print colours. Of course, you cannot have such a mask in a transparency film.

Transparency films, on the other hand, are designed to reproduce the scene in suitable tones and colours that look right in a projected image.

Black-and-white films form an image of metallic silver in proportion to the light that reaches the film during exposure. This is normally a negative, but the first image can be removed, and the remaining light-sensitive halides fogged and developed to form a positive image. This is called reversal processing.

Colour films each have three light-sensitive layers. They respond respectively to blue, green and red light. On processing, the silver image is replaced with a dye image—yellow in the blue-sensitive layer, magenta in the green-sensitive, and cyan in the red-sensitive one.

The dye image is opposite in colour and tone after negative processing; and 'reversed' to match the subject after reversal processing.

Colour negative films

Colour negative films are normally either medium speed (80–100 ASA, 20–21 DIN) or fast (400 ASA, 27 DIN). Even the moderate speed emulsions are quite grainy, but 35 mm negatives can give enlargements up to 15 × 12 inches (38 × 30 cm) before the grain becomes obtrusive while 110 negatives will go up to 5 × 7 inches (13 × 18 cm). The faster ones are more grainy, but not perhaps as much so as one might first imagine. Prints up to 10 × 8 inches (25 × 20 cm) from 35 mm negatives are fine for album or display use.

The main difference between films from various manufacturers are in colour relationships, brightness and contrast. You should find the one that produces the prints you like. However, since commercially produced 'machine' prints vary much more than the films themselves, your choice of laboratory is much more critical than your choice of film.

In addition to the normally available types, there are one or two professional colour negative films available. These tend to be designed especially for portraits. They have, too, a slightly lower colour saturation. I generally choose these films because I prefer them. If you use these films, note that they are intended for exposure in a particular sort of lighting, just as transparency films are. For best results, choose one for the lighting you want to use, or expose through a filter, see the chapter on *Colours and Filters*.

Colour negative films are processed in a colour developer that forms black silver and appropriately coloured dyes by reaction with 'colour couplers' incorporated in the three emulsion layers. The silver is then bleached out and the film fixed. In suitable chemicals, this process is as quick and simple as black-and-white film processing.

Black-and-white negative films

There is a much wider choice of black-and-white film than of colour film except for 110 cameras, for which there is just one—Verichrome Pan, rated at 125 ASA, for general purpose work.

Ultra-slow films (2–10 ASA, 4–11 DIN) are intended for microfilming. You can put them in your Minolta if you want enormous grain-free enlargements. They are, though, very high contrast, and so slow as to be an embarrassment. The SR-T meters can be set for 6 ASA film, but most of the other models only for 12. So you need to work out the exposure by multiplying from a suitable meter setting, and use manual shutter speed and lens aperture settings. Even then, an exposure of around 1/60 at *f*4 in bright sun does not give you much scope.

Slow films (12–50 ASA, 12–18 DIN) are the ones you want for making really big enlargements. You can make virtually grainless 20 × 16 inches (50 × 40 cm) prints. Exposures are quite reasonable—like those with the slowest transparency films.

Medium-speed films (64–200 ASA, 19–24 DIN) are the ones for everyday photography. Any well-known make offers a combination of fine grain and convenient speed. They give grain-free enlargements up to 12 × 10 inches (30 × 25 cm), and are quite suitable for much larger pictures.

Fast films (250–640 ASA, 25–29 DIN) are ideal for low-light situations— giving you acceptable combinations of aperture and shutter speed; and for high-speed subjects. However, many photographers standardize on 400 ASA film for all their black-and-white work. With careful processing, you can expect good 10 × 8 inches (25 × 20 cm) prints. If you like the fashionable crisply focused grain effect, of course, these films are ideal for you.

Ultra-fast films (800–4000 ASA, 30–37 DIN) are just that. They sacrifice virtually all image quality to getting a picture 'come what may.' Even enprints show marked grain; but if you want to take pictures by street lighting, or in a disco, you have little choice.

Naturally, the categories of film speed are arbitrary. On top of that you can move films from any category to the next by altering the processing.

The film speeds quoted by manufacturers tend to give the *minimum* exposure for a normal contrast scene. With

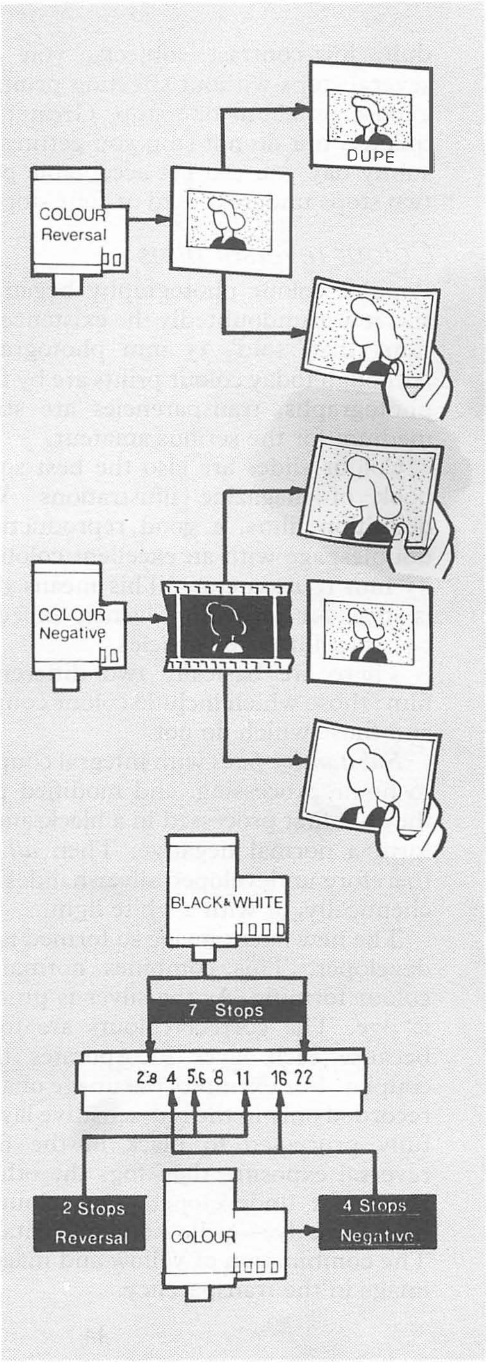
CHOOSING A FILM

Transparency films were the first common colour films. The camera film forms the transparency (slide) directly on processing; but you can have duplicates or prints made from slides.

Colour negative films are intended for producing colour prints. They can, though, be printed on to 'print' film to produce excellent transparencies; or be used to make black-and-white prints.

FILM LATITUDE

Of course, there is always one optimum exposure to produce the picture you want from any particular scene. However, with a normal scene, you can allow some error to creep in without losing everything. The diagram gives a guide as to the variation you may be able to accept with various film types.



dull, low-contrast subjects, you can overexpose by several stops without affecting print quality, and underexpose by about one stop. Greater errors reduce print quality, but do not stop you getting pictures. Even on a sunny day you can get acceptable prints from negatives two stops underexposed or four stops overexposed.

Colour reversal films

Popular colour photography began with colour slides; and it was undoubtedly the existence of excellent reversal films that 'sold' 35 mm photography to enthusiasts. Although today colour prints are by far the most common photographs, transparencies are still the main colour medium for the serious amateur.

Colour slides are also the best source of material for book of magazine illustrations. With today's high-definition films, a good reproduction house can fill a double-page with an excellent colour illustration from a 35 mm transparency. This means that a Minolta outfit is ideal for recording events, expeditions or places for possible illustrated articles.

There are basically two different types of reversal film: those which include colour couplers in the emulsion and those which do not.

Substantive films with integral couplers lend themselves to home processing, and modified processing. Basically they are first processed in a black-and-white developer to form a normal negative. Then *all* the unexposed and therefore undeveloped silver halides are 'exposed', either chemically, or with a white light.

The new latent image so formed is developed in colour developer. This combines normal development with colour forming. As the silver is produced in the film, so is dye. The correct colours are formed in each layer because each layer incorporates the appropriate dye coupler. For example, the image of a bright red subject is recorded only in the red-sensitive layer. This layer is then fully processed to black in the first developer. The reversal exposure then fogs the other two layers which are so far undeveloped. On colour development, they both form dye—yellow and magenta. No cyan dye forms. The combination of yellow and magenta dye forms a red image in the transparency.

The final stages are to bleach out the silver and to fix the film.

Non-substantive films are much more complicated. Each colour-sensitive layer is separately fogged to suitably coloured light, and developed with the correct colour dye couplers. This type of film, typified by Kodachrome, must be processed in a complex carefully controlled laboratory. In most countries, only the manufacturer operates a processing service. This type of processing, however, does appear to produce a sharper, finer grained image than that produced in equivalent substantive films.

Slow films (12–40 ASA, 12–17 DIN) produce the sharpest and most brilliant images. They are ideal for lecture-hall projection or for high quality photomechanical reproduction. If you want your slides for these reasons, choose the slowest film available. However, some people find the contrast and colour saturation too high for normal use.

Medium-speed films (50–100 ASA, 18–20 DIN) are probably the best everyday choice. The image quality of these films matches that of the slowest films a few years ago. The grain is rarely obtrusive.

Fast films (125–500 ASA, 22–28 DIN) let you make the most of dull lighting. Also, you need the highest feasible speed if you are to shoot through really long-focus lenses. The most recent types are quite acceptable for most purposes. In fact, I regularly use a 400 ASA, 27 DIN film. I do not find the grain obtrusive, even when it is 'push' processed to 800 ASA, 30 DIN. What is more, I prefer the colours it produces.

Black-and-white reversal films

These are by far the smallest category. There are only one or two such films around. They are slow-to-medium speed, and produce sparkling transparencies. You can reversal process many black-and-white films, but that produces rather low-contrast transparencies.

Film speeds

The light sensitivity of films is expressed as their speed. Two film speed scales are in current use: ASA/BS (now sometimes called ISO; for International Standards

Organization) and DIN. These are the figures we have already used to quantify film speeds.

The ASA scale is an arithmetic one. A doubling of the ASA speed represents a doubling of the light sensitivity of the film. Thus, to produce the same darkening a 100 ASA film needs just half the light needed by a 50 ASA type. With any particular subject, you can give one stop less exposure with the faster film.

The DIN scale is expressed logarithmically. Each doubling in sensitivity is represented by an addition of three to the film speed, where 50 ASA film is rated as 18 DIN, and 100 ASA as 21 DIN. You can easily remember how to convert from one scale to other, 12 ASA is equivalent to 12 DIN.

The meters in Minolta cameras are calibrated in ASA figures. Most of the cameras carry a conversion scale on the back (inside the film-carton-top holder if fitted) in case you have only DIN rated film.

The way film speed is measured for colour films, is different from the black-and-white methods. Because of this, most film manufacturers mark their films with 'recommended meter setting', rather than 'film speed'. Whatever they call the figure, its effect is the same.

The sensitivity of a film depends on its processing as well as on its emulsion characteristics. So, if you want to follow the manufacturer's recommendations, you must follow the established processing procedure.

Your own film speed

If you have no reason to do otherwise, set the film manufacturer's recommended meter setting on your camera. With negative films (colour or black-and-white) that will give you good results. It will also probably give you the best results with transparency films.

However, with transparencies, the exposure you give in the camera determines the density of your final picture. So the camera exposure is much more critical. It depends not only on the film emulsion and processing, but also on your personal preferences. Some people like comparatively dense transparencies with strong colours. Others prefer lighter, more pastel results. The brightness of your projector, too, can influence the optimum exposure.

There are also slight variations in meter sensitivity, lens aperture, and shutter speed from one camera to the next. These are carefully controlled in Minoltas; but, especially in older cameras, may add together to alter the exposure slightly. Thus you may not get the sort of transparencies you want with the recommended meter setting.

The answer is simple: change the film speed setting. All Minoltas are calibrated in $\frac{1}{3}$ stop intervals, represented by the dots between the film speed numerals. This allows you to set any figure on the normal ASA scale. It also gives you the freedom to decide to set your meter $\frac{1}{3}$, $\frac{2}{3}$ or even a whole stop away from the recommended speed to give you the results you want.

The best approach is to test your cameras before you take any important pictures. Choose a moderate-speed transparency film. If it is available, buy the professional type, which has a recommended film speed marked on its instruction sheet. Load your camera, and choose a suitable subject, whatever type of photograph you want to take most often. Now shoot a series of similar pictures, starting from half the rated ASA setting, and using each mark up to double the setting, (seven shots). Either set the camera for automatic exposure, or match the meter needle carefully for each shot. Do this with two more subjects, you can usually 'squeeze' 21 shots on to a 20-exposure roll of film, and have the film processed.

When the transparencies are processed, look at them carefully projected in your normal way. Decide which are best. If they are those rated at the manufacturers film speed, then stick to the rating on your film boxes. If you consistently prefer under or overrated results, note which are best, and always modify the film speed by the same amount, whatever films you use.

Suppose your test shots were on 50 ASA film, but you preferred the 80 ASA setting, then always alter the speed by $\frac{2}{3}$ stop. With 400 ASA film, for example, set the meter to 640 ASA.

Keep a constant check on your results, though. You may find your requirements change, and then you want a slightly different meter setting.

Because the density is determined in print making, you do not have to be so accurate with negative films. However, if you consistently modify your transparency film settings, you might just as well do the same with negative films.

Processing and film speed

The more a film is developed, the more silver halide grains are converted to metallic silver. Thus, within reason, you can compensate for underexposure by increasing the processing time, or using a specially formulated high-energy developer.

'Pushing' a film, as this is called, largely makes use of its inherent latitude. With extended development, highlight areas become darker (in a negative) faster than shadow areas. Thus the contrast increases as the film darkens more.

The true increase in speed is shown by the shadow areas. Although you may get printable negatives, you cannot truly be said to have increased the film speed unless you have produced more detail in shadow areas than you would otherwise get. In practice, most negative films can be uprated by about $1\frac{1}{2}$ stops by careful processing in a suitable developer. Couple this with an exposure latitude of about the same order, and you can expect to be able to rate a negative film about 3 stops under its normal speed—say 3200 for a 400 ASA film, without too much loss of shadow detail.

The problem is more complicated with colour films. The colours can change unacceptably with increased development. This produces off-colour transparencies, or unprintable negatives.

However, with transparency films, you must always alter the processing if you have altered the film speed rating. Otherwise, the density will be wrong. Kodachrome films cannot be push processed. Virtually all others can be. You can uprate most of them by up to 2 stops (250 ASA instead of 64 for example) without too much loss of quality.

The high-speed (400 ASA) colour negative films all produce satisfactory negatives at 1600 ASA (with suitable processing) but it is not usual to push-process the 80–100 ASA types.

If you process your own films, pushing is quite simple. Film and chemical kits explain just how. If you send them to a processor, though, you may have to choose carefully. Find out what is possible in your area before you deviate from the figure on the film box. Make sure, too, that your instructions will be followed.

I deliberately uprated the first film I shot in an XE-1 as the weather was appalling. When it came back, it was all 'underexposed'. On checking with the laboratory, the photodealer who handled that film discovered that pushed films had to be labelled 'For the attention of a particular person'; writing 'Exposed at 320 ASA, please give extended development' was not enough—so, beware.

You can 'downrate' films as well. This, though, has no particular benefit, and is normally done only as a counter to exposure errors, ie failing to set your ASA dial to the right speed.

Of course, for uprating or downrating, a whole film has to be processed in the same way. So you have to use the same meter setting throughout. If you under or overexpose some shots by mistake, keep the meter setting the same, and arrange for suitable processing—except on Kodachrome, where that is not possible.

Nothing ever comes free. Pushing a film increases the grain to more or less the extent you would expect. So, in most cases, there is no point in rating a 100 ASA film at 400 ASA. The results with a 400 ASA type are usually better, and it is more convenient.

Grain

All films depend on the conversion of light-sensitive halides into metallic silver grains. The silver forms the image in black-and-white films, but is replaced by dyes in colour materials. The way the silver halide grains react to light gives the film its individual characteristics.

The image on any film is visibly uneven. This unevenness, called 'grain', is produced by the aggregation of groups of individual silver grains (or dye images). As a general principle, the higher the sensitivity of a film, the more pronounced its grain. Progressively, of course, manufacturers have reduced the grain structure on films, while maintaining their speed. This has led to the introduction and acceptance of smaller and smaller formats. Undoubtedly, the performance of modern colour films is an integral part in the success of the Minolta SLRs and other 35 mm cameras.

It has allowed, too, the introduction of the Minolta 110 Zoom SLR. The films are fine grained enough for you to be able to achieve quite acceptable 5 × 7 inches (13 × 18 cm) prints from the tiny 14 × 17 mm negatives. Transparencies, too, are perfectly acceptable for home projection.

Contrast

A film records the camera image as a range of tones from black to white (coloured, of course, on colour films). You can always expect pure white subjects to come out white, and pure black ones black. What happens in between, though, varies widely from film to film.

Inevitably, the darkest greys become black, and the palest greys white. In a high-contrast picture, more of the tones are reproduced either pure black or pure white. The ultimate contrast is achieved with reproduction materials, such as 'lith' film and suitable developers. These materials can reproduce a scene as totally black and totally white with no intermediate tones at all. On the other hand, low-contrast materials reproduce the subject as a whole range of intermediate tones, distinguishing between as many subtle differences as possible.

Inevitably, because no photograph can reproduce the wide range of tones in a brilliantly sunlit scene, this requires a compromise. A transparency film of low enough contrast to do full justice to a sunlit scene would produce dull pictures in any other circumstances. Neither the whites would be white, nor the blacks black. To enable you to produce reasonable pictures in most circumstances, transparency films all have a relatively high contrast. That is why they produce exaggerated contrast on sunlit days.

It does not matter if a negative lacks strong blacks or pure whites, because it is not the final product. So negative films are of much lower contrast; inherently capable of recording a greater range of tones than transparency films. However, colour printing processes are virtually fixed contrast, so the overall position in colour is much are nearly always rather too contrasty for brilliantly-lit scenes.

Black-and-white print materials, on the other hand, are available in a range of contrast grades. So you can produce a print with a fuller range of tones.

All things being equal, the faster a film, the lower its contrast capabilities. This, though, is not strongly reflected in present-day materials. The contrast is determined in black-and-white films as much by the development as by the emulsion. The recommendations given by the manufacturers are intended to produce similar contrast in all films. Only the very slowest, special microcopy materials, are overcontrasty; and the very fastest, surveillance materials, particularly low in contrast.

Transparency materials tend to show the trend slightly more. Colour contrast, in particular, is noticeably different. Slow films almost always give more saturated (stronger) colours than the higher speed ones. Even so, there are considerable variations between similar speed films from different manufacturers.

Exposure latitude

Imagine two mid-toned parts of an evenly lit subject, one just twice as dark as the other. On a low-contrast film, they may be reproduced at quite similar densities. On a high-contrast material, the difference will be much greater.

In the same way, changing the exposure by one stop will have much less effect on a low-contrast (higher speed) film. Thus, exposure latitude is directly related to film contrast. The higher the contrast, the more accurate you need to be with exposure. We have already noted that exposure is critical in transparency films because the camera-original material produces the final picture. The relatively high contrast needed to produce good projected images makes such films even more sensitive to exposure changes.

In all normal lights, the through-the-lens exposure system of any Minolta SLR is accurate enough for taking transparencies. Unusual conditions such as strong backlight, spotlighting, sunsets, night pictures, and so on, are less certain.

If you are in any doubt, bracket your exposures on transparency film. A few extra shots are much cheaper than rehiring a model, or paying a return visit to the Taj Mahal.

With a normal subject, you can get acceptable transparencies if you underexpose by up to 1 stop or overexpose by up to $\frac{2}{3}$ stop.

With their lower contrast, and density correction, negative films can accept about $1\frac{2}{3}$ stops underexposure, and possibly 2 or 3 stops overexposure.

The contrast of your subject is also a factor in exposure latitude. Assume that your film can cope with a 50:1 brightness ratio. On a dull day, the scene may be only 10:1. With correct exposure, you are using only a little of the film's capability. In fact, you can underexpose or overexpose by 2 stops, and still expect the film to record the whole range of subject tones accurately. Of course, with a transparency film, you will get an unacceptably dark or light picture, so the latitude provided by a low-contrast subject is only of use with negative films (except, of course, for special effect transparencies).

On a dull day, you can safely rate negative films one stop faster than they are—say 800 ASA instead of 400, without altering the processing. At night, or indoors, though, the contrast tends to be even higher than it is in bright sun, so stick to the 'correct' rating.

The important parts of your subject, too, determine the latitude you have. If you overexpose a wedding picture, for example, even by $\frac{1}{2}$ stop, you may 'burn out' detail in the bride's white dress. On the other hand, slight underexposure can make a black cat's fur look like a piece of cloth.

Exposure

The light reaching your film depends on the light reflected from the subject, the lens aperture, and the shutter speed. All exposure meters, including the ones built into Minolta SLRs, measure the light intensity and recommend a suitable exposure for a particular speed of film. The next chapter *Exposure* tells you just what is involved.

The effects of incorrect exposure are quite obvious. Underexposed negatives are thin, and underexposed slides are too dense. Both lack details in the shadow areas. Overexposed negatives are dense, and overexposed transparencies pale. Both lack details in the highlight areas.

Under normal conditions, it does not matter what combination of time (shutter speed) and intensity (altered by lens aperture) you choose. Thus, on a bright sunny day, with a 25 ASA (15 DIN) film, you can give 1/30 at *f* 16, 1/60 at *f* 11, 1/125 at *f* 8, 1/250 at *f* 5.6, 1/500 at *f* 4, 1/1000 at *f* 8 or 1/2000 at *f* 2. All have the same effect on the film. This is expressed as the law of reciprocity: exposure is determined by time multiplied by intensity. So if time varies as the reciprocal of intensity, exposure remains constant. This gives you the facility to manipulate movement blur and depth of field.

Reciprocity law failure

Unfortunately, the law of reciprocity only holds over a moderate range of shutter speeds. The range varies from film to film. Special long-exposure films may obey it from ½ to 60 seconds; but in most cases normal daylight films obey the law between about 1/1000 second and ⅛ second.

Outside their range, films are less sensitive. This means that you need to give more exposure. The amount depends on the emulsion characteristics, but in the absence of any better guide give double the exposure at 1 second, and four times the exposure at 10 seconds. No exposure meters make the compensation. You must do it yourself, in both manual and automatic exposure modes. You may even have to switch an automatic camera to manual operation.

With colour films, the situation is further complicated. The exposure may have different effects on the different colour-sensitive layers; changing the colour balance, and ultimately introducing impossible colour shifts. The only way to be sure is to follow the film manufacturer's directions.

The advent of 'computer' flashguns has introduced ultra-short exposure times to everyday photography. In quite normal shots you may use 1/5000 second or less. This is usually satisfactory. If you go really close, though, you can reduce the exposure time to 1/50 000 second. Then you have problems—especially in colour. Strangely, colour transparency materials often cause less trouble than do colour negatives.

The best solution is to cover the flashtube with white cloth, or similar material. This reduces the intensity of the flash, and so allows a longer duration.

Colour sensitivity

All modern black-and-white camera films respond to light of all colours—they are *panchromatic*; and of course colour films also respond to light of all colours.

Transparency films, though, do introduce one problem. They record the scene accurately. If the lighting is reddish, so will be the transparency; likewise, blue light produces a blue slide. Our eyes soon become accustomed to the colour of light. We neither notice that light bulbs give an orange light, nor do we register the blue of an overcast day. To reproduce the scene as you see it rather than as it actually is, you need film designed (balanced) for the prevailing light.

Colour materials are made today for exposure either to daylight, blue flash, or electronic flash; or to studio-type tungsten lighting. With other lighting, or if you have the wrong film, you need a filter. The chapter on *Colours and Filters* explains just why, and which you need.

Film packings

Films for 35 mm cameras are normally sold in cassettes. This, though, is an expensive way of buying them. You can reduce the cost to about half (3/5 with colour reversal film) by buying bulk film and loading it yourself.

It is quite possible to reload most film manufacturer's cassettes, although some, notably those from Eastman Kodak, are crimped together, and cannot be reloaded. Cassettes designed for reloading are better, however. They are simpler to open, and have a more durable light trap. Even if you use them just once, they cost only a quarter of the difference between bulk film and ready-loaded cassettes.

You can buy most film in bulk, normally without processing included. Then you can either process it yourself, or send it to a laboratory. If you plan to buy your film in bulk, then obtain a cassette loader too. It only costs the price of two or three cassettes of film, and makes life very much easier.

Storage

Film deteriorates if you keep it. It is especially sensitive to warm, humid conditions. If you can, keep your film in a refrigerator until you need it. For long-term storage a freezer is better still.

Manufacturers have two separate standards for film production: amateur and professional. Amateur films are made with the knowledge that they will be kept in a drug-store window, used slowly, and maybe processed only after a delay of several months. None of these things is good for image quality. Amateur films, however, make the best of it.

Professional films, on the other hand are much more sensitive. The manufacturer expects them to be stored in a freezer, used as soon as they are taken out, and processed immediately. Treated that way, they give better results than equivalent amateur products. Treated as an everyday film, they deteriorate fast. So, choose your film to suit the style of your photography. For example, take amateur films on a long touring holiday.

If you store your film in a refrigerator or freezer, do so in its unopened package. When you take it out, give it time to warm up to room temperature *before* you break the seal. Wait 2 or 3 hours after removing material from the refrigerator; and 24 hours for freezer-stored films. If you open it too soon, you may get condensation on the film; that does it no good at all.

However you store your film, always keep it in its original sealed container, or foil pack, until just before you need it. The packing protects it from moisture and destructive atmospheric pollution.

Loading 35 mm cameras

Film cassettes are light-proof, but do not expose them to direct sun. Some light may leak in if you do. In the absence of any other shade, turn your back on the sun while loading and unloading your Minolta.

Pull up the film rewind knob to open your Minolta SLR. The back is hinged on all the cameras.

Always take special care when your camera back is open. The back is comparatively flexible, and can be distorted. If that happens it may let in light to fog your film. Be careful, too, that no dirt or grit gets in while you are loading. On windy days shield the camera as much as possible.

With the camera back open, and the rewind knob pulled up, the new film cassette goes into the left-hand chamber. Push back the rewind knob to retain the cassette with its spindle; pull the film across the shutter, and fix it to the take-up spool. On the newer cameras, just slide the end under one of the white plastic tabs. On some of the SR models, you push the end into a slot instead.

Wind on, with the normal transport lever or power winder, until both sprockets of the film drive roller engage the film sprocket holes. Of course, you have to release the shutter between frame-size winds. On electronic models, set the shutter to a manual speed, such as X, for this. Otherwise, if you have the lens cap on, the shutter may lock open.

Take up any slack by turning the film rewind knob in its normal, rewind, direction, and close the camera back. Make two blind exposures, still on a manual speed. Wind on a third time and you are ready to take the first shot. The automatic frame counter should now read 1.

As you make the blind exposures watch the film rewind knob. If the film is winding properly, the knob will turn at each stroke of the film transport lever. The safe-load signal fitted to some Minoltas provides an alternative check. The orange band is visible only when a film is correctly loaded. It moves slowly from left to right as the film is wound through.

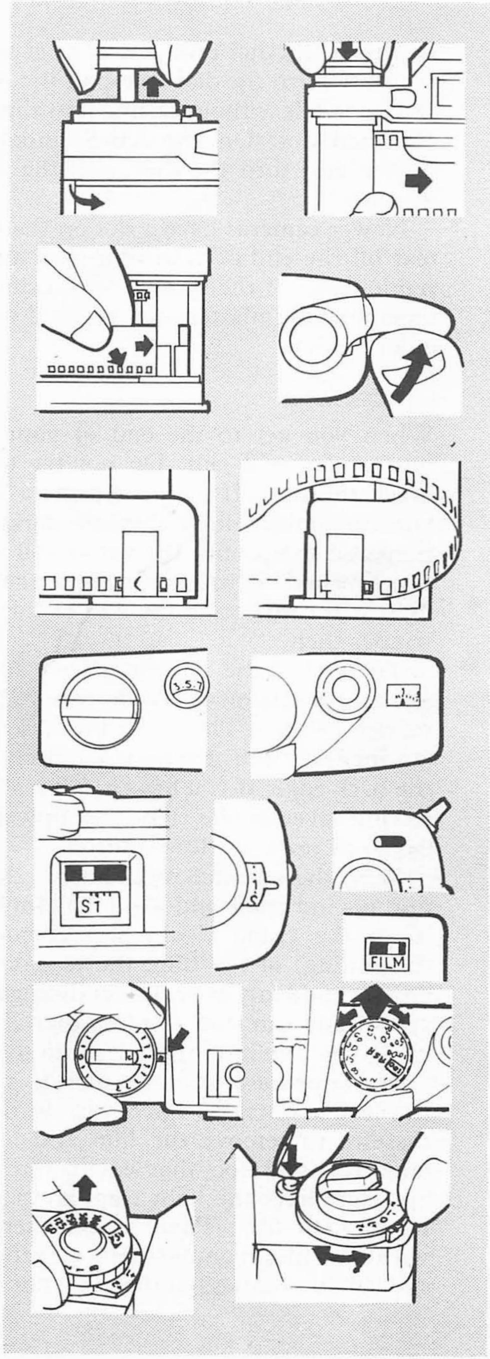
Neglect to check film transport at your peril! I once ran through more than thirty carefully posed group shots before my XM began to transport the film. I noticed only when the counter reached 36 and the film kept on transporting. I will not make that mistake again.

Setting the film speed

When you load your camera, make sure that the exposure meter is set to the correct film speed. This is essential if you are to get accurate exposures, especially with automatic models.

On the SR-7, the SR-T and XG models, raise the shutter speed dial, and turn it until the correct speed appears in the cut-out above 1000. The dots represent intermediate ASA settings as shown in the diagram. On the XE models, turn the dial around the rewind lever, without raising it until the correct figure (or dash) aligns with the white dot. On the XD, press the release button

LOADING 35 mm FILM



To open the camera back pull up the rewind release knob. Put the film cassette in its chamber so that the film lies across the shutter. Push the rewind knob back. Pull the film leader across to the transport spool, and engage it there. On the newer cameras, turn the film back on itself to go under a tab and ensure that the tooth engages in a sprocket hole.

On older models, first push the film end under the tab.

Wind the film on until the sprocket holes top and bottom engage on the sprockets of the transport roller. Close the camera back.

Wind on until the film counter reads 1.

Counters on SR-1, SR-3, SR-1; and on SR-7 and SR-T models.

Counter on XE-1; on XG; and on XD.

The safe-load indicator on the XE-1, SR-T 303 models, XG and XD indicates winding on with an orange bar.

Turn the film speed dial to the correct ASA setting. This is essential for correct metering or automatic exposure.

XE dial; SR-T, SR-7 dial.

XG dial; XD dial.

and turn the dial until the correct figure appears in the cut-out. Turn the dial on top of the AE finder of the XM (XK) models without raising it to align the figure with the chromed dot. On the AE-S finder, press the release button and turn the dial until the figure appears in its window.

Newer cameras have a slot on the back cover. You can tear off the end of your film pack and slot it there in to remind you of the film you are using. Medical adhesive tape (sticking plaster) can be used to the same effect on older models.

Unloading

When you get to the end of your film, the transport mechanism will jam. Do not try to force it, you may break the film. If so, your camera is immobilized until you can unload it in absolute darkness, unless you are prepared to sacrifice the whole roll of pictures you have just finished. If you are using a power winder, the pilot light will come on at the end of the film. Switch off the winder then.

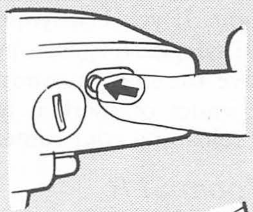
To rewind the film, you have to disengage the film advance mechanism. To do this you push in the rewind release button. This is in the base plate about 35 mm ($1\frac{1}{3}$ inches) from the right-hand end and quite close to the back edge. If you have a power winder fitted, push its rewind lever to the right and upward. This presses the camera's rewind release button.

With the advance mechanism released, hinge out the film rewind crank and wind the film back into its cassette. Turn the crank clockwise. As you come to the end (beginning) of the film, the tension increases, then decreases suddenly as the leader disengages from the take-up spool. You can stop winding then if you want to, or you can go on to wind the leader into the cassette.

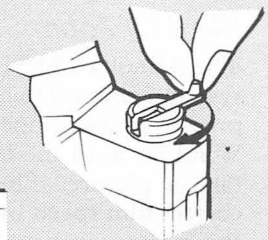
If you process your own film, it is much better to leave the leader outside. Then you do not have to open the cassette to remove the film and load your developing tank. It is said, too, that leaving film between the cassette lips completes the light trap, and reduces the chance of fogging the film. There is some sense in this: however, with new film manufactuer's cassettes, this precaution is superfluous, unless you leave your exposed cassettes in

UNLOADING

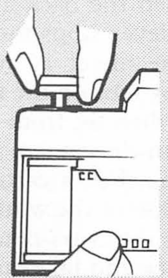
35 mm film must be rewound before removing the cassette. First press the rewind-release button to disengage the film transport system.



Turn the rewind crank until the film pulls out of the film transport mechanism. Two extra turns takes the leader into the cassette if you want that.

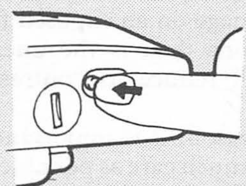


Pull up the rewind knob to open the back. Remove the used cassette for processing.

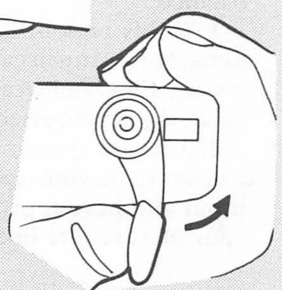


MULTIPLE EXPOSURES

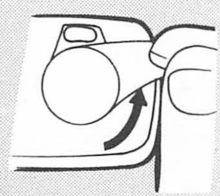
On the SR-T 303, 303b, XD or XM, depress the rewind-release button to disengage the film transport mechanism after the first picture.



Operate the transport lever to reset the shutter without moving the film. You can repeat the whole operation as often as you wish.



The XE-1 and XEb have a multiple-exposure lever. Push it to the right before using the transport lever, and the film does not move.



bright sunlight. If you load your own cassettes, though, it is an added safeguard against possibly worn light traps.

If you leave the film protruding from your cassettes, tear off the leader or mark it in some way to prevent accidentally reloading your camera with exposed film.

The 110 Zoom SLR

The Minolta 110 SLR uses the simple cartridge-loading system common to all these cameras. To load it, you just press the catch, open the back and drop in a cartridge. Wind on until the lever stops moving. You are ready to take a picture. The meter is automatically set to the correct film speed by tabs on the film cartridge. You read the frame number directly from the film backing paper through a window in the camera back.

Once you have finished a cartridge, wind the film off with five or six strokes of the wind-on lever. The counter window then shows the cross-hatched end of the backing paper. Open the back and take out the cartridge.

Processing

The latent image on an exposed film is more sensitive to poor conditions than is the unexposed film. Heat and humidity will reduce its contrast, and spoil its colour balance.

For this reason, it is important to store your exposed films with as much care as possible. If you must keep them for any time, foil wrap them and put them in a cool place. Have them processed as soon as possible.

If you are shooting on professional film, do not leave a cassette in your camera to 'finish off sometime'. Take it out and have it processed straight away. If you do not, your pictures are likely to be less than the best.

EXPOSURE

The amount of light that reaches your film is critical. It determines just how much the film will darken (or lighten it it is a transparency film) when it is processed. As we have already discussed, you alter the lens aperture and shutter speed to match the lighting conditions to the film speed. This chapter is about exposure in normal-range photography. There is more about close-up exposures in the chapter on *Shooting at Close Range.*

With a normal outdoor scene there is little problem, the exposure is so certain that simple-camera makers can fix the settings in advance. As long as the user keeps to bright sunny days, he gets excellent exposures. Once, though, the conditions become even slightly unusual, you need much more sophisticated exposure control.

Simple rules

Film manufacturers pack an exposure guide with each film. If you follow that, you will get perfectly good exposures in normal conditions. Some time ago, before built-in meters were common, my hand-held exposure meter gave out half way through a 4-month long expedition. Looking now at my transparencies, I cannot tell which were metered and which followed the film instructions. That is not surprising, since they were all taken in tropical sunlight, which is virtually invariable from dawn 'till dusk.

In fact, you do not even need the instructions. You can follow the simple 'rule of thumb' on which they are based: in bright sun expose for 1/ASA speed at *f* 16. For example, with a 125 ASA film give 1/125 at *f* 16. On a cloudy bright day open up the lens to *f* 8 with the same shutter speed.

With negative films—black-and-white or colour—these rules will give you acceptable pictures practically all the time. Life is not so simple, though when you take transparencies. The exposure you give in the camera decides the density of your final picture. Combined with the higher contrast of reversal films, that makes accurate exposure much more important.

It is well worth remembering the *rule* even with a fully automatic camera. It provides a constant check on your exposures. If your built-in meter gives a widely different exposure, check why. There are four possible reasons: the meter is faulty; the battery is flat; you have set the wrong film speed; or left the compensation dial on the wrong setting.

Exposure meters

Basically, every exposure metering system has two functions. It measures the light level, and it calculates the exposure needed for film of a particular speed. The built-in meters on Minolta cameras are coupled to the lens aperture and shutter speed and operated by the normal camera controls. For manual control, you simply align the meter needle with a pointer or to the shutter speed indicated, and the camera gives the metered exposure. With automatic models, the meter makes the adjustments, but the results are just the same.

The meter built into your Minolta measures the light reflected from the scene. The SR-7 and 110 Zoom SLR measure an area a little smaller than the standard lens (wide end of the zoom) covers. All the other cameras have through-the-lens metering, so the metering area changes with the lens you mount.

Light-sensitive substances

The first photoelectric exposure meters used a selenium cell to generate a current proportional to the light falling on it. The current energized a sensitive galvanometer to indicate the light level. Such meters are reliable and accurate; but the selenium cell is of necessity quite large, and does not react well in extremely low light. The large metering window of the original Minolta Meter SR is typical of such a selenium meter.

The next substance commonly employed was cadmium sulphide (CdS). The resistance of a CdS cell is reduced in proportion to the light falling on it. This resistance is used to modulate the current from a small battery. The modulated current is again proportional to the light level, which can be measured by a suitable galvanometer. CdS cells are much smaller than similarly sensitive selenium ones. This made it possible for manufacturers to incorporate the cells within the camera, measuring the light coming through the main lens.

CdS cells, though, still have two major problems: they are much more sensitive to red light than to green and blue; and they react comparatively slowly to changing light levels.

The excess red sensitivity is generally only partially corrected: so CdS cell meters (separate or built-in) tend to overestimate tungsten light levels. In fact, for tungsten exposures with a suitably balanced film, I always set the meter $\frac{2}{3}$ stop (2 film speed steps) slower than the film I am using.

The slow response makes it essential that you wait for the needle to settle in extra-low light levels. It can go on moving a little for 30 seconds or more. Rather more serious though is the memory that such cells have. If you expose a CdS cell to a really bright light, full sunlight straight into the lens, for example, you may put it out of action for several hours. During that time it remembers the bright light and overestimates light falling on it.

In normal use, this is seldom a problem. However, whenever you move from sun to the deepest shade, it is worth while to wait a few minutes before you take a CdS meter reading. That way, you can be quite sure of its accuracy.

Despite these difficulties CdS cells are ideal for most camera use. The meter in, for example, the XE cameras is at no disadvantage to that in the XD models in normal daylight or artificial light work.

A number of other chemicals produce electric current in proportion to the light level, like selenium, but the current is minute. The advent of integrated circuitry, however, has made these newer light metering materials usable. Coupled with a minute amplifier, silicon and other cells (often called photodiodes) produce highly sensitive and reliable exposure metering.

Not only can their sensitivity be made to match more nearly that of film, they react much more quickly than do CdS meters, even at very low light levels. The increased speed of reaction is particularly useful when shooting continuous bursts with a power winder or motor drive. That is why the XM-Motor is fitted with the silicon cell AE-S finder instead of the CdS cell AE finder.

Coupled exposure meters

The selenium cell Minolta SR-meter introduced for the SR-3 in 1961 couples to the shutter speed dial. The meter is fixed to a special meter shoe on the camera front, and carries its own shutter speed dial. After fitting the meter to the camera, turn its dial to couple it to the camera dial. Now, once the film speed is set on the meter, the meter needle indicates the recommended lens aperture. Simply point the camera and meter to a suitable part of your subject (the meter covers an angle a little smaller than the standard lens). Shade the meter from overhead sun; and set the indicated aperture on the lens diaphragm ring. The meter has a dual range; for normal use, the ASA dial is set to line with the white dot, and the white figures indicate the aperture. In low light, set the dial to the yellow dot, and read from the yellow figures. A diffuser allows you to measure incident light.

All the Minolta clip-on meters work in the same way. The later CdS celled versions (Minolta SR-Meter 2, SR-Meter V and SR-Meter S) are powered by a single 1.35 volt mercury cell (type PX625 or equivalent). They have a battery check (CHECK or BC) position on the operating switch, and a battery check mark on the meter dial.

The meters have high and low range positions. On the SR-Meter 2, set the switch to H, and read the white figures in normal lighting; set it to L and read the orange figures if you do not get a reading on H. On the SR Meter V and S, turn the meter on, and read the red figures in normal lighting. In low light, push in the button at the centre of the meter switch, and read the white aperture figures.

The Minolta SR-7 introduced the built-in coupled exposure meter to conventional Minolta SLRs. The CdS cell measures light over an angle of about 30° in front of the camera. The SR-7 (model V) meter is much the same.

In either case, set the film speed by raising the shutter speed dial and turning it until the correct figure appears in the cut-out between ASA and 1000. The meter battery (PX 625) fits in a compartment in the base of the camera, and the meter switch is also on the camera base. The SR-7 (model V) has a battery check position and a check mark in the centre of the aperture scale.

To measure exposure, once the film speed is set, point your camera toward your subject, and read the lens aperture from the scale between the rewind knob and the pentaprism. If the shutter speed/aperture combination is unsuitable, alter the shutter speed, and set the correspondingly indicated aperture.

In low light levels, select the extra-sensitive meter range by pressing in the spring-loaded button. It is on the back of the SR-7, just below the meter scale, and on the left-hand side of the lens mount on the SR-7 model V.

Through-the-lens meters

Minolta introduced through-the-lens metering with the SR-T 101 in 1966. The system uses two CdS cells housed in the pentaprism. The meter is powered by a single 1.35 volt type PX625 or equivalent battery. The CdS-modulated current is displayed on a single needle which moves up or down the right-hand edge of the viewfinder image. The position of this needle is determined solely by the light passing through the lens.

A ring-ended follower moves with the film speed, shutter speed and (preselected) aperture on an MC or MD lens. Setting this pointer to cover the needle matches the exposure controls to the metered light level, as long as the film speed is correctly set.

With meter-coupled MC or MD lenses, the meter operates only at full aperture. If you push the stop-down button, either the meter will switch off or it will give incorrect readings. With uncoupled lenses and accessories, the meter gives stop-down readings. Simply close down the diaphragm to match the needle to the pointer (which represents the film speed and shutter speed).

The meter is basically the same on all the SR-T models. The Minolta full-aperture metering system works quite simply by noting the number of stops below maximum aperture that the diaphragm control is set. The meter coupler of each MC or MD lens is in exactly the same place on the camera—just touching the meter teller—at full aperture, irrespective of the actual value of that full aperture. As the meter measures light through that full aperture, there is no need for complex aperture indexing mechanisms. The teller is just moved exactly the same distance for each whole stop that any lens is stopped down. When you mount a lens, that is set to less than its maximum aperture, the teller is moved the appropriate amount as you turn the lens in its bayonet.

If the lens or accessory has no meter coupler, naturally, the system measures at the picture-taking aperture without modification. Of course, you must use the depth-of-field preview button to close down the aperture on any automatic-diaphragm equipment.

There are no Minolta cameras with through-the-lens meters confined to stop-down metering.

Where do they measure?

Minolta cameras have meter cells that measure the light intensity on the focusing screen. They measure an average of the light from the whole scene, with extra weight given to the centre portion.

This configuration gives the highest proportion of accurate exposures, but cannot be expected to be right every time. Naturally, if the part you want to expose accurately is unlike the majority of the picture, and at the edge, the meter cannot cope. It is for the unusual scenes that automatic Minolta SLRs give you manual override, and exposure compensation dials.

SR-T metering procedure

Once you have set the film speed, the normal procedure is to choose a suitable shutter speed and alter the aperture to align the pointer.

Focus on your subject, or a substitute if necessary, and turn the aperture ring until the needle is covered by the pointer. The exposure is now set. It is wise now to check that the combination of shutter speed and aperture is the optimum for the results you want.

If the aperture is unsuitable, alter it to a suitable one, focus the camera again and centre the pointer to the needle by adjusting the shutter speed.

Once you have chosen a suitable exposure combination you can switch the meter off if you wish. You do not need to meter again until the lighting conditions change, the sun coming out from behind a cloud, for example.

Automatic exposure

More recently, electronic control has been introduced for focal plane shutters. Combined with through-the-lens measurement, and the Minolta MC or MD lens coupling system, these provide simple automatic exposure control.

You focus on your subject, and the camera sets a shutter speed to suit the light level, lens aperture and film speed. The shutter speed is displayed on a scale on the right of the viewfinder. If it is unsuitable, you can alter the aperture to change it to a suitable one. That is all that is involved with normal subjects. With special subjects, you can choose your exposure manually, except on the 110 SLR, or use the exposure compensation dial (of which more later).

The great advantage of automatic exposure is that you can concentrate your whole attention on composing your pictures—and that is the point of photography. Once you have set a suitable aperture, the camera alters the shutter speed if the lighting changes. In practice, it makes only a slight variation in normally constant lighting. There is a bonus, too: you can snatch a shot of something unusual without having to stop and set the exposure.

Shutter speed priority

Sometimes, though, the shutter speed is all-important. You may, for example, want 1/125 second to be sure of the right blur behind a moving subject when you swing or pan the camera to follow it. You can set that speed on an aperture priority camera by adjusting the aperture. If, however, conditions change rapidly, your camera may give you 1/60 or 1/250 second instead.

To avoid this rare occurrence, Minolta introduced the XD cameras. They allow you to opt for shutter speed priority automation. In that mode, you set the shutter speed you want, and the camera sets the lens aperture to suit. If that aperture, though, is outside the range of the lens you are using, the camera will alter the shutter speed as well.

Exposure compensation

Sometimes you know that the metered exposure will give you the results you want; and you also know that the exposure will be consistently wrong.

For example, when you are shooting a spotlit performer on stage from a fixed position, it is likely that the darkened stage will unduly influence your meter—even though it is centre weighted.

With normal automatic exposure your pictures will be overexposed by perhaps a whole stop.

If you want to retain the automatic exposure, perhaps because the spotlight is changing colour or intensity, you can use the compensation dial. Press its lock and move it away from '0'. In this case set – 1 to give you a whole stop less exposure than is normal for the film you are using. Notice that the compensation scale is on the film speed dial. What you are really doing is altering the film speed setting. Turning the exposure compensation dial, though, is much better than actually changing the film speed number. If you put the camera away without putting the dial back you still know the true film speed. Changing the ASA setting is a sure recipe for confusion.

Despite that, always put the dial back to '0' when you have finished using compensated exposures. It is much too easy to get the wrong exposure next time if you do not.

Manual override

All the automatic Minolta SLRs (except the 110 Zoom) allow you to set the exposure manually if you want to. Simply take the shutter dial away from its automatic setting—or turn the XD mode switch to 'M'.

Now, except on the XG, the meter read-out continues to show the shutter speed corresponding to the lens aperture and lighting conditions for the film speed you have set. However, you actually get whatever speed you have set on the shutter dial, just as you do on the manual exposure models. By setting the indicated speed, you have the exact equivalent of match-needle metering. On the XG, you must meter in the automatic mode before selecting the manual shutter speed.

There are two major uses of manual exposure: when conditions are such that the meter indicates the wrong exposure—especially with high-contrast or backlit sub-

EXPOSURE METERS

All Minolta through-lens meters show the exposure in the viewfinder.

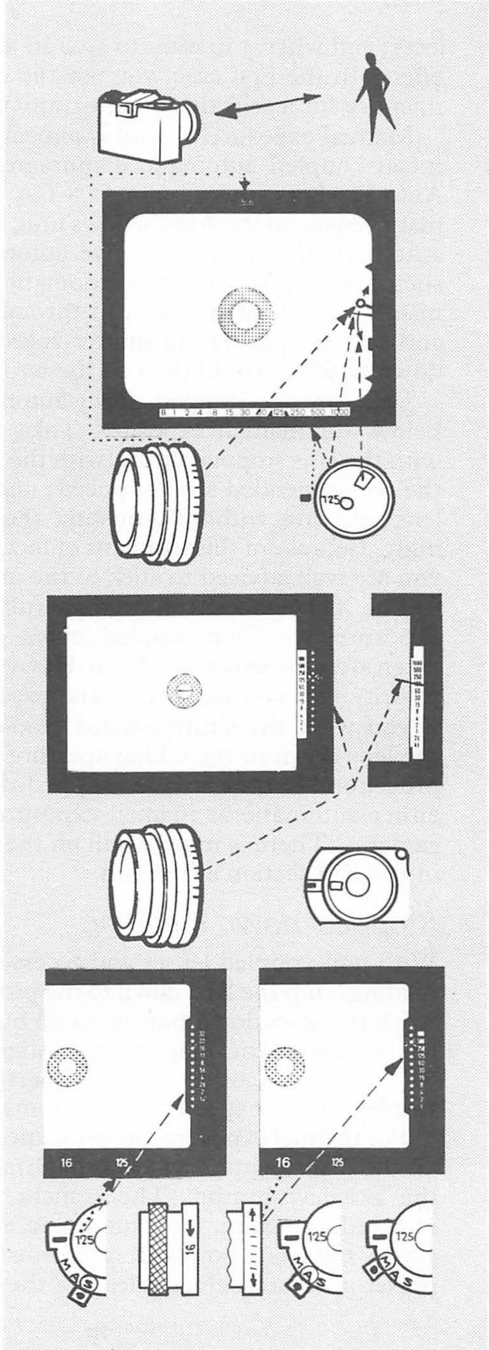
On the SR-T models, the light entering the lens moves the meter needle. The shutter speed dial, film speed chosen and lens aperture ring move the ring-ended follower. When the two are matched, the camera is set for its metered exposure. On the SR-T 303 models, the shutter speed and aperture are displayed in the viewfinder. On the SR-T 101 models, the shutter speed is shown.

On the aperture-priority automatic-exposure models, the film speed and lens aperture information combines with the light reading to indicate the shutter speed required.

Left The XG uses LEDs to indicate speed. (Speeds from 1 to 1/15 second are shown by a single LED on the XG-1). *Right* The XE models a needle against the shutter-speed scale.

The XD offers a choice of automatic-exposure models. In the S mode, the meter chooses the lens aperture to suit the shutter speed. In the A mode, it sets the shutter speed to suit the aperture. In the M mode, it indicates the shutter speed to suit the aperture, but does not set it.

The actual settings are displayed except on the XD-5.



jects; and when you want to give an unusual exposure for effect. In the first case, you use the manual settings as a memory for a selective or substitute meter reading.

Manual exposure control is almost essential with non-meter-coupled automatic diaphragm lenses such as the Auto Rokkors, the 35 mm *f*2.8 CA Shift Rokkor, automatic lenses on the Autobellows unit, etc. The CdS-celled automatic models cannot give automatic exposure with such lenses if you use the automatic diaphragm mechanism. The meter would read through the full aperture, and set the appropriate shutter speed for that, then stop down to what would then be the wrong aperture.

You can use stopped-down automatic metering—see below—or manual exposure. Take your meter reading with the lens stopped down (with the preview button), set the recommended shutter speed; and do not change the lens aperture without adjusting the speed correspondingly. Because of the problems of focusing stopped-down, you are well advised to stick to the manual mode.

The XD cameras can produce full-aperture automatic exposures with non-coupled lenses—the final reading is taken after the lens stops down. However, only on aperture priority can you be sure of the exact combination, and if you want the shutter-speed read-out, you must stop the lens down to the taking aperture. The recommended procedure is thus to use stopped-down metering, and either automatic or manual exposure, as with the other cameras. There is more detail on the various possibilities in the XD section at the end.

Stopped-down metering

With non-coupled lenses and accessories, to take a meter reading, stop the lens down to the picture-taking aperture (with the stop-down button on all but the XG if the lens has an automatic diaphragm). Align the needle of the SR-T cameras, or set the lens aperture to give the most suitable shutter speed on the automatic models.

For manual exposure, on any camera, you can now open up the diaphragm of an auto-diaphragm lens by releasing the preview button. The camera remains set to the metered exposure. For automatic exposure (on appropriate models), however, you must stop down to the preset aperture before releasing the shutter. This is the

STOP DOWN METERING

With an uncoupled lens, the through-lens Minolta meters work at the shooting aperture.

SR-T Cameras

1. With an automatic-diaphragm lens, press the stop-down (preview) button to set the lens to the picture take-up aperture. On most cameras, the button stays in or out, but on the newest models it is spring-loaded.
2. Adjust lens aperture to move needle.
3. Adjust shutter speed to move follower.

XE Cameras

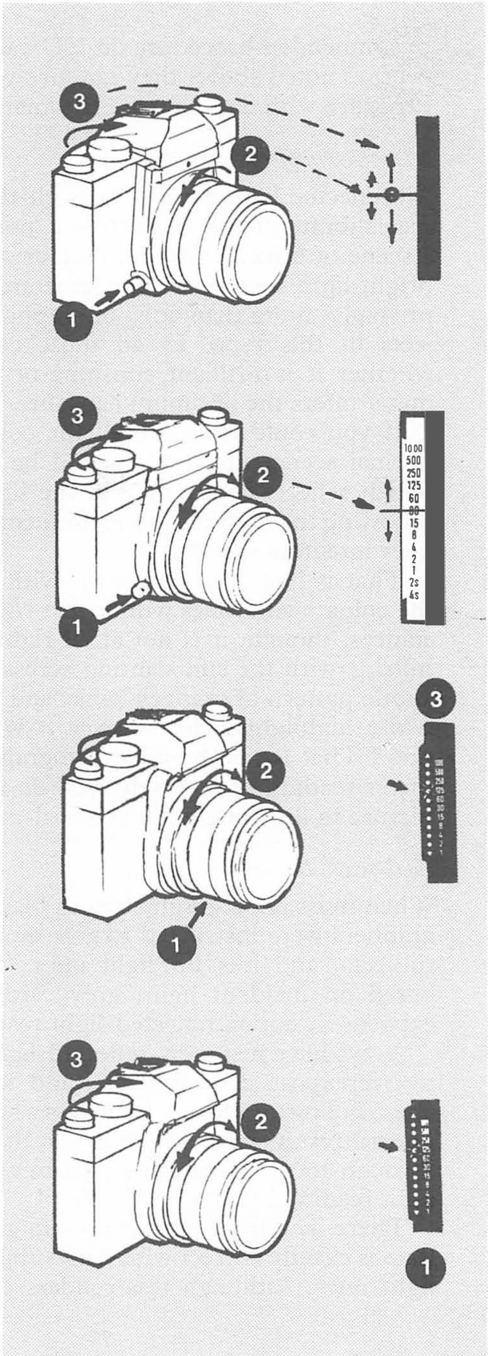
1. Stop down if necessary.
2. Adjust lens aperture to change shutter speed. Keep camera stopped down for exposure.
3. For manual control adjust shutter speed to match needle.

Manual exposure control on XD cameras

1. The viewfinder scale shows the recommended shutter speed.
2. Altering the lens aperture alters the metered shutter speed.
3. Match the speed with the shutter-speed dial.

On XD cameras, use the 'A' mode.

1. Hold in the previous button.
2. Adjust the lens aperture to display the correct shutter speed.



recommended procedure on XD cameras as well. However, as noted above, they can give you correct automatic exposure with non-coupled automatic-diaphragm lenses.

Measuring exposure

All reflected light meters, through-the-lens or otherwise, are calibrated to measure from a 'normal' scene. That is, a scene of mixed light and dark areas without any really bright light sources, or any large areas of darkness. Surprisingly, more than 90% of all photographs are of subjects of this type. In all those cases, irrespective of whether it is brilliant sunshine or dreary twilight, the meter offers the optimum exposure.

If you could integrate all the colours and tones in a normal scene, the result would be a neutral mid-grey, which reflects about 18% of the light falling on it. So, following the meter reading produces a photograph which does integrate to a mid-grey.

That is just what you want with a normal scene. All the colours and tones will be just right. In other circumstances, though, it is not at all right. Think of a snowy hillside with the sun slanting across. The snow shows a subtle pattern of orangey-pinks and blues with sparkling white highlights. How dreary it would look all a dull grey! That is just how it photographs if you follow the meter reading. Conversely, you do not want a pale grey picture to illustrate work in a coal-mine.

Subject tones

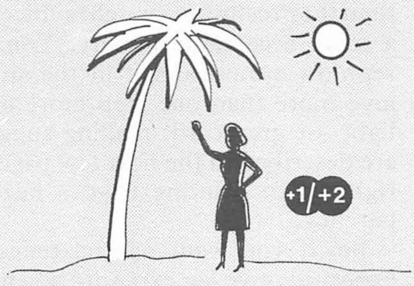
When most photography was in black and white, photographers were instructed to give more exposure for dark subjects, and less for light ones. That information is based on incident light, grey card, or exposure table exposures; not on reflected-light readings.

As we have just seen, reflected-light readings will tend to overexpose dark subjects, and to underexpose light ones. Following the advice will exacerbate that; so, to get normal results you should do just the opposite with your through-the-lens metering camera which takes reflected-light readings.

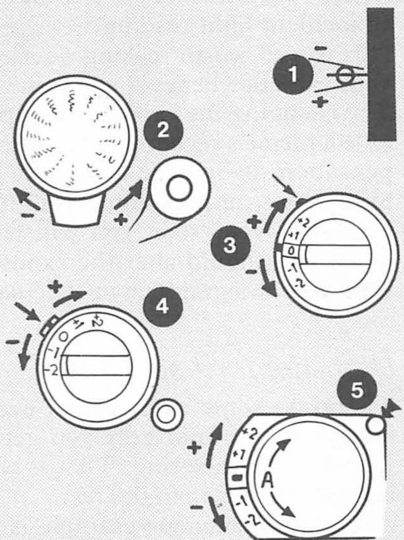
There is, though, some sense in giving more exposure than is exactly correct with dark subjects, and less so with light ones. Although this renders dark subjects lighter

COMPENSATING FOR UNUSUAL LIGHTING

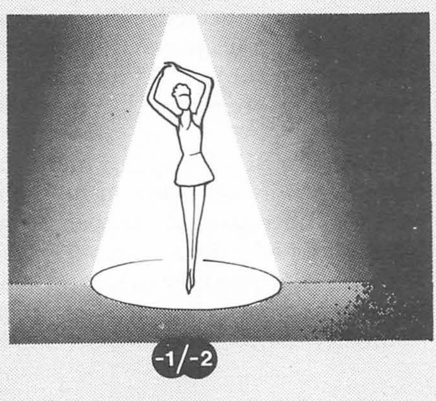
When you want detail in a backlit subject, you need to increase the exposure by one or two stops. You can do that simply by setting the appropriate manual exposure, or with the automatic-exposure system on any X-sync camera.



1. The SR-T ring can be aligned for 1 stop under or over the meter reading.
2. On the XM, the AE finder compensation switch is under the shutter-speed dial. It is spring-loaded.
3. For the XE models, you compensate with a ring surrounding the film-speed dial. Press in the lock to turn it.
4. On the XD cameras, press in the knob and move it to the setting you want.
5. On the XG models, you move the shutter dial. Depress the release, and set A to the factor you need.



Spotlit subjects call for a reduction in the metered exposure. Otherwise you may produce burnt-out highlights.



than they really are, or light subjects darker, it can produce a more acceptable picture. You are likely that way to reproduce more detail in the subject. Do not, though, give more than one stop more or less than the *incident* light (or grey card) reading suggests. These techniques are described in the next few pages. You can put the tone right when printing from a negative, but not a transparency.

So, if you want natural tones, keep to the metered exposure; give *less* exposure when you measure from dark subjects, and *more* when you measure from light ones. Better still, measure from a mid-tone substitute, or take an incident light reading.

It is well worth making a series of test exposures with your camera whenever you come across unusual subjects. Try changing the exposure by up to two stops either side of the meter's recommendations. Use the exposure compensation dial on the automatic exposure models. Keep brief notes, and examine your transparencies or prints carefully. Very soon you will be able to recognize just when you should alter the exposure to suit the way you want to photograph any particular subject.

High-contrast subjects

There are some cases when, even though your subject integrates to a mid-grey you get unsatisfactory pictures with normal metering. That is when part of the subject is much darker than the rest.

The most obvious example is a person standing with his back to the sky. Much of the scene is the sky. When you take a reflected-light reading, the meter does not know that you are most interested in the smallish dark part of the subject. As a result if you follow the recommendation your model comes out considerably underexposed.

Minolta SR-T and XE meters are constructed to give slightly more exposure in high-contrast situations. This CLC (contrast-light compensation) metering helps, but cannot be a complete answer.

The best solution to the problem is to go close to the important part of your subject. Take a reading from a suitably toned sector—your model's face, perhaps, or,

METERING CONSIDERATIONS

There are times when a direct reading does not produce the result you want.

Add-on meters and the SR-7 meters, may be over-influenced by the sky, point your camera down a little when the sky is bright.

For high-contrast lighting, you can take a reading of highlight and shadows. If the film has enough latitude, set an intermediate exposure. If not, decide where you want details, set exposure for that.

In unusual lighting, the meter will not set the correct exposure. Go in close to meter, if possible, and set the exposure manually.

Sometimes you have to move only a few yards to ensure a suitable metering area.

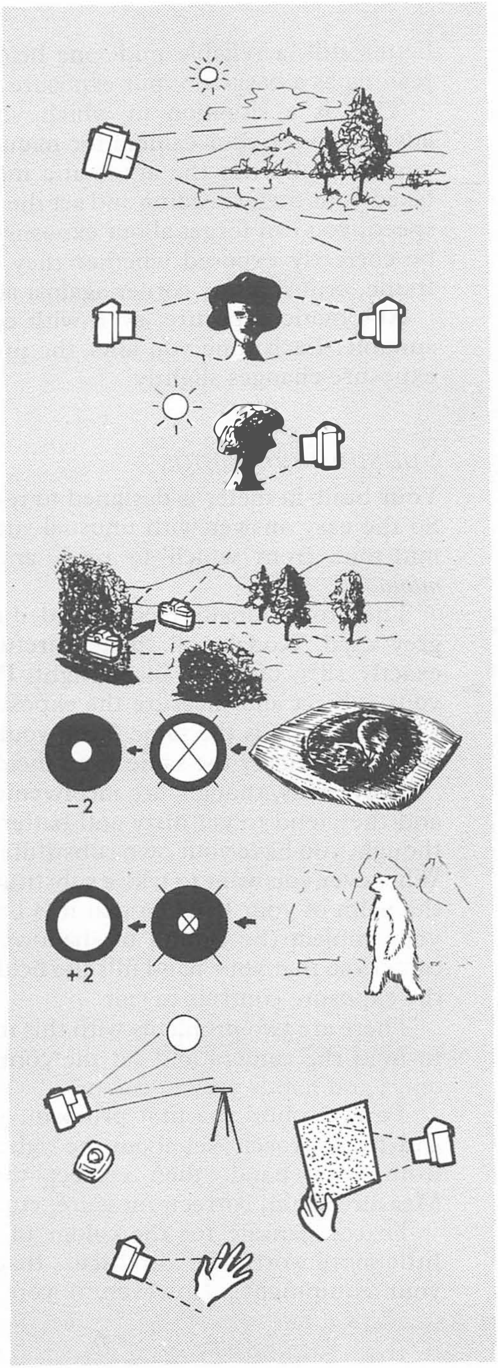
With a dark subject, the meter suggests too much exposure. For a black cat to appear black, you need two stops less.

Conversely, metering from a light subject suggests too little exposure, and then you must give more.

When the subject tones are unusual, it is better not to rely on a reflected-light reading, even with a compensation.

You can measure the incident light with a suitably-equipped hand meter or add-on SR meter. Set the exposure on the shutter-speed and lens-aperture controls.

A substitute reading is a good alternative. Use a grey card or your hand. Again, set the exposure manually.



better still, a reliable mid-tone held close by. Use that reading as a basis for your exposure setting.

This is a situation in which you are much better advised to set your camera for manual exposure, even if you normally use the automatic mode. Once you have taken your meter reading and set the aperture and shutter speed, you can forget about exposure. Your subjects will be correctly exposed whether they occupy most of the frame, or just a tiny corner against acres of bright sky.

Automatic exposure, even with compensation, is less suitable. Each time you alter the proportion of sky, the exposure changes slightly.

Substitute readings

Your built-in meter is designed to read from a mid-tone. So the easy answer with unusual subjects is to give it a mid-tone from which to read, and set the exposure *manually*.

The professionally recommended metering object is a grey card. Kodak sell them, carefully made to reflect exactly 18% of the available light. Put a grey card near your subject and measure the exposure from it. As long as the lighting is the same (keep your shadow away), the result is virtually the same as an incident-light reading.

Grey cards, though, are inconvenient to carry around, and they tend to get dirty and battered. Do not despair, though, you have your own substitute nearby: your hand. Whenever you want to take a substitute reading, just hold the palm of your hand so that it is lit in the same way as your subject (be careful of shadows again). Point your camera so that your hand fills the field of view, and adjust the exposure controls to suit.

There are two problems with this method: it is difficult to hold the camera and set the controls with one hand only; and hands vary in colour.

To get round the first problem, you may need a to-and-fro approach; set about the right exposure. Measure from your hand, then correct the camera settings. Measure again, correct, measure, etc.

To compensate for the colour of your hand needs a little more work. We will discuss that shortly (see testing your equipment). However, if you are stuck, measure

THE MINOLTA AUTOMETER II

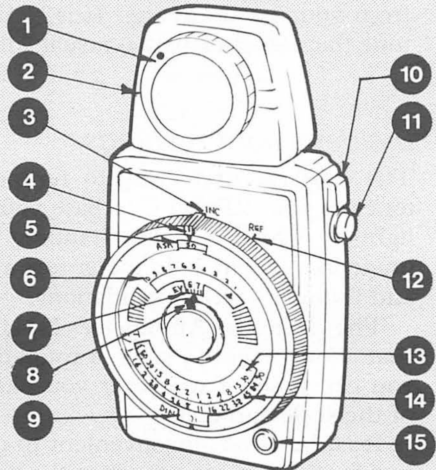
Silicon cell Minolta Autometer II has a motor-drive scale. The single type 544 6V silver oxide cell goes in the compartment at the base.

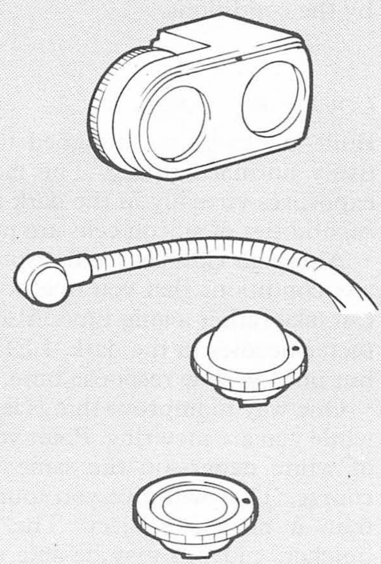
1. Diffuser-mount index.
2. Incident-light diffuser.
3. Incident-light setting.
4. Film speed/meter mode index.
5. Film-speed window (ASA).
6. Reference number scale.
7. Exposure value scale.
8. Out-of-range warning.
9. Film-speed scale (DIN).
10. Button lock.
11. Measuring button.
12. Reflected-light measuring index.
13. Shutter-speed scale.
14. Lens-aperture scale.
15. Battery check lamp.

The viewfinder 10° corrects the meter to semi-spot reflected light readings. Set the main index to REF. The broken circle in the viewfinder indicates the metering area. There is an alternative viewfinder-less reflected light attachment giving a metering angle of about 40°.

The mini-receptor plugs into a jack on the back of the measuring head. 4× and 8× ND diffusers extend the meter's range for 2 and 3 stops brighter.

The flat diffuser allows you to measure illuminance. Set the meter for 100 ASA, then read off the reference number, and convert it to lux or foot candles on the scale at the back. The meter also has a spot sensor for printing exposure measurement.





ILLUMINANCE TABLE (for flat diffuser)

EV	LUX	ft-c	2	10	093	11	5000	460
ASA			3	20	1.86	12	10000	930
100	C = 250	C = 23	4	40	3.7	13	20000	1860
4	0.16	0.015	5	80	7.4	14	40000	3700
3	0.31	0.03	6	160	14.8	15	80000	7400
2	063	0.06	7	320	30	16	160000	14800
-1	1.25	0.12	8	640	60	17	320000	30000
0	2.5	0.23	9	1280	120			
1	5	0.46	10	2500	230			

from your hand anyway. It is likely to be nearer a mid-tone than an obviously unusual subject.

Incident-light readings

The most accurate way to reproduce the colours and tones of your subject is to base your exposure just on the light by which it is lit. Standing by your subject, you point an incident-light meter toward the camera position, and follow its recommendations.

The Minolta Autometer II allows you to do just that. Conveniently, it has a rotatable light sensor so that you can point it wherever you like without losing sight of the scale and dial.

It is, however, inconvenient to carry a separate meter just for those occasions when the built-in system is fooled by the conditions.

Low-light levels

Built-in meters are designed to work best in comparatively normal lighting. The fact that you can measure exposures virtually in the dark is a bonus. The low-light capabilities of silicon cells are particularly impressive.

Although CdS cells will respond accurately in virtually any conditions that you might want to photograph, they can take rather a long time. Also, it is very difficult to see meter needles in the dark. LED displays overcome that, but not the slow response time.

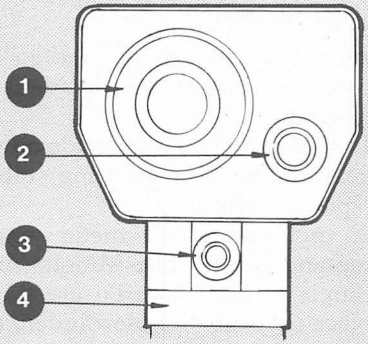
One way to improve things is to increase the light level while you are metering. Point your camera toward a piece of white paper—in the same light as your subject, of course. That will give you four or five times more light than a normal subject. The CdS cells will respond quicker, and you may be able to see the meter needle if your camera has one. As you might expect, this procedure is called *white card* metering.

Naturally, you now have to give four or five times (2 stops) more exposure, just as you do if you meter from snow. In fact, because of failure of the reciprocity law (as we discussed in the chapter on *Films*) you will probably need to give even more exposure.

SPOT METERS

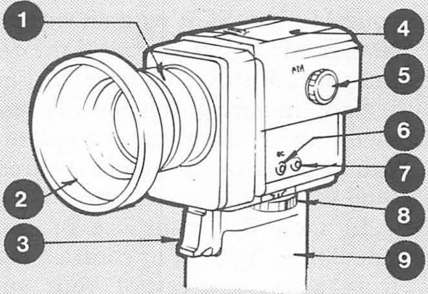
The original Minolta spot meter used CdS cells to provide a 1° reading.

1. Lens (9° image.)
2. Film-speed (ASA) dial.
3. Scale switch.
4. Battery holder hand grip.



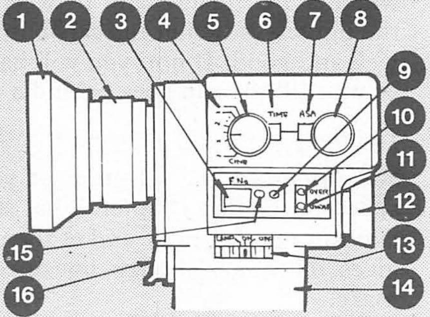
The Auto Spot II has a viewfinder readout, too. EV numbers at the top exposure combination below.

1. Focus ring.
2. Hooded lens.
3. Trigger.
4. Battery chamber cover.
5. Film-speed (ASA) knob.
6. Battery-check lamp.
7. Battery-check button.
8. Main switch; sprung for scale illumination.
9. Hand grip.



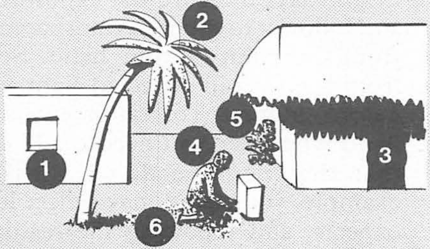
The Auto Spot II Digital shows EV numbers on screen aperture on side.

1. Lens hood.
2. Focus ring.
3. Aperture read-out.
4. Movie scale.
5. Exposure-time knob.
6. Shutter speed.
7. Film speed (ASA).
8. Film speed knob.
9. +2/3 stop LED.
10. Over-range warning.
11. Under-range warning.
12. Eyepiece.
13. Power switch.
14. Hand grip.
15. +1/3 stop LED.
16. Trigger.



You decide which areas should be a midtone.

1. Sunlit white, brightest highlight.
2. Sunlit midtone.
3. Deepest shadow, outside the film's range.
4. Shadowed white—about the same brightness as sunlit midtone.
5. Shadowed midtone.
6. Shadowed black, darkest area with details.



Spot metering

Sometimes you can neither go close to your unusual subject, nor measure the incident light directly or from a grey card.

In that case, you can decide on your exposure either by estimation, or by measuring suitable parts of the scene by spot metering.

A spot meter is a meter with a very narrow light acceptance angle. The Minolta Autospot II meters have an angle of just that. To use the meter you sight your subject through the viewfinder, and measure when the central marker spot covers just the right part. Fitting your Minolta SLR with an extreme long-focus lens has a similar effect (but you need the 1600 mm *f* 11 mirror lens to approach the same selectivity).

Spot metering follows the same rules as any other metering. You can only calculate the correct exposure if you measure from a mid-tone area, or compensate for the tone you do measure from.

In fact, the main use of spot measurements is in calculating lighting or contrast ratios. If you can measure from selected areas of your subject, you can decide whether the relationship between the darkest parts and the lightest is within the capabilities of your film. If it is, well and good. If not, you will have to alter the lighting, or wait till the sun goes behind a cloud.

Testing your equipment

We discussed the selection of your own personal film speed in the film chapter. That should take care of your exposure preferences, and of the exact results your meter gives. There are, though, one or two more tests you could make.

The most important is calibrating your hand. On a bright day, measure the exposure from a normal scene, and follow it to expose a transparency. Then take a reading from the palm of your hand. See how much it differs from the overall reflected-light figure. If it is less than $\frac{1}{3}$ stop, ignore it. You can safely follow readings from your hand whenever you need to. If the difference is greater than that, note exactly what it is and remember it. For example, your hand may reflect less light than the meter expects, and following the reading would then lead to overexposure by perhaps one stop. Once you know that, you can always close your lens down by that much.

It is also useful to know just how your meter reacts to back lit subjects. For this test, you should follow the meter needle exactly, or shoot on automatic with the exposure compensation dial set to '0'. Use transparency film, as with all tests.

Choose a bright day with the sun fairly high in the sky. Place a suitable model on a suitable hilltop with his or her back to the sun. Now take a series of pictures starting about 6 m (20 ft) away and moving closer with each shot until you include just your subject's face. Note the exposure your camera gives for each shot. The idea is for the first picture to be mainly bright sky, and the last to be mainly shadowed face.

After processing, you will see immediately how the flesh tones vary with the exposure, and how that is influenced less and less by the sky as you go in close. The advantage of this information is that you can estimate the correction you are likely to need for any back lit shots you take without time to meter properly. As the meter sensitivity varies slightly from model to model, and in some models changes slightly with production date, it is wise for you to test your own cameras.

M.W.—F

MOVEMENT AND THE CAMERA

If the image on the film moves perceptibly while you are taking a picture, the result will be blurred. It matters not whether it is the subject that moves or the camera. The extent of the blur is determined solely by the amount of image movement while the shutter is open. So, the longer the shutter speed, the greater the blur; and the faster the relative movement, the greater the blur. Choosing the right speed to freeze or blur the movement is a key to good pictures.

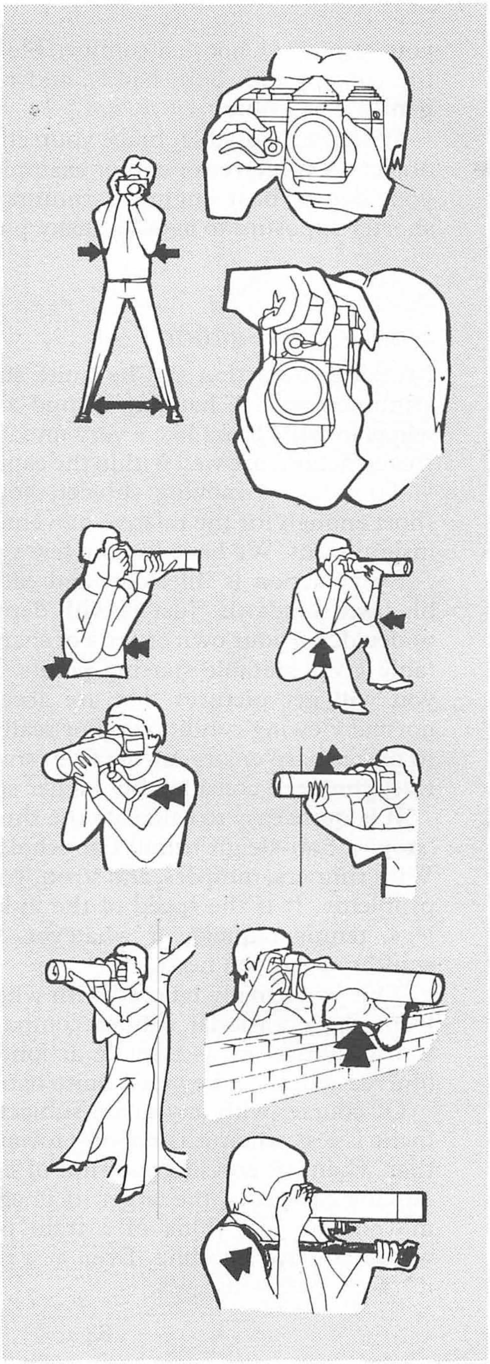
The effect of any particular shutter speed is exactly the same whether you set it manually, as you have to on an SR or SR-T camera, or the camera 'chooses' it, as it does on any of the electronic models. So the speed shown in the viewfinder read-out is the exact equivalent of a speed set on the shutter speed dial. Of course, automatic cameras set the speeds steplessly, thus you do not often get an exactly equivalent speed—you get 1/42 or 1/137, rather than 1/30 or 1/125.

On the automatic cameras, though, (unless you set the metered speed manually), changing conditions may give you an unexpected result. For that reason it is preferable to use automatic Minoltas in the manual (match-needle) mode for moving subjects. The XD lets you use shutter speed priority automation, so that you can set the speed you want, and know that you will get that speed—as long as a correct exposure is possible within the lens' aperture range.

Camera shake

Even the most experienced photographer can spoil his pictures by moving the camera during exposure. With care, though, you should be able to take shake-free pictures at 1/60 second and faster with the standard lens on

HOLDING YOUR CAMERA



The way you hold your camera can help greatly in reducing shake-induced blur. Stand comfortably with your elbows in to your sides. Support the camera and focus with your left hand, while you operate the other controls with your right hand.

With long lenses, you have to be especially still. Support the weight of the lens on your left hand; and tuck your elbows in really firmly. When possible, sit or lie down for extra stability.

A small table tripod can double as a chest-pod. When it is available, use any extra support that you can find.

Whenever possible, lean yourself or your long lens against suitable support.

A 'bean bag' helps when you can lean on top of your solid object. It keeps the camera extra steady.

A rifle grip is probably the handiest field accessory. The Minolta Tele Holder is adjustable to suit all lenses and holds.

your camera. Choose a comfortable relaxed stance, hold the camera with both hands, and release the shutter as gently as possible.

Whenever possible, brace yourself against any suitable object—a wall, tree or car for example. Beware, though, if your car or boat engine is running, you need a much shorter exposure to avoid a shaky picture.

Freezing the action

Freezing the action can be quite startling: water like a crumbled sponge hanging in mid-air; or a seagull with wings in what looks like a very unnatural position. These frozen actions are well within the capabilities of a Minolta.

To freeze a moving subject, you need an exposure short enough for the relative movement of its image to be insignificant. We have listed a few typical examples.

Every action is different, and each photographer has his own standards. Just as with depth of field, you have to decide on your own criteria of sharpness. However, the table gives suitable starting points. If you follow them, you will get pictures that are acceptably sharp under normal viewing conditions. For really critical analysis, or to make sharp enlargements from small parts of the negative, you need considerably higher speeds.

It is quite easy to calculate the shutter speed needed to 'stop' a bob-sleigh team. The whole unit moves as one. With runners, jumpers, and so on, you have much greater problems. It is the speed of the individual parts—arms, legs, tennis raquets, or whatever, that determines the shutter speed you need.

This is normally ignored with wheeled vehicles. Apart from the occasional rubber company, which demands sharp pictures of its tyres in action, we normally accept blurred wheels. They look quite natural.

Of course, with any given subject, the relative movement is less when it is moving toward or away from you than when it is crossing your line of sight. The nearer your moving subject is, the larger its image and so the relative movement. Just think of a train passing the platform where you are standing. Even at a relatively slow speed, it 'races' past your eyes.

at 1/125 second with a standard (50 mm) lens, you will need 1/500 second with a 200 mm.

I have a striking example of this. I photographed a group of zebra at 1/60 second with a 400 mm lens. All were acceptably sharp except for one animal. It turned its head just as I took the picture, and that has come out as a totally unrecognizable blur.

In the same way, the basic shake-free hand-holding speed of 1/60 becomes 1/250 with a 200 mm lens, or 1/500 with a 400 mm one. In fact, that gives us a simple rule of thumb. Set the shutter speed closest to the focal length of the lens (in millimetres) and you will not be far wrong. Of course, with wide-angle lenses, you can use longer shutter speeds without shake. If necessary, you can use 1/15 second quite comfortably with a 17 mm lens, and probably even with a 20 mm one.

The magnification of any movement is why a tripod or other firm support is so much more necessary with long-focus lenses. In practice, you are unlikely to make use of the true optical potential of any Rokkor lens longer than 200 mm if you hand-hold your camera.

Shutters and movement

A focal plane shutter exposes the film sequentially. At fast shutter speeds, the film is exposed through a moving slit. With a horizontally moving shutter, the image on one side of the frame is recorded about 1/80 second before that on the other edge. If, during that time, the subject moves significantly, its image will be distorted.

For example, a racing car may move 2 or 3 feet in that time. If you were to take a static camera picture of such a car passing across your field of view, and filling most of the frame width, it would appear to be lengthened or shortened. With a car travelling from left to right, the back is photographed first. By the time the front is photographed, it has travelled some distance. The effect is to stretch the car out somewhat. A car travelling in the other direction is contracted by about the same amount.

However, you are so unlikely to attempt such a picture that the image distortion is of no real importance. Panning with the subject, of course, avoids it entirely. Vertically travelling shutters cross the film quicker, and the chance of visible distortion is even less.

Freezing flash

Really close, and you need exceptionally short exposures, beyond the capabilities of a normal shutter. Here, a 'computer' flashgun is marvellous. For example, the Minolta Auto Electroflash 200X has a guide number of 20 m (60 ft) at full power. It has a full flash duration at 7 m of about 1/1000 second. At 1 m, to produce the same light intensity it cuts off the flash after about 1/40 000 second. On this flashgun, you get exposure times of 1/6000 second or less whenever you are on 'Lo'.

The same principles apply to any computer flashgun, and take you well into the realms of laboratory high-speed photography. You can certainly freeze the crown produced by a drop of milk, or the pieces of a shattering light bulb. There is, of course, still the problem of taking the picture exactly at the right moment.

With actions like these, you cannot expect your reactions to be quick enough—though some clubs run 'quick-draw' contests to test this. You need a mechanical flash release mechanism. With a little expertise, you can construct a suitable trigger mechanism. Alternatively, some accessory suppliers sell light sensors that will fire your flash just as a moving object passes them; but then, of course, you must operate in darkness with the shutter held open until the flash has fired. Nevertheless, these gadgets leave the way open to numerous ingenuities; and, one hopes, interesting pictures.

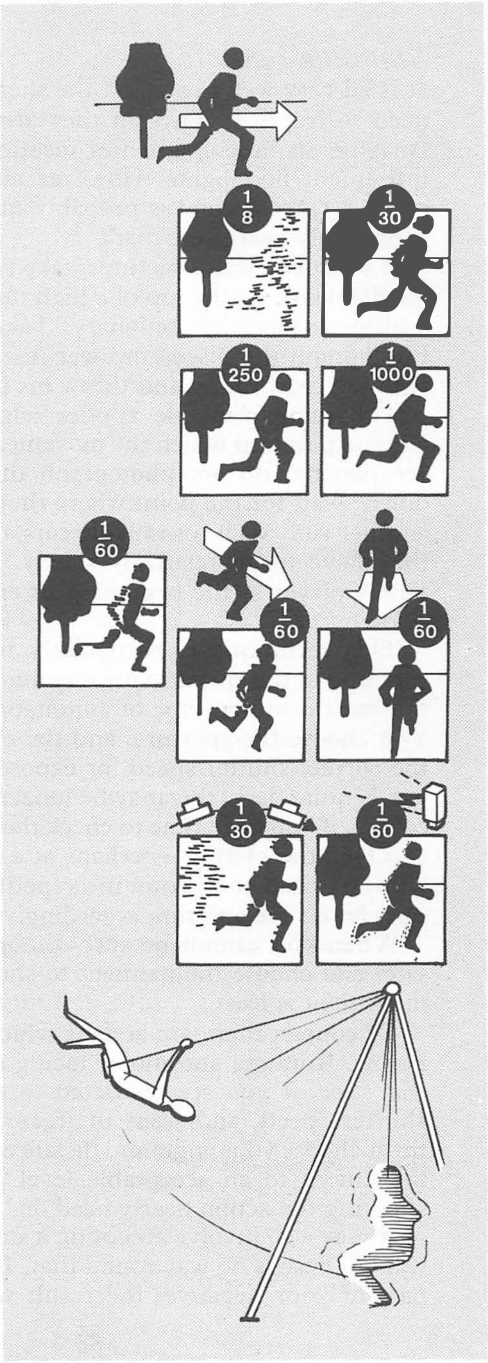
Returning to the more mundane, electronic flash is ideal for stopping much indoor movement. A flash duration of around 1/1000 second matches your outdoor action capabilities. It is fine for pancake tossing or children playing, and can even manage most indoor sports.

Do be considerate, though. Competitors are not going to thank you for half-blinding them with a brilliant flash in the middle of a critical game.

Lenses and blur

We have so far in this chapter ignored a very important fact. The focal length of the lens determines the size of the image of any subject. Longer focus lenses magnify the image; so they magnify the movement. Thus, if you know that in a particular situation, a train comes out sharp

MOVEMENT



Assuming your camera is steady; the shutter speed controls the way moving subjects come out. A runner just filling the frame comes out sharp at 1/1000 second. At slower speeds, he comes out progressively more blurred. You choose the effect you want.

The direction of the movement affects the blur. Movement directly toward the camera is the least seen.

Even at slow speeds, you can produce a sharp picture if you pan accurately with the movement. That, of course, blurs the background. Electronic flash can freeze the action irrespective of the shutter speed—unless the ambient light is too bright.

Many actions have a static point, such as the top of a swing. Choose that, and you can take sharp pictures irrespective of the shutter speed, within reason. Of course, at its lowest point, a swing is moving at its fastest and most blurring.

Stationary points

It is all very well to suggest the short shutter speeds you need to freeze action; but they are often unobtainable. Imagine an indoor athletics meeting, lit just by rather infrequent floodlights. However fast your film (within reason) 1/250 second is probably quite impossible; 1/30 is probably nearer the mark.

If you need sharp pictures, take them when the movement is least. At the top of a high jump or pole vault, the jumper is virtually stationary. Take your picture then. Photograph the discus thrower just as he is 'wound up' ready to twirl round and throw his projectile.

The same principle applies whatever your subject. Choose points at which the movement is least. If children are playing, do not photograph them running up and down; wait for the point where they turn before making another run. Wait for rallying cars at a sharp bend where they have to go relatively slowly. Photograph a golfer tennis player at the beginning or end of his swing; and so on.

This technique is particularly useful when you are shooting in the aperture priority automatic mode. That is the most common type of automation in Minolta SLRs. You choose the aperture, and the electronic system sets the correct shutter speed for exposure. When your subject is quite dark, this may be longer than you expect. Of course, if you have time to check the shutter speed before you take the picture—perhaps at a previous attempt, or with an earlier competitor in a repetitive action—then you can choose the aperture accordingly.

When you cannot be sure, though, it is better to be safe, and choose the moment to shoot when the relative movement is least.

Of course, there are actions which have no stationary points. Running and motor racing are two examples. In that case, if you are restricted to a comparatively long shutter speed, and want to freeze the movement, you must choose your angle and distance to reduce the relative movement to an acceptable level. That usually means shooting the action nearly head on.

It may also involve accepting a smaller image than you want. There is no way round that. If you were to enlarge part of your negative, the result would be exactly the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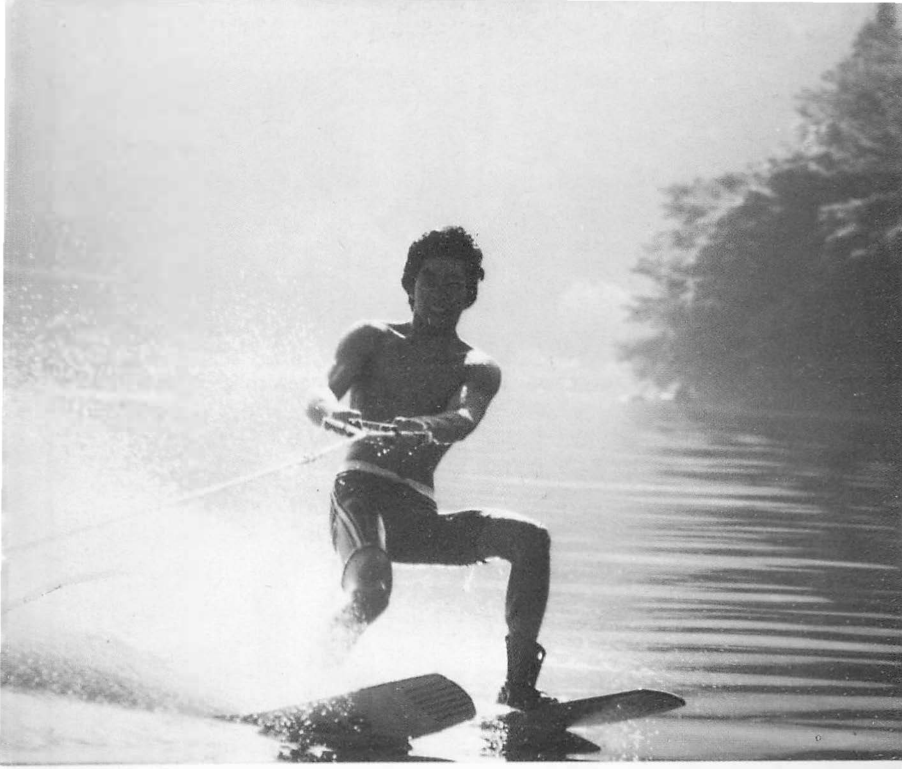


SPRAY

Above. Against the light, the flying splashes sparkle. With a relatively long-focus lens, the photographer needed a fast speed to freeze the droplets, slight under-exposure produces the silhouette.

SPEED

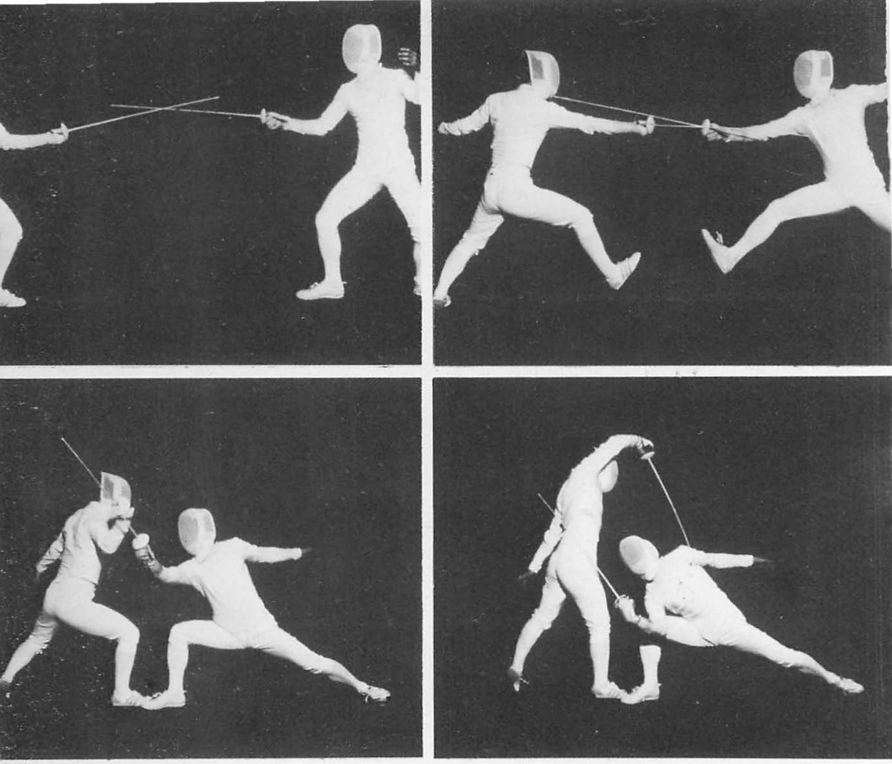
Opposite, top. Panning with the movement, at a reasonably long shutter speed gives this boat a real sense of speed.

WHITE WATER

Opposite, bottom. A high speed again, to 'freeze' the boiling turmoil reveals the skill of these canoeists.

STRAIGHT ON

Previous page. With the 1600 mm RF Rokkor, the photographer could select only 1/250 second. This produced a sharp picture because he chose to picture the competitors travelling directly towards him. (All from colour transparencies.)



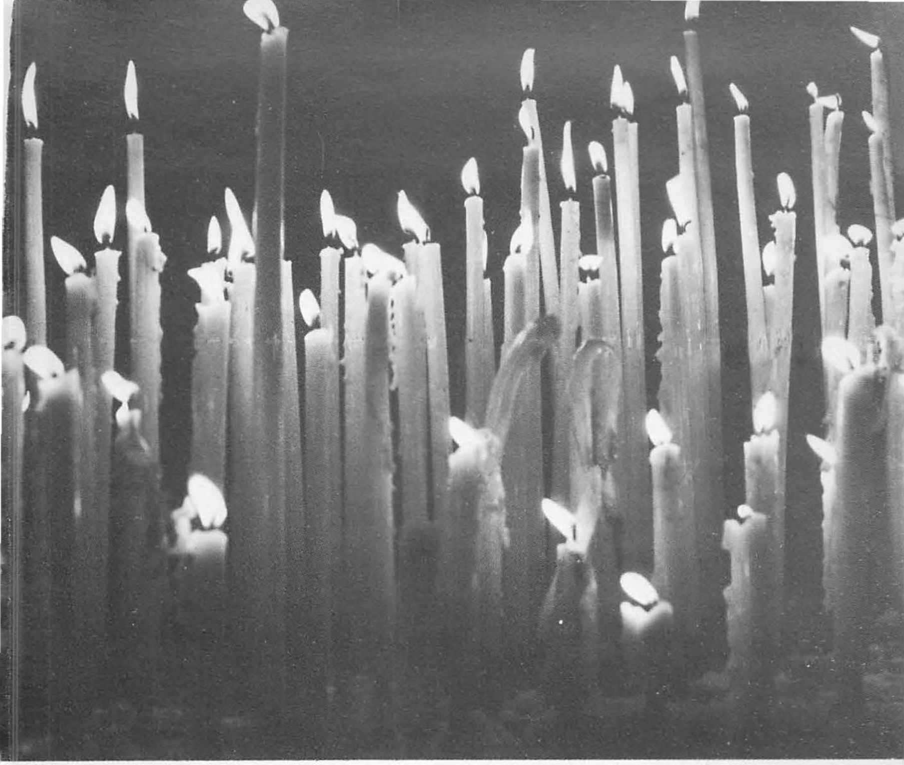
FENCING SERIES
Equipped with a power winder, or an XM motor drive, you can represent action as a series of shots. Sometimes, an equally-spaced 'continuous' sequence is best; other times use the power wind to the ready for the moments you need. (From colour transparencies.)

SLIDE DOWN

Above. You can pan diagonally if that's the way your subject goes. Here I used the 85 mm *f* 1.7 MC Rokkor with 1/30 second exposure as the little girl slid down – *Clyde Reynolds*.

STATIC MACHINE

Overleaf. Collector's specimens are often stationary. Few photographs can do more than record them. Choose a pleasing angle, and avoid extraneous detail. I used the 85 mm *f* 1.7 Rokkor at *f* 2.8 for this transparency.



WATER IN MOTION

Above. Natural water often looks its most attractive if it is blurred in motion. A shutter speed of around 1/60 second is usually right with a standard lens. (From a colour transparency.)

CANDLES

Previous page, top. Go in close to simple subjects to produce a striking composition. A standard (50 mm) lens and unbiased automatic exposure was right here – *Beatrice Reynolds.*

TILE PATTERN

Previous page, bottom. Early morning sun set these roof tiles in stark relief. The 75–200 mm MD Zoom Rokkor gave ample choice of framing for this colour shot – *Clyde Reynolds.*

same as going closer, or using a longer-focus lens. Your subject would be blurred.

Do you want it sharp?

There are few pictures as dead-looking as those of a racing car frozen stiff as it travels past at 150 miles per hour. How much better such pictures look with a suitable amount of blur to show the movement.

At the most simple level, you just have to use a longer shutter speed to induce the blur. For most subjects, four to eight times the longest possible freezing speed is a good starting point. Thus, if you decide that you need 1/500 second to get acceptably sharp pictures of a moto-cross event, you need about 1/60 or 1/125 to get reasonably blurred pictures.

Such a technique is particularly attractive with moving lights. A night shot, say 1 or 2 seconds, of a fairground can look like an abstract firework display with lines and swirls of light merging into a scene of fantasy.

More difficult, but equally intriguing, is a firework display itself. With a long exposure, on B, your film charts the path of each spark of coloured light. Then there are the ever-popular shots of night traffic. Each light reinforcing the one before to produce continuous ribbons of light.

Panning

Most pictures of moving subjects, though, look better if the main subject is sharp, and the background blurred. In fact, it is hard to imagine the side view of a ski jumper without the diagonal blur of a smeared background. To achieve that effect, you just have to move the camera with the subject. The technique is commonly called panning.

The shutter speed you choose, of course, determines the amount of blur in the background. Basically, for the effect most people prefer, choose speeds about the same as those we recommend for blurring the subject. Do try a whole range, though, until you are sure of what you want. With really careful panning you can take sharp pictures at speeds as long as $\frac{1}{8}$ second.

The way to follow your subject is to swing with the camera. Take up a nice comfortable feet-apart stance facing the position you expect to take the picture. Now turn as far toward the place your subject will appear as possible. Sight your auto-cross rider through the viewfinder. Swing smoothly round as the rider approaches, keeping his image in the same position on your viewfinder screen. Gently depress the shutter release as you face forward again. Do not stop moving there though: carry on swinging round. A smooth follow through is important if you are to achieve sharp pictures.

Naturally, the closer you are to your subject the faster you need to pan. This means that for a given image size, you need to swing quicker with shorter-focus lenses. Long-focus lenses are easier to use, however, they introduce their normal conditions, and magnify any errors you may make in the pan.

Panning with a short-focus (wide-angle) lens close to a moving subject has an additional effect: only part of the subject comes out sharp. Suppose you follow a racing driver's helmet accurately as he drives past a few feet from your camera. The centre section of his car will come out sharp, but the nose and tail will be very blurred. The effect is almost like a zoom burst.

If you are interested in action photography, it is well worth practising your panning technique; you do not need any special subject—a busy road is ideal. Pan with one vehicle after another until you are sure that you can keep your subject just where you want in the viewfinder. Then train yourself to release the shutter just at the right moment. Of course, as with any moving subject, you have to begin to press the shutter button just a little before you want to take the picture.

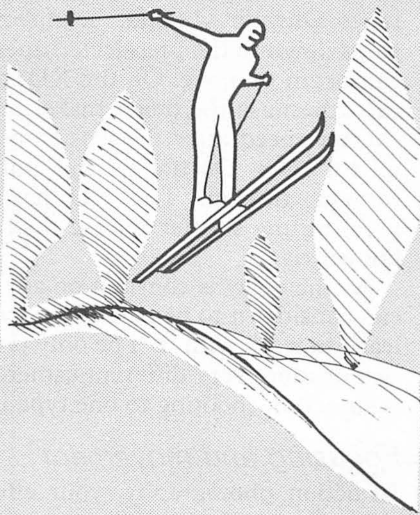
Timing action

Two factors combine to delay your picture taking. Your reaction time, and the mechanical delay in your camera.

Reaction time is important. It is the time it takes between your decision to make a movement and your actually making the movement. Just as when you are driving a car you travel some distance between seeing a hazard and applying the brakes; when you are taking a picture your subject can move some way after you decide to press the button. You must learn just how long that delay is, then you can anticipate your action shots.

Mechanical delay is essential in all cameras. Several

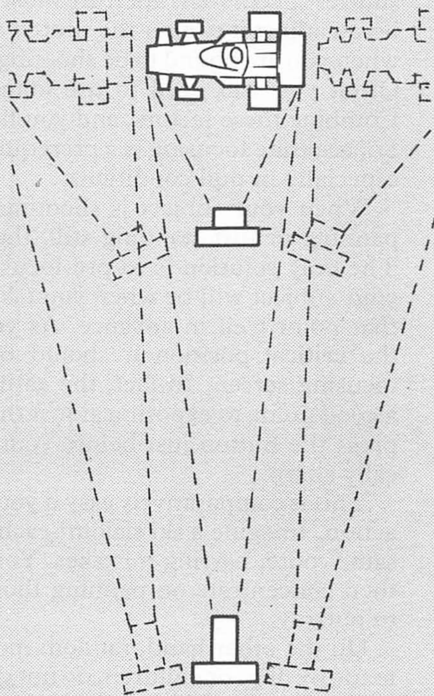
PANNING AND MOVEMENT



Follow a moving subject accurately, and you achieve a sharp picture against a blurred background.

The degree of blur depends on the shutter speed, and on the rate of pan. For most fast-moving subjects 1/60 or 1/125 is about the right choice. Note, of course, that you must follow the speed and direction of your subject.

To pan, you turn from the hips and pick up your target in the viewfinder well before you want to take the picture. Swing with your subject, release the shutter at the correct point, and follow through well.



The longer the lens you use, the less you need to give to cover the same distance. However, at the same time, the greater the need for accuracy. The slightest relative movement can produce an unacceptable blur.

parts have to move when you release the shutter. Single-lens reflexes have more moving parts than other camera types. On your Minolta, the mirror moves up and the lens stops down to the preselected aperture before the shutter can begin to move. On the XD, the sequence is complicated because the meter makes a final adjustment to the shutter speed after the lens stops down, and before the mirror rises. Do not let this put you off this excellent camera, though. The XD has a shorter delay after pressing the shutter release than have some of its best-known rivals.

As the delay is constant on any particular camera, you can consider it to be part of the overall reaction time, and learn to work with it. The only problem comes if you use two or more very different cameras. In that case, confine your action shooting to one type if possible.

Focusing and movement

In action photography, your effect is decided by your shutter speed. Lens aperture must take second place (even if you adjust it to alter the shutter speed). There are times when you are bound to be shooting at very wide apertures. Often you will need to use longer than normal lenses. Combine these factors, and you have little depth of field. So, accurate focusing is a prerequisite of sharp pictures—especially in dull conditions.

When your subject is shooting past, whether you are panning or just standing still, there is no time to focus. The only solution is to pre-focus. Decide exactly where your subject will be when you take the picture. Focus on that point well in advance. As your subject approaches the critical position it should become sharper on the focusing screen. In fact, the gathering sharpness can be a good guide to exposing at just the right point. You must press the button just before your subject becomes critically sharp.

This is comparatively easy if you are picturing repetitive action. Imagine a ski slalom: each competitor follows the same route, barring mistakes. You can focus on the first, then concentrate on panning those of the rest you want to portray.

On the other hand, random movements, such as those made by dogs or children, do not give you that help. When you are photographing them, use a zone-focusing technique. Choose a lens and exposure combination that gives you a reasonable depth of field—confine yourself to peaks in the action if needed. Focus your lens on a point in the middle of the play area. Check your depth-of-field scale, and note the nearest and furthest points of sharp focus. Locate these points in the scene. If there are no natural features to help, put down unobtrusive markers. Now you know that within the limits you have set, your subjects will be sharply focused. You can concentrate on picturing the action.

Films and filters

Naturally, as always, your lens aperture is determined by the shutter speed you need, the lighting, and the film speed. As we have noted, the shutter speed is decided by the picture you want, and you can probably do nothing about the light level.

You can, though, decide on the film speed. Moving subjects are the main impetus for using high-speed films. Even though such films (especially if you uprate them) have lower resolution than slower ones, they are likely to give you sharper results. You can combine reasonable depth of field with effective action stopping. Of course, in the ultimate conditions, such as indoor sport, you need uprated fast films (say 1200 ASA or more) to give you even recognizable pictures.

Conversely, if you want to exaggerate movement blur, you may need very low sensitivity. For this, neutral-density filters are ideal. Their function is to reduce the light reaching the film without altering its colour. There is more about them in the chapters on *Films* and *Colour and Filters*.

One curious thing about moving subjects is that if they occupy part of your picture for a small enough proportion of the total exposure, they do not show up at all. Imagine a market square on a Sunday. People walk in and out, a few stop for conversation, maybe sit a few minutes, then carry on their way. There is no market, so no one stops for too long; but the square is never empty either.

You can take a picture of the square without people. Fix your camera in position, fit suitable neutral-density filters; and open up the shutter, set on B, with a locking cable release. Lock the shutter open, and leave it for an hour or so. If you are lucky, and no one stood still for more than 5 minutes or so, your negative will show the square, but none of the passers by.

Adding blur

You can 'freeze' a moving subject, reveal its motion or even ignore it with simple changes in technique. You can go further—exaggerate speed, or even simulate it.

Suppose that you pan, very carefully, with a tortoise as he walks past. Take a photograph with $\frac{1}{4}$ or $\frac{1}{2}$ second exposure. The resulting picture shows an apparently maniac animal careering across the garden. Of course, you cannot expect to pan smoothly enough with a hand-held camera, but a pan-and-tilt tripod should solve that problem.

Further, you can move the camera so that a static subject appears blurred. There are few cases in normal lighting where such an effect makes a picture. At night, though, there are often glowing points of light to picture. Perhaps the lights of a town seen from the air, or again, a fairground. Open your shutter, on B, and move the camera across the scene; up and down, around it, or however you fancy. Each sparkling point will be smeared out and will trace the path your camera made.

The earth goes round once every day. You can demonstrate that quite simply with your camera. You need a clear, moonless night. Go well away from any artificial lights (houses, streets, towns and so forth). Set your lens on about *f*4 or *f*5.6 with reasonably fast film. Set your shutter on B and lock it open. Leave your camera there for several hours. Then close the shutter. On developing, the film will show trails of the stars, each one following a circular path as the earth revolved below them. If you left the camera there for, say, 3 hours, you will find that each track is just one-eighth of a full circle; demonstrating the earth's 24-hour rotation.

Speed streaks

Comic strips have established the streak effect emanating behind a character as a symbol of speed. With a little care you can produce the same effect.

You need complete darkness. Set up your camera on a tripod. Put a dim light low down facing the camera, but not shining into the lens at all. This light will illuminate the back of your moving subject. If your subject runs between the light and the camera with the shutter held open (on B) he will record as a series of streaks where the light strikes. That gives the speed streaks—now for the main exposure.

Just before you close the shutter, fire a flash (with its test button) from a suitable position near the camera. That gives you a single frozen image. Your comic-strip picture is complete.

LIGHTING

Photographs are formed by light. The direction, strength and harshness hide or reveal the features of the subject. Choosing or manipulating the lighting is a major way of controlling your pictures. Since the earliest days, painters have used 'shading' to define the shapes of their subjects. In the same way, photographers use the 'modelling' provided by suitable lighting to reveal the third dimension.

Sunlight

Bright sun is the most popular photographic lighting. It is also one of the least satisfactory for many subjects. Strong sunlight is very harsh. The areas where it strikes the subject are brilliantly illuminated, and the shadows are very dark. Our eye can penetrate them, but in a photograph they often come out as black holes.

When the sun is somewhere behind you, it illuminates landscapes or townscapes well. The different colours and tones are sharply defined, producing clear sparkling pictures—in colour or black and white. Introduce people, though, and you begin to be less successful.

If the sun is at all high in the sky, it casts shadows in their eye sockets, producing a strange almost eyeless effect. What is more, if you can see the eyes, they are screwed up as your subjects squint into the sun. The effect is not flattering at all.

As you turn round toward the sun, the light comes more from the side. Its harshness is further emphasized. Strong side lighting can give you dramatic landscapes, especially with low morning or evening sun. Those dramatic black shadows are an important feature; but make sure that you know just how much of your picture they will occupy. They can be overpowering.

Harsh dramatic pictures of people are most unflattering. Strong sidelighting is probably the most cruel. It can turn the most attractive model into something resembling a witch—not the best way to impress.

Deciding on the exposure is a problem. Films are not capable of reproducing detail in the brightest sunlit areas and in the deep shadows. If you take a general reading of mixed highlight and shadow, you will get white highlights and black shadows. Great for dramatic patterns, but for little use.

The normal practice is to expose for the sunlit areas and treat the shadows as black emphasis. With the sun behind you, that is the exposure your meter will suggest. For sidelit shots, turn away from the sun to take a meter reading (assuming that the subject is more or less similar). You can set that exposure manually on every camera except the 110 Zoom SLR. On that move the exposure compensation slider to give you one stop less exposure if your sidelit picture is more than about one-third heavy shadows.

On the automatic models, if you prefer to do so, you adjust the exposure with the compensation dial after composing your picture. Remember the shutter speed indicated by the meter, and turn the dial to give that speed for your picture.

Skylight

Of course, when the sun is shining, there is some light coming from a blue sky. It is not enough, though, to reduce the harsh shadows to a reasonable level. Further, it is blue. This is particularly noticeable in snow scenes. All the shadows take on a bright blue hue in colour pictures. You can correct that with a suitable filter if all your subject is in the shade; but not with mixed sun and shade.

Brightness range

On a bright sunny day, areas of deep shadow may be receiving less than 1/10 of the light reaching the sunlit parts of a scene. The difference between the darkest and lightest parts of the subject (black and white paint, perhaps) is likely to be at least double that. Combining the two gives a total brightness range of 200:1.

In black and white, you can use special low-contrast techniques to compress the range of brightness into a

M.W.—G

print. With colour films, you are restricted to the contrast provided by the manufacturer. The problem is emphasized, too, by the colours. Overexposed areas produce pale washed-out colours, and underexposed parts overstrong coloration.

Modern colour films can work quite well with a brightness ratio of 20:1 or 30:1. Prints from negatives or transparencies however, have a much lower range, and often are less satisfactory than transparencies for reproduction of high contrast subjects.

You can measure the brightness range with a spot meter or by going close with your through-the-lens meter. If the subject makes that difficult, you can measure the lighting ratio instead. Any even-toned card or similar object will do as a test target. Measure the exposure with the card lit by the main light source (the sun, for example) then turned away so that only the light that reaches the shadows reaches the card. With a normal subject you get the most attractive transparencies if the lighting is around 4:1 (ie just 2 stops difference).

If you can, try to brighten the shadows with reflected or extra light. Otherwise, calculate your exposure so that the brightest important highlights are correctly exposed. That normally means giving not much more than the normal bright sun exposure; in other words, virtually ignoring the shadows.

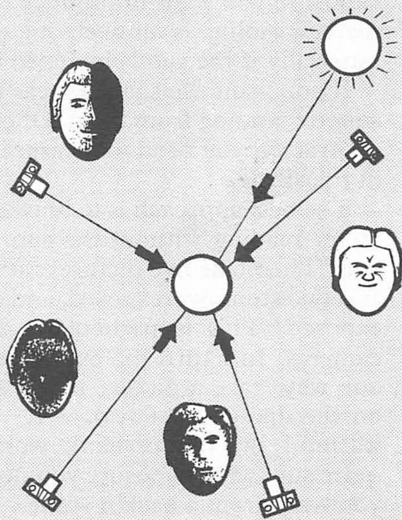
Backlighting

Once you turn toward the sun, everything becomes different. The shadows that could be a problem with sidelighting are now the main part of your picture. For most effect, they need to show little detail. Your picture is made by the brilliant highlights where the sun picks out the top edges of your subject.

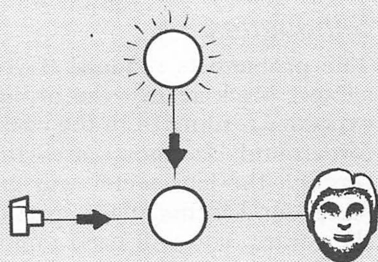
'Contre-jour' pictures—as backlit scenes were once commonly described—are still considered a little daring. In fact, they are just making full use of the camera's potential. Naturally, they need some surfaces to sparkle. Water or shiny leaves are popular subjects. Going closer, the technique is particularly attractive with hairy subjects—plants or animals, for example. Each hair glows individually, producing a halo-like effect.

With strong backlighting, you have to decide on the

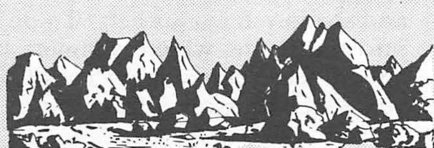
LIGHTING WITH THE SUN



The sun's direction determines the lighting in your pictures. It is striking and high contrast on bright days, but the directional effects are the same even when it is quite cloudy. Of course, when it is really dull, the light is virtually directionless.



Direct overhead sun is particularly unflattering.



Scenery too, benefits from the most suitable choice of lighting. Even overall illumination is fine for picturesque locations, but often a more dramatic approach adds its own attraction.

exposure you want to produce the right effect. A normal meter reading is unlikely to produce an ideal result, especially if the sun is included in your picture.

If you want the shaded areas to show some detail, take a meter reading from them. Of course, to reproduce them accurately, you need to measure from a mid-tone subject in the shade.

The best approach is to bracket your exposures. Take a meter reading without the sun shining directly into the lens. Then take five pictures: at the metered reading, one and two stops overexposed, and one and two stops under-exposed. This is particularly easy with the automatic cameras. Just turn the exposure compensation dial fully one way; take a picture there, and at each other setting on the dial (+2, +1, 0, −1, −2). This sounds a little wasteful, but it is certainly worthwhile until you can be quite sure what exposure you need to give you the results you want from a backlit scene.

Silhouettes

The problem is reduced if you want your foreground subject black against the brilliant background. Take an exposure reading from the background alone. Ignore the foreground. In most cases that is the exposure your through-the-lens meter will give you. If, however, the foreground forms a large part of the scene, especially in the centre, you will need to give less exposure than the meter suggests.

With manual exposure, close the lens down one or two stops from the metered reading. On automatic, select −1 or −2 on the compensation scale. This reduction in exposure has the effect of intensifying any colours in the background—a particular advantage with sunsets.

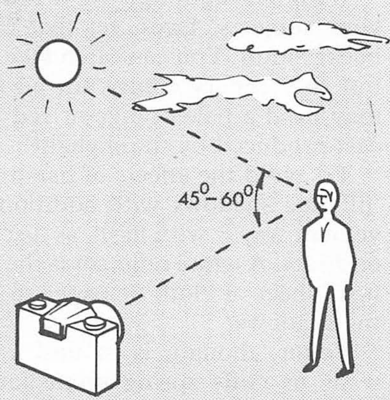
People in the sun

As we have discussed, brilliant sunshine is nowhere near ideal portrait lighting. If it is unavoidable, though, there are some ways you can help.

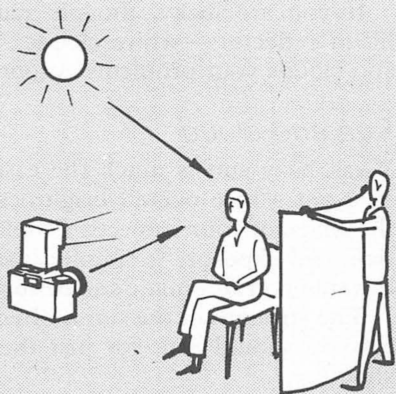
The most important thing is to avoid screwed-up eyes and shadowed eye sockets. To do so, you must either go into the shade, which is almost like shooting on a dull day; or face your subjects away from the sun, which gives you either back- or sidelighting.

LIGHTING PEOPLE

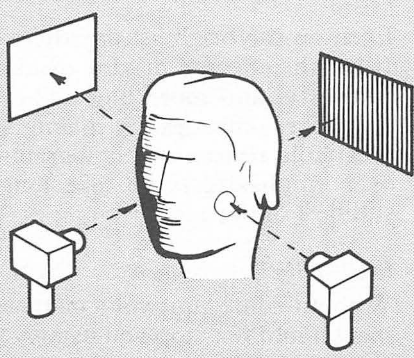
Attractive portraits outdoors depend on the right conditions. Slightly overcast sun is almost ideal. Not too high in the sky, though, and well to one side of the camera. Avoid sun-over-the-shoulder shots whenever possible. They are often less than the best.



When the sun glares from an open sky, the contrast is often too high. The simplest way to throw light into the shadows is to reflect it from suitable white material—even a white-washed wall. Alternatively, you can use fill flash.



For complete control, you need to measure the lighting ratio in your portraits. For flattering colour shots a 3:1 ratio between main light and shadow regions is ideal. For other purposes, you may want more lighting contrast—up to about 8:1 (3 stops), for 'character' studies in black and white.



With backlighting, you just take a meter reading from your subjects' faces, set that exposure, and ignore the background. You can often take quite attractive pictures, but the scenery comes out all pale and faded, and you may need a pale orange or red filter to remove the blue cast produced by the skylight.

To avoid the effects of harsh sidelighting, you have to 'fill' the shadows with additional light. The most convenient way is with flash, as discussed in the next chapter on *Flash*. A white reflector is the alternative. You can hold up a sheet of cloth or paper to reflect the sun back into the shadows.

Better, though, is to find a natural reflector. White walls or cliffs spring immediately to mind. Pose your subjects as close to them as possible; the difference will be really striking.

If you are lucky, though, nature will provide ideal fill-in reflectors—white clouds. With a mixture of sun and clouds your problems evaporate.

Sun and clouds

Weak hazy sun is much the easiest photographic light. You get a nice overall brightness. Pale shadows define the shape of your subjects. People look their most attractive, and exposure is simple: just follow the meter. You can shoot on automatic and be sure of excellent exposures.

The strength of the sun is often variable in light cloud. So you should wait for just the right emphasis before shooting.

Haze

Even on the brightest day there is some haze in the air. It has the effect of making distant scenes look softer, less contrasty, and more blue. The blue distance has been used for centuries by painters, and has become an inevitable feature of photography. Colour films tend to over emphasize it, so take long-distance shots on the sunniest of days.

Dull days

Without some sun, your pictures have less sparkle; but that should not stop you using your camera on dull days.

It should, though, make you think more carefully about your subjects.

Apart from slight shadows underneath, the overall lighting gives little modelling; and shapes tend to become rather confused.

When the weather is dull, colours come out much less bright; and black-and-white pictures tend to have a flat look. There is little to portray shape, distance, or even size. To be successful, you have to concentrate on comparatively close subjects. Choose striking colour compositions, easily recognized objects, or strong patterns. Of course, there are plenty of splendid misty views to take; but even those need extra careful composition to come to life in a photograph.

To make the most of the colours of your subject, be slightly mean with exposure on transparencies, and generous on negatives.

Rain and snow produce an added dimension. Glistening roads or white fields reflect the light up. This reduces the modelling still further, making colour and pattern even more important.

Lighting indoors

Modern flashguns are very simple to use, and give reliable exposures. For example, an Auto Electroflash 32 on your hot shoe can give you accurately exposed pictures of subjects up to 5.7 m (18½ ft) away. Unfortunately, portraits are seldom pleasing. The lighting is flat and uninteresting; faces stare blankly out of an apparently dark room, quite often with bright red eyes; and your subject casts a strong black shadow on anything close behind.

The next chapter discusses ways of improving flash pictures; but here we are looking at other forms of indoor lighting.

Window lighting

Daylight streams in through your windows. It is not, though, particularly bright for photography. We will look at the exposure problems as we go along.

Window lighting is also rather patchy and directional. To get typical sun-over-the-shoulder pictures, you can stand with your back to the window. The effect is rather like the lighting outdoors on a dull day. Good for architectural interiors, but not very exciting for taking pictures of people, animals, or even still-life.

To show off faces to their best advantage, you need to light them from one side; and preferably somewhat from above. For a single portrait, seat your model quite close to the windows, and shoot from near the outside wall of the room.

See how just one side is lit. By altering your relative positions, you can change the balance between light and dark areas. Move your subject away from the window, stay close to it yourself, and you nearly get more frontal lighting which is more flattering. Conversely, take the camera nearer the inside wall; and with your model close to the window, the light falls much more obliquely on her face. That can give great emphasis to character in older people. The strong crosslighting shows up every hair and wrinkle.

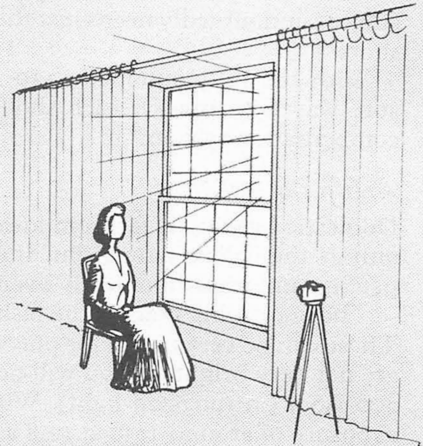
There is still a problem with lighting ratio—especially on colour film. The light coming directly through the window may be 30 or 40 times as bright as that reflected back by the room. So the shadows are receiving relatively less light than they would outdoors in bright sun.

The answer, once again, is a reflector. A white sheet is ideal. Support it just outside your picture area so that it lightens the shadows. Keep the reflector as near the camera's viewpoint as possible. Otherwise you may overlight the wrong parts of your subject, cheeks and ears in particular. Remember, though, that the shadows need to look rather lighter than you expect for them to come out right in the picture.

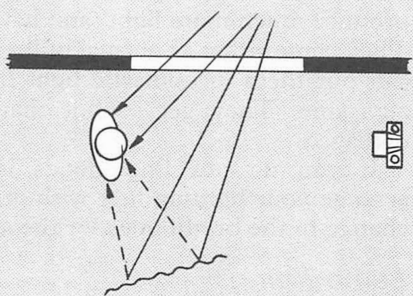
As the lighting is very uneven, and room interiors are seldom a suitable tone, you have to be very selective with your exposure metering. When you have set up your reflectors, take an exposure reading from your subject's face alone, or from a suitable substitute. Use that for your exposure calculations. Exposure times can be quite short. With 200 ASA film, you will probably need about 1/30 at *f* 5.6 near a big window on a bright cloudy day.

This is another case where you are better not relying on an automatic exposure system. Imagine a room with dark walls and white window surrounds. Just moving your viewpoint a little can change the meter reading by a

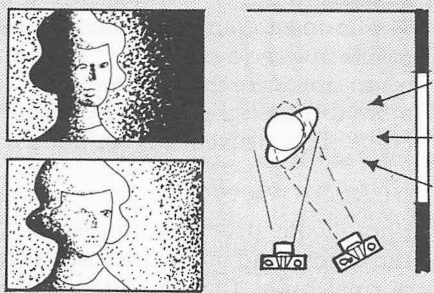
WINDOW LIGHT



The light just inside a window is strong enough to allow you to use a reasonable aperture and shutter speed for portraits. It is easy to move your sitter around to provide the direction you need.



The light streaming in is strongly directional. To reduce the contrast, you often need a white or shiny reflector.



As you move your sitter nearer the window, and your camera way into the room, so the lighting becomes more glancing and less flattering.

couple of stops, as the background changes. Yet your subject undoubtedly needs just the same exposure in both shots.

With the fully automatic 110 Zoom SLR, your only sure way is to bracket each shot by using the exposure compensation system.

Artificial lighting

Domestic lighting is far from ideal for photography. Not only is the colour wrong, but the light is normally very patchy, and much too nearly overhead.

The one saving grace is the fashion for little spotlights. These can be very useful for photographic lighting. They are not very bright, so you will need film rated at least at 400 ASA (in tungsten light). With that, you can expect exposure of around 1/30 at *f* 2.8 as long as your lights are reasonably close (not more than 2 m or 6 ft away).

Much more useful, and not particularly expensive, are Photoflood lamps. These look like ordinary bulbs, but produce much more light (and have a much shorter life). They come either as normal bulbs or reflector spots. You can put them in domestic light fittings, but this is not advisable. They get so hot that the fittings may be damaged.

If you do put Photofloods into ordinary holders, arrange your lighting first with ordinary bulbs, and just change to the bright ones for the actual photography.

Lamp fittings

Built-in reflector Photofloods behave just like their domestic equivalents. They produce a mildly directional light. The ordinary bulb-shaped Photofloods, though, can go into a number of different fittings.

The most common reflectors look like large pudding basins about 30 cm (12 in) in diameter. They produce a beam similar to the reflector bulbs. Larger bowls produce more diffuse light, smaller ones more concentrated light. None of the usual fittings mimic a projector type spotlight.

Studio-type lighting

Photofloods provide low-cost lighting. Studio lamps, on the other hand are much more versatile. These use more normal bulbs that provide a slightly more yellow light.

In fact, most artificial-light colour film is now balanced for this colour, rather than for Photofloods, but the difference is not critical.

Studio lamps use either mains voltage theatre-type bulbs, or tungsten halogen bulbs. Some of the latter operate on low voltage power supplies, so they must be fed from a transformer.

The lamp fittings for studio lamps vary from the simple 'movie lights' to sophisticated profile spots. Movie lights, and similar units, produce reasonably concentrated light, rather like the internally silvered reflector bulbs. Unfortunately, though, many of them produce an uneven spread of light. The double reflector ones are the worst. They cast double shadows, which are quite unacceptable.

The more sophisticated studio lamps, though, are the ideal photographic lighting. They have relatively long life (whether used with normal or tungsten-halogen bulbs) and provide enough light for conveniently short exposure times at moderate apertures. With adjustable lensed spotlights, you can put the light exactly where you want it. By altering the beam angle (where that does not alter the area of subject being lit) you can alter the light intensity.

As with all other continuous lights, ie not flash, you can see exactly what effect each light has, and measure the lighting balance if you want to.

If you use these lamps, though, do stick to photographic bulbs. Theatre, projector, display, and other bulbs are made to different specifications. They are unlikely to be the right colour for photography, and they may not have the same light output as apparently similar photographic bulbs.

Studio lamps use a lot of electricity. Be sure that your total current consumption is well within the capacity of your wiring.

Basic set-up

The primary aim of lighting is to illuminate your subject. The way you do that, though, has a vital bearing on the way it comes out in your photograph. The most basic aim is to mimic ideal outdoor lighting. We are used to seeing things lit by the sun and accept that as natural.

Start with your main (key) light. This is the main illumination. Its position and light quality define your subject. The conventional position for that light is to one side and somewhat above the camera—so that the light rays make an angle of about 30–45° to the camera axis in both planes; normally, too, the keylight is fairly concentrated, so that it throws relatively sharp shadows.

Move your keylight around until you have just the modelling effect you want. With portraits, look particularly to see that the nose shadow falls attractive. If, when the direction is right, the shadows are too harsh, diffuse the light by putting some translucent paper or plastic between it and the subject. If, on the other hand, the shadows are too soft, use a harsher (more focused) light.

With a single light, the lighting ratio will be much too high for normal pictures. You can reduce that with a fill-in light shining from close to the camera position. This is normally a softer light than the key. It must produce about a quarter of the illumination on the subject, too. The more diffuse the light, the lower its intensity from the same bulb. A large flat reflector, though, is not usually sufficient to reduce the intensity enough if both your lights have the same bulbs.

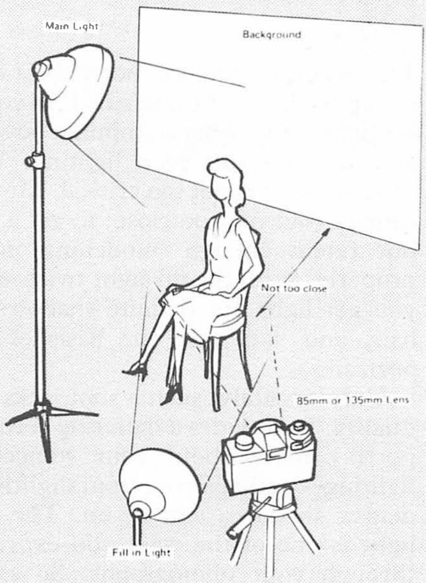
The solution is simple. Move the fill-light further away. With two identical lamps (and reflectors) you get one-quarter the illumination from the fill-light if it is twice as far away as the keylight. Be very careful that your fill-light casts no shadows. Double shadows look very odd, because we live on a planet with only one sun.

As an alternative to the fill-light, you can use a large white reflector just as with window light. This, though, is usually more difficult to arrange.

Once you are satisfied that the shadows are in the right place, the right sharpness and intensity, you can add other lights for effect. For example, you may want to light the background separately—to change its significance or to mask unwanted shadows, or to backlight your model's hair to make it shine.

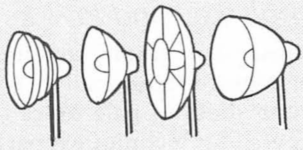
Exposure is simple. Meter from your subject, or from a suitable substitute. If you have a reasonably even-toned and evenly lit subject, you can meter from the camera position, or shoot on automatic. However, with most subjects, it is better to decide the exposure from close-up readings, and to set that manually.

ARTIFICIAL LIGHTING

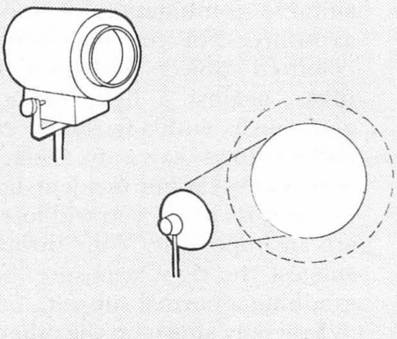


The basic lighting set up for ordinary portraits. The main light provides the directional lighting. Choose its height and angle to provide the modelling you want. Add a fill light close to the camera to reduce the contrast, and perhaps a spotlight to put highlights in the hair.

You may want to light the background separately.



The most common form of tungsten lighting is the photoflood bulb. You can choose from a wide range of reflectors to provide varying degrees of diffusion.



Most reflectors provide a relatively even bright central area, and a less bright surround. You can align them to produce the effect you want. For more strongly directional light, you can use a spotlight.

Portraits

The easiest way to take portraits is with the basic lighting set up we have just described. If you use a relatively soft keylight, either a big aluminium bowl, or a white umbrella, you get nice soft even lighting. The angle is not too obvious, so it is not too critical. Move the light nearer the camera (but not too close) to get a more flattering result but retain enough 'modelling' to show the features properly. With the fill-light twice as far from the subject, you get light but definite shadows. Add sparkle to the hair, and you have the basis of a safe, conventional portrait.

Unfortunately, such a shot lacks character and individuality. It provides a flattering record but little more. To portray more about your subject, you need harsher lighting—perhaps even from slightly behind the subject—denser shadows, and so on. The way you arrange the light is one of the ways you express your individuality through your photographs. So experiment; learn just what the lights can do, and create your own style with them.

High-key and low-key shots

Most photographs contain a more or less complete range of tones. Occasionally, though, you may wish to confine your shots to pale tones (high-key) or dark tones (low-key). This technique is particularly effective if you include just a tiny area of contrast.

The production of high- or low-key pictures calls for a suitable combination of subject choice, lighting, and exposure. For the high-key shots, you need a light-coloured subject, perhaps a fair-haired model in a light dress, against a light background. Light the subject generously, with a fairly low ratio between the highlights and shadows (say 2:1). Then give slightly less exposure than a grey card or incident-light reading suggests. If you overexpose at all, you will lose highlight details, and they are all important. Your through-the-lens meter will *not* suggest the right exposure, because you are not photographing a normal subject.

Low-key shots, on the other hand, call for the opposite technique. Dark subject and background, brooding lighting, rather higher contrast perhaps, and slightly generous exposure.

The exposures are a particular problem on transparency film. If you make too much allowance for highlight detail in a high-key scene, or for shadow detail in a low-key one, you can lose the effect by altering the overall density too much.

On transparency films, try a range of exposures. The exact density is critical. With negative (print) films the camera exposure is less critical, the print exposure vital. Do not expect an automatic printer (as used in normal develop-and-print services) to produce a satisfactory result. Such printers, just like reflected-light meters, are calibrated to produce good results from normal scenes.

Photography at night

Outdoors, once the sun goes down, you have either a moonlit scene, or one lit by bright patches of artificial light.

Moonlit scenes are much like sunlit ones. The only problem is the low level of illumination. Exposure times are likely to be around 15 or 20 seconds at *f*2 even with 400 ASA film. This is well outside the range of exposures you can measure with the CdS meters built into Minolta SLRs. It ls also outside the stated range of the silicon cell meters of the AES finder and XD cameras. These, though, will give reasonably accurate long exposures up to about 20 seconds.

There are two problems. If you give a moonlit scene the full exposure, it will look like a sunlit picture—more or less; and most films suffer from failure of the reciprocity law with such long exposures. With black-and-white film, the two effects can cancel out; the decreased sensitivity resulting in an underexposed negative. In colour, you may get the same exposure effect, but you are likely to get unwanted colour shifts as well. There is little that you can do about them without tests.

Buy several rolls of film of the same batch number. Make a series of test exposures on one roll. After it is processed, you can then decide on your exposure, and estimate the filters you may need to give the colour balance you want. Remember that the filters will absorb some light; resulting in the need for longer exposure; and thus perhaps making more filtration necessary. Now you can take your pictures. Bracket your exposures, and try a range of slightly different filters; with luck, you will get one or two satisfactory pictures.

Lighted areas outdoors

Most artificially lit scenes are attractive because of the contrast between the lights and the unlit areas. Streaks of moving cars, advertising signs and fireworks all spring immediately to mind. Your pictures consist of lines and points of colour standing out from a dark background.

The exposures appear at first to be a problem, but are often not critical. A straightforward automatic exposure can give quite pleasing results. However, if the lights form but a small part of the whole area, they may be over-exposed. This does not matter in a black-and-white shot, but results in pale colours on colour film.

The SR-T meters may be difficult to use at night, because you cannot see the needle. Such lighting conditions may be outside the range of the SR-7 and the SR-meters.

With these cameras (and with the automatic models if you are unsure of the result) you should estimate the exposure. On a medium-speed film, an exposure of around 1/30 or 1/60 at *f*4 is likely to prove about right. Obviously, for moving lights and fireworks, you need much longer exposures; for streak effects, set the lens on about *f*8 or *f*11 and leave the shutter open for as long as the movement demands. Use similar settings for fireworks, holding the shutter open long enough to picture as many bursts as you want.

Whenever possible, bracket your exposures. There is no correct choice. Changing over a wide range of apertures will give you a series of different pictures, all with some attraction. You can then choose the ones you like best.

Lighted buildings or street scenes often look better against a deep blue sky. To achieve this effect, you can take your pictures at dusk. It is difficult, though, to choose just the moment when the sky will look best. If you can, leave the camera on a tripod and make a double exposure of the scene. That is easy on the SR-T303 model, XE-1, XM, or XD-7 but a little more complex with some of the other models. The technique is explained in detail for each camera at the end of the book.

Take your first picture at dusk. Underexpose by two or three stops. Reset the shutter without moving the film. When it is fully dark, expose for the lights.

FLASH

The problem with studio lights of any kind is that they need to be bright. To give you convenient exposure times, your lights need to mimic the sun, at least the sun through clouds. Of course, they are much nearer your subject, so the inverse square law is on your side. They produce a lot of light, and much more heat, all the time they are switched on. You take photographs with 1/60 second's worth—now and then, at intervals.

Flash makes use of that. By producing the light just when you want it, and only when you want it, a flashgun makes much better use of the energy. That saves power, and often reduces the discomfort of bright lighting. Because of its relatively minute power consumption, too, flash is an ideal portable light source.

Early photographers ignited trays of theatrical-type flash powder, or strips of magnesium ribbon to provide an instant light source. Then in the 1930s, flashbulbs appeared on the scene. These are sealed glass bulbs containing metal wire or foil in an oxygen atmosphere. Fired electrically, a flashbulb provides a reasonably predictable amount of light over a period of about 1/30 second (the time varies with bulb type). Once used, a flashbulb is discarded.

More recently, electronic flash units have become the normal flash source for serious photographers. These produce a very short duration flash by passing an electric discharge through a gas-filled tube. During the 1970s, the advances in electronic engineering have made quite powerful electronic flash units available at moderate prices.

For most purposes, your pictures will be lit equally well with bulbs or electronic flash. However, electronic units are more convenient to carry, and allow you to freeze comparatively fast-moving actions; they do, though, restrict the shutter speeds you can use. Bulbs, on the other hand, are more economical if you only take the occasional shot, and offer much more light than most portable electronic units.

Light in the dark

Flash is most commonly used just to provide enough light to get an exposure. You can put a flashgun on any Minolta SLR. Set a suitable shutter speed, follow the simple exposure instructions (with a 'computer' unit, such as the Minolta Electroflash 200-X, that means selecting a lens aperture) and get adequately exposed pictures of any subject within range.

Unfortunately, adequately exposed is all that can be said about such pictures. The lighting is flat and uninteresting—just about acceptable for passport pictures. Faces stare blankly out of an apparently blacked-out room, quite often with bright red eyes; and your subject casts a strong black shadow on anything close behind. In fact, flash on camera is about the worst lighting it is possible to devise for portraits. It is especially bad in large halls, where only a few people are well lit and the rest fade off into the darkness behind.

Of course, we all use flash on our cameras where there is no alternative. You cannot set up elaborate lighting layouts at most weddings or parties, for example. When you are forced to use this form of lighting, there is just one thing you can do: keep the flashgun as far from the camara lens as possible. The best way is on a large flash bracket (or flash bar) like wedding photographers use. Large professional shape flashguns, such as the Minolta Electroflash 400 and 450, are always mounted with the flashtube some way from the lens. A greater distance, though, would do no harm.

Red-eye

Light reflected from the back of your subject's eyes comes out red on colour film. As a general rule, you can expect such reflection if your flash source is less than 1/30 of your subject distance from your camera lens. So, if you are photographing a model from 3 m (10 ft), you may produce red-eyed pictures if your flash tube is less than 100 mm (4 inches) from the lens.

Moving the flash further away is the obvious solution.

That is why most camera-mounting electronic flashguns have their flash tube at the top. Particularly with the smaller models, though, that may not be far enough. A flash bar is better. If your flash position is fixed, there are two things you can do to help. Firstly, keep the ambient lighting as high as possible, and persuade your subjects to look toward the lights immediately before the photograph; that ensures that their pupils are as closed down as possible, reducing the red area. Secondly, try to avoid taking pictures of people looking directly at the camera.

Try existing light

Whenever possible, try to take existing-light shots as well as flash shots. With today's 400 ASA colour films, there are few occasions that will stump you completely with a Minolta SLR. Back them up with flash-on-camera shots, by all means. Often, the best wedding or party pictures are those taken by natural light.

Connecting up a flashgun

Most flashguns have two connectors—one built into the 'foot', and one on a short lead. It does not matter which one you fix to the camera, the effect is the same. All 35 mm Minolta SLRs have a 3 mm (PC) coaxial socket (older models have two). All the newer cameras have 'hot-shoe' contacts in their accessory shoes as well. In either case, though, you must make sure that you choose the right shutter settings.

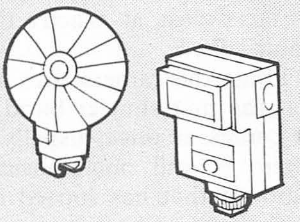
The flash is fired when contacts close in the camera shutter. The X-contact built into every Minolta SLR connects just as the first shutter blind reaches the far side of the film gate. The FP-contact, fitted to SR cameras, most of the SR-Ts and the XE-1 and XM, fires the flash a little sooner. It is intended for special flashbulbs. The contact timing is called the synchronization. A shutter with flash contacts is thus said to be flash synchronized.

Electronic flash

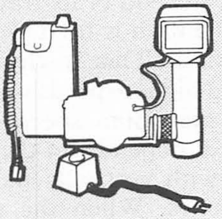
An electronic flashgun produces light for a short period of time by discharging the electric charge in a capacitor through a gas-filled tube. The light is produced virtually the instant that a switch is closed. So, X-synchronized

FLASH

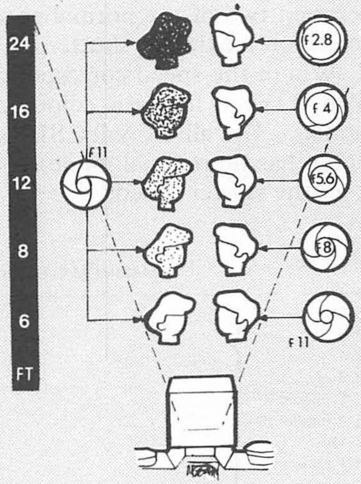
Flash bulbs (now rare) are fired in small flashguns, normally with folding reflectors. For most uses, electronic flash is more convenient. Small units, such as the Auto-electroflash 200X provide a readily available light source.



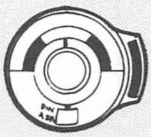
For more ambitous work, a large portable outfit, such as the Auto-electroflash 450 provides considerable light output, and versatile operation.



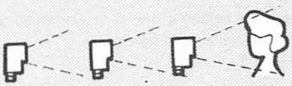
The illuminating power of a flash falls off with distance. Thus with a constant (manual) output, you regulate the exposure by choosing an aperture appropriate to the distance. Automatic (computer) flashguns regulate the flash to suit a particular aperture regardless of distance (within limits).



You can calculate the lens aperture from the flash dial. With automatic units you need to know the film speed. For manual operation, your subject distance as well.



With thyrister circuits, the closer you go, the less power an automatic flash needs.



Some units allow automatic control of bounced flash. The sensor remains aimed forward wherever the flash points.

contacts close at exactly the right time to fire an electronic tube.

Thus, the camera fires an electronic flash the instant that the first shutter blind uncovers the film. The light all comes at once, usually in less than 1/1000 second. There is still one consideration; the second shutter blind. If that has started moving before the first blind reaches the end of its travel it blanks off part of the film when the flash is fired. So, only part of the picture is lit by the flash. That is why electronic flash cannot be used with the higher speeds on a focal plane shutter.

The maximum speed at which electronic flash synchronizes depends on the shutter design. Normally it is higher with vertically moving shutters than with horizontal ones. When the suitable speed is intermediate between two of the normal speeds, it is given a separate detent on a Minolta shutter dial. The position is marked X. Where the speed corresponds with a normal one, the normal speed figure is coloured (red or yellow on most models). On all Minolta SLRs (except the 110 model, which has no manual mode) you can.use electronic flash at all the slower speeds.

MAXIMUM ELECTRONIC FLASH SPEEDS

SR-2 SR-3 SR-1 SR-7	1/50
SR-1 (model V) SR-7 (model V) SR-1S SR-T cameras XG cameras SR-M	1/60
*XE cameras	1/90
*XD cameras	1/100
*XM	
*110 SLR	1/150

*On these cameras, the 'X' or 'O' setting gives the electronic flash speed whether or not the camera has a good battery.

Power sources

There are three possible power sources for electronic flashguns: household electricity (through a suitable converter lead), rechargeable batteries, or expendable batteries. Your choice depends on the way you use your flashguns.

For portable use, especially outdoors or in large rooms, batteries are ideal. Rechargeable ones are much cheaper in the long run, but also more trouble. To keep them in top condition, you must recharge them every so often, usually not less than once a month, even if you do not use them. There is a special problem if the batteries are permanently built in. They can hold but a limited charge. Once 'flat', you have to wait for them to be recharged before you can use the flash again. In most recent flashguns, though, the rechargeable cells are the NiCd type that can be replaced with normal dry batteries. So you can always buy more power for your flashgun.

If, on the other hand, you work mostly indoors, direct mains power is undoubtedly the cheapest way of running flashguns. The leads, though, are a nuisance, especially if you have a maze of synchronizing leads as well. I find that I can put up with them, though, and use mains-powered flashes. Virtually all small mains-powered models can take batteries instead for portable use.

Flashbulbs

To use flashbulbs, you need a simple battery-capacitor flashgun. This puts a burst of electricity through the bulb when the flash contacts close.

Flashbulbs produce a burst of light by burning some metal foil or wire. This takes much longer than does electronic flash. In fact, you have to wait about 20 ms (1/50 second) after making the contact before the light is bright enough. Thus, the bulb contact on a shutter closes *before* the shutter opens. On a diaphragm shutter, such as most 'compact' cameras, there is no problem. All the film is exposed simultaneously. So, as long as the shutter is delayed by the right amount you can choose whatever shutter speed you like.

On most SLRs, though, the focal plane shutter complicates matters. At speeds above 1/60 second, the film is exposed sequentially. If the lighting varies during exposure, then the picture comes out uneven. The light from a normal flashbulb changes considerably during its short life. So, special bulbs are made for use with focal plane shutters. These FP bulbs have a relatively long and even light output. With an FP bulb, you set the flash synchronization to FP, by switching on the SR-T 303 or 303b XE-1 or XM, or by selecting the correct socket on the other FP-equipped models. You can then choose whatever shutter speed you like. However, at speeds above 1/60 second, the shutter speed controls exposure, reducing the effective output from the bulb.

FP bulbs are difficult to get. With ordinary bulbs (AG-3b, PF1b etc.) you have to use X-synchronization just as you do with electronic flash. To allow time for the light to build up, you have to use long shutter speeds of 1/15 second or longer on most cameras. This is not practical, because you get just as much camera shake with bulbs as you do with daylight. Thus, with the newer cameras, 'flash' must mean electronic flash. Even with the oldest Minolta SLR, electronic flash is today, the most convenient answer to flash photography.

Exposure

You cannot measure flash light with a normal exposure meter—either hand-held or through-the-lens. You can either use a flash meter (such as the Minolta Flash Meter II—which we describe later) or calculate it.

The light output from a flashgun (bulb or electronic) is the same each time it is fired. The most useful way to express the output is as a guide number. The guide number is the product of the distance from the flash to the subject and the lens aperture you need for correct exposure. Thus with a guide number of 55 ft, the correct amount of light reaches your film with the flash 5 ft from your subject and the lens at *f* 11. The exposure is exactly the same at *f* 5.6 and 10 ft or *f* 2.8 and 20 ft, or any other combination of the two figures.

As the light output is always the same, you obviously need a different aperture with films of different speeds. To find the guide number you want, consult either the table provided with the flashgun, or the calculator disc on the back of the gun itself. On a typical disc, you set an arrow to the film speed, and a range of apertures lines up with a range of distances. Either look up the aperture you need on the disc, or multiply any convenient pair of aperture and distance to find the guide number.

Now you have a guide number, it is easy to calculate the aperture you need. Just focus on your subject, read the distance from the lens' scale, and divide that into the guide number. For example, with a guide number of 25 m; if your subject is 3 m away, your simple division gives a result of $8\frac{1}{3}$. So you set your lens to *f*8 for correct exposure. The only change to this rule is if you are using FP bulbs. Their guide number changes with the shutter speed you choose (faster than 1/60 second).

One other point—the guide number given for flash guns assumes they will be used in a normal room. Outdoors, or in very large rooms, there are no walls nearby to reflect light onto the subject. Then, the guide number needs to be reduced. With no other information, try halving it. Conversely, in a small light-coloured room, such as a bathroom, you should double the guide number.

Flash and distance

The reason that guide numbers produce the right exposure setting is that the light from a flash gun obeys the *inverse square law*. That is, the brightness on a given area is inversely proportional to the square of the distance from the flash. That, of course, ties in very neatly with the fact that the proportion of light reaching the film is inversely proportional to the square of the *f*-number.

It also means that if the flash is twice the 'correct' distance away, the subject is only one-quarter lit. At three times the distance, the light drops off to one-ninth. This 'fall-off' is very obvious in direct-flash pictures. Everything more than a few feet behind your subject comes out dark and underexposed. Anything much nearer comes out overexposed, and whitely glaring.

By simple extension, of course, you do not have to be far beyond the maximum range of your flashgun, and your pictures will have absolutely no flash lighting in them at all. That is a major limitation outdoors at night.

Power of flashguns

Flashbulbs produce quite a lot of light. The largest are still the brightest portable light sources. Electronic flashes, on the other hand, vary from tiny outputs up to the flashbulb range. The largest 'pocket' guns such as the Auto Electroflash 32, have power outputs about the same as a small flashbulb. Larger professional type hand flashes, such as the Auto Electroflash 450, can produce up to twice the light that an AG-3b flashbulb gives.

The power of a flashgun is best compared as its guide number. There are, unfortunately, two conventions in use: to give the 25 ASA number or the 100 ASA number. The 100 ASA number is just double the 25 ASA figure. Of course, the guide number in feet is roughly three times its equivalent in metres.

A flashgun with a (25 ASA/15 DIN) guide number of more than 12 m or 40 ft is powerful enough for most home photography. However, you should aim for at least 20 m or 65 ft if you want to try interesting flash effects.

One point, though. On most electronic flashguns, the ready light comes on when the gun is about 80–85% charged. If you wait a little longer, you can be quite sure that you get a full power flash. Of course, before the light comes on you get less light even if the flash works.

'Computer' flashguns

The advent of simple light-activated switches has heralded the production of automatic flash. The sensor cell reacts after a fixed amount of light has been reflected from your subject. It switches off the flash—instantly. To get accurate flash exposure, all you need to do is keep the lens set to the right aperture, and stay within the flashgun's range.

The simplest models, such as the Auto Electroflash 25 require you to set one particular aperture for each film speed. A mark on the calculator disc shows it quite clearly. For example, on the Auto Electroflash 25, with 100 ASA film, you need *f*5.6. On more sophisticated models, you have a choice of aperture for each film speed. The Auto Electroflash 450, for example, lets you choose any aperture between *f*2.8 and *f*11 with 100 ASA film. You must, though, set the lens aperture and the flash control to the same figure. Often the automatic control, and the calculator dial are colour coded to lead you to the right figure.

However the settings are controlled, each aperture is associated with a maximum distance. You must not go beyond that distance if you want correctly exposed pictures.

On the Electroflash 450, you have a special diffuser for wider than standard lenses. With such adapters, you must adjust the flash sensor, setting the control beside the calculator to 'wide'. On other models, you just set a wider aperture on the camera when you use the wide-angle converter. Each flashgun is different, so each has its own instructions.

There are two types of computer circuitry. The earlier models just switch the unwanted power to another part of the circuit and so waste it. Newer, 'thyristor' models actually stop the capacitor discharge, leaving the unused power still available. This allows them a much shorter recycling time when used close up.

Apart from the recycling time, the two types work just the same. They reduce the flash to a preset brilliance. Thus, the flash can be as short as 1/50 000 second. As we have seen in the chapter on *Movement and the Camera*, that can be extremely useful.

Of course, an automatic flashgun is fooled by unusual conditions just as easily as an automatic exposure camera. If your subject is isolated against a black background, it may be overexposed. Conversely with a light-coloured background, or worse still a mirror, the result will be underexposure. The answer to both these exposure problems is to calculate the exposure normally from the guide number, and to set your flash for manual exposure.

The mirror, though, is an insuperable problem. If you fire your flashgun directly toward a highly reflective surface, the flash is reflected back to your camera, ruining the picture. If you must shoot as if from directly in front of the mirror the 35 mm CA Shift Rokkor allows you to stand to one side and avoid the reflection. The only other solution is to shoot from a different angle, or move your flash away from your camera.

Move your flash away

There is one major disadvantage with automatic flash. It encourages you to keep the flashgun on your camera. We started with the problems that causes—now for some solutions.

The simplest way is to move your flash a few feet away from the camera. Treat it just as you would a tungsten key light. In fact, lighting with flash is just the same as lighting with any other source. It is just more difficult, because you cannot see the results until the film is processed. Studio flash units have built-in modelling lights to help with that, but even these can be misleading.

To move your flash away, you need a connecting lead. This has a 3 mm coaxial (PC) plug on one end, and socket on the other; you just plug it between the camera socket and the flash lead. The best sort are coiled, like a telephone hand-set lead. Uncoiled leads always tie themselves in knots in your gadget bag. Long leads do not work well with bulb flashguns as they introduce too much resistance.

Of course, a single flash somewhere away from the camera produces harsh light, just like direct sunlight. Do not move the light too far to the side. If possible, too, put a simple reflector on the other side of your subject.

Calculate the exposure from the flash to camera distance, and the guide number. In most cases, an automatic flashgun gives the right exposure. Some flashguns such as the Auto Electroflash 450 allow you to use a remote sensor. That remains at the camera position, and it cuts out the flash when enough light has reached the camera.

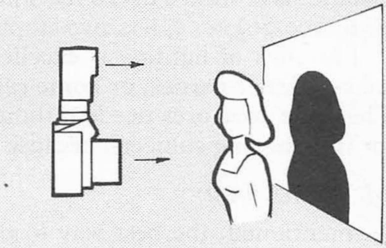
Bounced flash

Instead of pointing your flashgun toward your subject, you can reflect the light from any suitable white surface (or even a pastel-coloured surface for black-and-white shots). Keep your flash on a long lead, and place it facing toward the reflector. You can then have freedom of movement with the camera.

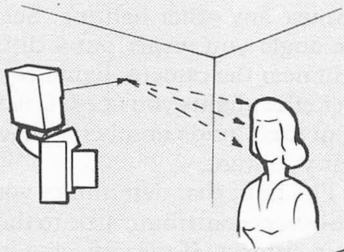
Bounced flash produces an even diffused lighting. For example, if you point your flashgun to the ceiling, it can light a whole room quite evenly, rather like the light outdoors on a dull day. Of course, the sensor on an ordinary automatic flash will point to the reflector as well. It cannot measure the light that way. So you must work manually.

Calculate the exposure from the guide number. Work out the distance from the flash to your subject, via the reflector, then open up by an extra two stops to take account of absorption. You will not be far wrong. For example, in an average modern living room, and a guide number of 30 m (100 ft) you need an aperture of around *f* 4 to *f* 2.8 for flash bounced from the ceiling. The average

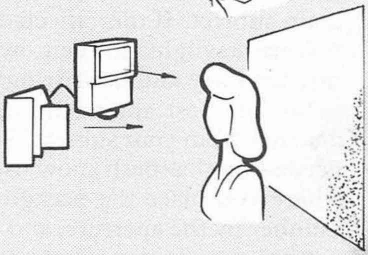
FLASH LIGHTING



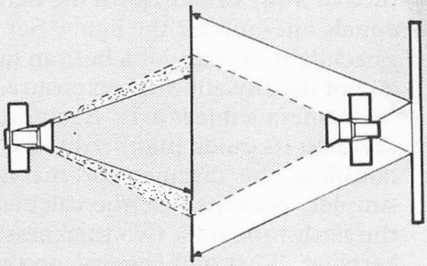
Although the hot shoe is a convenient place for a flash, it leads to disappointing portraits.



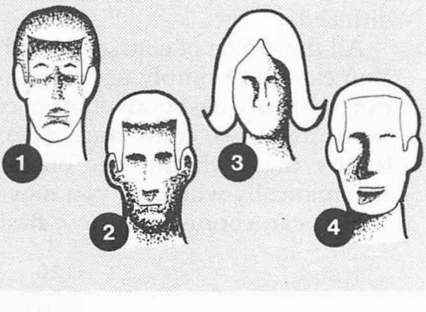
Bounce the light from a white ceiling or wall, to produce much softer lighting. Very flattering for portraits. This calls, though, for quite a powerful flash.



To control the modelling, hold your flash well away from the camera. This also keeps the shadow to one side. Fill in with a second flash if possible to avoid harsh contrast.



Not all flashes cover the angle of wide-angle lens. Some are provided with diffusers to widen the angle. As an alternative, try bouncing the flash from a convenient white reflector.



Just as with sunlight, the angle of the flash is important.

1. Flash too high.
2. Flash too low.
3. Flash too far to one side without fill.
4. Two flashes can produce double shadows.

distance is around 6 m (20 ft). Thus, the calculation runs: 30/6 (100/20) = *f*5, less two stops gives *f*3.5 (*f*2.8–*f*4).

This sort of lighting is excellent for fairly static subjects—dinner parties, or home celebrations, for example. The wide apertures needed, though, make it impractical for fast-moving subjects, because focusing is too difficult.

Multiple flash

As mentioned, the best way to use flash is the way that you use any other lighting. Set up a keylight to give just the angle you want; put a diffused, and less bright fill-light near the camera; light the background and add whatever effect lights you need. Calculate all the flash distances from their guide numbers to give you the lighting balance that you want.

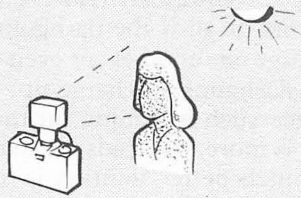
The light that determines your exposure is the key. All the others contribute little to the exposure needed for your main subject. If they affected it considerably, they would become keylights in their own right, competing with the intended key and destroying your lighting.

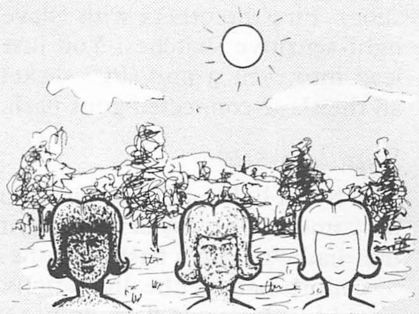
So, the best approach is to set your keylight a fixed distance from your subject. Set the camera to the aperture needed by that flash; now use that aperture to determine where you place the background light. Divide its guide number by the aperture, and use that distance; or move it further away to dim down the lighting (twice the distance equals one-quarter the light). Set up effect lights, such as a backlight for hair, or a bottom light for glassware. They do not usually affect the exposure. Now put a fill-light on the camera subject axis. Again, determine its placing by dividing its guide number by the lens aperture, and then doubling the distance for the normal 4:1 ratio. Even simpler, perhaps, use the calculated distance, but cover the flash tube with two thicknesses of clean white handkerchief. That will ensure, too that your fill-light is well diffused.

All the lights, of course, should be on manual exposure. You can quite simply use an automatic fill-light, though. Put an auto flashgun on the camera, set to give full exposure at two stops larger aperture than the one called for by the keylight. The on-camera flash then fills in automatically wherever you move.

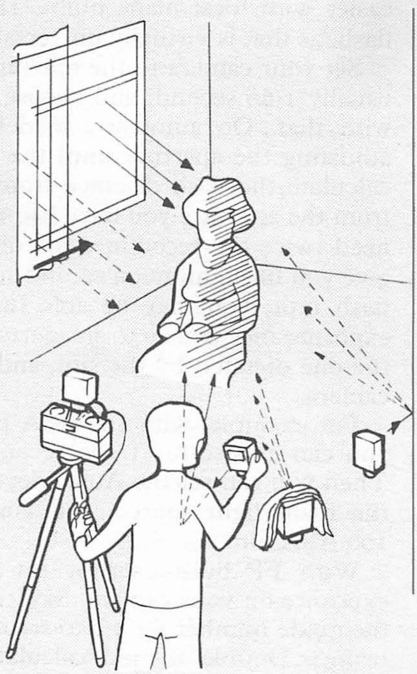
You can connect all these flashes with long leads and

FILL-IN FLASH





With back- or side-lit subjects, you often need to add extra light to the shadows. Work out the daylight aperture you need for your X speed and calculate your flash distance for that aperture. Double it for a natural looking picture, or reduce the light with a wide panel or clean handkerchief. With adjustable-output computer flash, you can set the flash for 2 stops wider aperture. Eg: 1/100 at f16 is correct for the sun, set the flash for f8.



Indoors too, you can fill in with an electronic flash. Again, use less than a full flash exposure. That is often difficult with direct flash because of the wide aperture you need for window light. You can diffuse or bounce the flash to reduce its power.

multiple connectors. However, that is not ideal. It may not work at all if the flashguns are different. They may discharge one another; or even damage one another. Even if the flashguns all charge up, and all fire, it is not good to place such a loading on the camera's flash contacts. What is more, the leads are a menace.

A much better solution is to have just one flash connected by a lead to the camera (or mounted on the hot shoe). Fire the others with 'slave' units. These are tiny light-sensitive switches. You just plug the normal flash lead into their 3 mm (PC) socket. When the flash fires, all the slave-connected guns flash.

Synchro-sun

The harsh light of direct sun is just like a single flash off the camera. One way of reducing its harshness is to 'fill-in' the shadows with a flash near the camera.

Unfortunately, the limitations on shutter speed imposed by electronic flash do not make this an ideal technique with a focal plane shutter camera. In fact, it is much easier with focal plane bulbs. However, first electronic flash, as that is virtually universal.

Set your camera to the maximum flash shutter speed, usually 1/60 second, and choose the lens aperture to go with that. On automatic models, you can do this by adjusting the aperture until the meter reads 1/60. Now calculate the flash distance from its guide number and from the aperture you have had to choose. As usual, you need twice the recommended distance (or nearly so) to give you fill-light, not a second sun. With a sophisticated flash unit, you may be able just to set the automatic exposure mechanism to an aperture two stops larger than the one dictated by the sun, and keep the flash on your camera.

For example, with 100 ASA film in the Minolta XD, you can expose for 1/100 second at *f*16 in bright sun. Then you can set the Auto Electroflash 280 as if it were the main light source, and you had selected *f*8 with 100 ASA film.

With FP bulbs, simply set the normal bright sun exposure on your camera. Say 1/250 at *f*8. Now look up the guide number for 1/250 second (and the film you are using). Double it, and calculate your flash-to-subject

OLDER GENERATION
Above. Strong sunlight shows up every line and wrinkle. Choose a viewpoint to let it fall well from the side. For this shot (on photomicrography colour film) I used a 135 mm lens at *f* 4 – *Clyde Reynolds*.

WINDOW LIGHT
Opposite. With 400 ASA film, an upstairs room is ideal for semi-formal portraits. I gave 1/60 at *f* 5.6 with a 100 mm lens for these shots. Window light, though, produces strong contrasts (*top*). I used a reflective sheet to throw light into the shadows for the bottom picture – *Clyde Reynolds*.

FRIENDS
Previous page. Bright sun high above is not ideal lighting, but if you turn your subjects away from its direct rays, it does help to produce crisp, attractive shots. (From a colour transparency.)

BEFORE THE RACE
Overleaf, left. Awful misty conditions lead me to choose manual exposure, from a substitute reading which produced a correctly-exposed transparency. These skiers filled the 28 mm lens frame nicely – *Clyde Reynolds*.

GRANDCHILD
Overleaf, right. Indoors, flash is often the best light source. Here, I moved the main light to the conventional side-and-above position, and lowered the contrast with an automatic flash from the camera. A 50 mm lens was an easy choice. (Colour transparency film.) – *Clyde Reynolds*.


Trofeo
SNOOPY CLUB
20
Trofeo
SNOOPY CLUB
24
Cortina D'Ampezzo
Trofeo
SNOOPY CLUB
16
D'Ampezzo
ROSSIGNOL
ROSSIGNOL

MULTI-ZOOM

Above. When you can make several exposures on one frame, you open up a new range of possibilities. This young lady is repeated four times at different zoom settings.

SOFTENING THE IMAGE

Previous pages. Occasionally, the bitingly sharp Rokkor image is too sharp. There are two solutions. The young lady with the telephone is pictured through the 85 mm *f* 2.8 MD Varisoft Rokkor. For the top picture, the lens was set on sharp, for the lower one, on maximum softening.
The other girl shows the effect with and without a Kodak diffusion screen in front of the lens – *Kodak.*

distance from that figure. Of course, you must use FP-synchronization to fire the flashbulb.

Flash meters

If you commonly take studio flash shots, a flash meter is a great boon. With such a meter, you can measure pre-precisely the lens aperture you need.

The Minolta Flash Meter uses a silicon cell to measure flash fired by its operating button, and ambient light for 1/30, 1/60, 1/125 or 1/250 second. It is powered by five 1.35 v mercury cells, and a single 1.5 v (size AA) pen cell. Measuring either reflected light with the 10° viewfinder or incident light (see the chapter on *Exposure*), the recommended aperture is displayed by a needle moving across a dial. Of course, the meter must be set for the correct ASA film speed rating.

This is the ideal way to determine the exposure needed with a multiple electronic flash set-up. To use it as a normal meter, or with fill-in flash, set the time control to your shutter speed. If you want to use a shutter speed outside the range, simply measure the aperture/speed combination within the meter's range, and calculate your exposure from that. You cannot do that if the flash is the main light source.

Minolta Flash Meter II

The Minolta Flash Meter II measures flash illumination and also continuous lighting over a much greater range of times. It can calculate the exposure you need for a combination of the two. The meter measures all the light reaching its silicon-cell receptor for a preset time. It is powered by a 9 v Mallory M1604 or similar battery. This allows about 1000 readings in the normal 'cord' mode, and about half that in the other modes.

The meter must be calibrated for film speed (ASA) by the right-hand side wheel (with its release button depressed), and for measuring time by the left-hand one. The measuring time represents shutter speeds or flash durations between 1 and 1/250 second. With the dome fitted to the sensor window, the meter measures incident light (a 4 × ND dome is available for use in very bright conditions). The meter can measure reflected light with a 45° acceptance angle, with the Reflected-Light Attachment in place of the dome; or with a 10° angle through the Viewfinder 10° Attachment. These, and a flat diffuser for measuring brightness ratios, bayonet on to the receptor head. The mini-receptor on a flexible lead can be plugged into a mini-jack on the head. This is useful if the subject is inaccessible.

The meter is normally used in the 'cord' mode. Plug your flashguns into the sync socket on the front of the meter. The sync cord II allows you to keep the meter and your camera connected to the flash units. In this mode, depressing the operating button first lights the battery check light, then with a click, fires the flashes and starts the meter. After the preset period, the recommended lens aperture appears in the meter window. One or both the lights beside this window may light as well. These indicate that you need to close down the lens by $\frac{1}{3}$ or $\frac{2}{3}$ stop more than the original (digital) figure. The meter reading extinguishes when you release the button.

With the meter set to 'cord', you can measure electronic flash, bulb flash, or continuous light. You can calculate fill-in flash (synchro-sun) ratios by measuring with and without the flash. Whatever you measure, you must choose the time to suit your purposes. For continuous light set the shutter speed you intend to use; for small flashguns, you can safely set 1/250 second; for large studio units 1/60 is preferable. For flashbulbs, you have to set 1/15 second or longer (the meter is effectively X-synchronized).

The other two meter modes (Non-C and Multi) are both for electronic flash only. In either mode, you should choose a time suitable for the flashguns in use, eg 1/250 for small units or 1/60 for studio flashes.

On Non-C and Multi, you do not need a sync cord. Press the meter button until the battery check/reset light appears. The meter is now 'armed' to measure electronic flashes (not bulbs or continuous light) and remains so for 90 seconds. On Non-C, the meter reacts to the first electronic flash that reaches it, measures for the preset duration, and indicates the lens aperture for the rest of the 90 second period or until the operating button is pressed again.

In the Multi mode, the meter measures every flash that reaches it during the 90 seconds, and adds them together, displaying the cumulative aperture. To measure longer periods, you must press the operating button before the 90 seconds are up. This clears the display, but the figure remains in the meter memory, and is added to the next flash. You can repeat this operation as often as you wish. Of course, you must read the meter after the last flash within 90 seconds of last pressing the button.

If you want to begin a new measuring sequence before the meter switches off automatically, you must move the mode switch to CORD or OFF, then back to MULTI. The reset light then goes out, and you can start again.

The Multi mode is essential if you are to measure the illumination in strobed shots, other multi-exposure work, or when 'painting' with light using electronic flash.

Thus, the Minolta Flash Meter II is a highly versatile meter, very useful for studio flash work. If you use a single flashgun, though, either guide number calculations, or the flash's own computer facility are perfectly adequate. With multi-flash set ups, too, you can learn quite quickly how to calculate the right exposure without a meter, as long as you stick to more or less conventional patterns.

A flash meter, however, is essential for anyone who is contemplating any amount of flexible or innovative flash photography in the studio or elsewhere. It is particularly useful if you take portrait shots in your subject's home.

COLOURS AND FILTERS

The world is coloured, and the most accurate way of picturing it is in colour. Unfortunately, many photographers rely too much on the colours to 'carry' their colour photographs. The colour, of course, is highly important, but so is the picture. I have heard advice given 'think of your colour shots as if they were black and white'. This has a lot of sense behind it. It emphasizes that the structure or composition of a colour picture is as important as it is in monochrome.

However, once you have a pleasing composition in tones, look at the colours too. Do they combine to form the emphasis you want? Can you avoid that nasty juxtaposition? Is the overall colour right for your subject?

The first two are features of your chosen subject, sometimes you can change them—alter your viewpoint, rearrange your subjects, or change a studio background, perhaps. To change the overall colour, you need to use a suitable coloured filter on your camera lens. You can make moderate changes when you print from colour negatives, but for gross effects, it is better to use a filter on your camera. Of course, the only sure way with transparencies is to photograph through a filter.

More often, though, you will want to use a filter to make subtle changes, to achieve just the tint that you want. The choice of filters is as personal as the choice of film.

Getting the colour just right

Colour transparency films reproduce the scene in a way that the manufacturers feel is best. That is different for each type of film. So the first thing to do is to try out as many films as possible. Keep away from trick shots for your tests. There is no need to duplicate every shot but do try a series of exposures on each subject.

Have your films processed at the most reliable laboratories you can—send them back to the manufacturers if possible. When you get the results, look at the colour balance, and at the grain structure. Decide which films you like best, and work with them. One slow 25-64 ASA; (15–19 DIN) and one fast 200–400 ASA, (24–27 DIN) should do most of what you need. Stick to your chosen film or films, and learn to make the very best of them.

With a colour temperature meter, it is easy to achieve a neutral colour balance within the limits of the film and processing variation. If you do not use one, you should learn just how your favourite film works in all normal lighting conditions. One or two test rolls will tell you whether you prefer the results as they are, or with a pale filter on your lens.

Most often, photographers prefer their daylight pictures a little 'warmer' or redder than the manufacturers allow. For this, the best choice is an 81A filter, or an R1.5. These filters are recommended for use on dull days, or at high altitudes when the light is particularly blue; but this should not stop you using them in any other conditions that you want to.

To make your tests, use a small series of filters: say 81, 81A, 81B, CC05M, CC20M, CC05R, CC10R and CC20R if your normal results are too blue. Choose your favourite subjects and conditions, and take a test shot through each filter, and one without. Put a clearly lettered identity card in each one. When your film is processed, you will know how best to filter your future shots.

Sunsets and sunrises

When the sun is low in the sky, the colour temperature drops dramatically. The late evening light can be more red than a tungsten bulb. Sometimes you have to compensate for that, but not too often. The 82-series blue filters are the ones normally chosen—an 82A being the most common.

That is fine if you want to take nice neutral-coloured shots. However, there is plenty of time for them when the sun is high. Much of the beauty of mornings comes from their pale golden light. Absorb that with a filter, and you are left with a rather odd looking shot. In most cases, you would be well advised to exaggerate the colour a little—

keep your 81A on the camera (if you use one) or even go further.

Sunsets, too, owe their crowning glory to their colour. You can never do one justice in a black-and-white print. So why try to take the colour out of your transparencies? buildings, or groups of people, landscapes, can be transformed into dreamland pictures when they are bathed in pale salmon light. Just as in the morning, consider enhancing the colour, rather than suppressing it.

When the sun goes down or comes up spectacularly, the colour becomes by far the most important element in your pictures. Obviously, you would not consider changing that to balance the film. The usual problem is in emphasizing the colours.

Luckily, few sunsets need detail in the rest of the subject. They often look best with a carefully composed silhouette in the foreground. So you can expose for the sky and forget the rest. Perhaps surprisingly, a meter reading taken directly from the sky as often as not leads to the best picture. However, coloured skies are definitely subjects that cry out for bracketing. Take at least five pictures at exposures grouped at one stop intervals round the meter reading.

Sunrises are sometimes like sunsets. Often, though, their main charm is the delicately lit mist that hangs across the scene. Exposure is now even more critical. In this case, though, an overall meter reading is highly likely to be correct. If possible in the time available bracket your shots at half-stop intervals.

Colour and mood

It is not just in the pretty morning and evening shots that the colour of light is such an important part of the scene. Just as without its attractive golden glow, a misty dawn becomes any old foggy day, so, in clinical grey, a mountain snow storm becomes almost cosy. So, think before you 'convert' a scene to a neutral colour.

The colour of the subject plays an important, sometimes dominant part, too. Pictures with subtle subdued colours emanate a feeling of calm and quiet. Put in a small contrast or two, and you can produce a striking image. On the other hand, pictures full of colour have an aura of liveliness and joy. They are often much more difficult to compose. If you overdo the mixture, you end up with a mess. The most successful pictures use just one or two dominant colours over most of the subject.

Once again, the choice of film, lighting and filters plays an important part. For preference, choose a transparency film. Negatives are usually printed on automatic machines, which cannot 'know' the effect you want. They will compensate if your picture is lighter or darker than normal, or if it has a less than neutral overall colour. The results will be disappointing. With transparency materials, on the other hand, you can be sure that the film records the colours and tones that the lens 'sees'.

Some films, usually the slower speed ones, produce much more brilliant colours than others. Amateur materials tend to be more brilliant than professional ones. Whenever possible, try to choose the material that suits your pictures best.

Lighting is probably even more important. On a bright sunny day, colours appear brilliant and sparkling, while on a dull day they can almost seem to disappear. In bright sun, too, a polarizing filter can make a startling difference to colour saturation, as we discuss a few pages on.

Distance and haze

Distant views come out much less clearly than you expect. This is partly because film is honest, and your eyes are not. The film records mist and haze that you can ignore. It is also partly because film is more sensitive to blue and UV radiation than your eyes. The haze reflects more blue and UV than other colours of light. So it appears more strongly in your pictures. However, the UV has only a slight effect with modern multi-element, multi-achromatic coated lenses. It is likely to be non-existent with zooms. You can, though, make sure that the effect is minimized on those occasions when haze is most of a problem.

Absorbing UV

A clear glass, UV-absorbing filter ensures that little of the haze-producing UV reaches your film. For colour transparencies, a 'skylight' (1A) is a better choice. It is a pale amber colour, and thus makes transparencies appear just a little 'warmer'. This counteracts any tendency toward a 'cold' blue picture which is likely when UV is strong; such as high in the mountains, or by large stretches of water. The stronger amber or red filters, such as the 81A we have already considered, absorb UV radiation; so a 1A does no more than add a little more 'warmth' if combined with one of them. For haze reduction on black-and-white films, the normal yellow (sky) filter is ideal. If the light does not allow that, you can use a UV or skylight filter with monochrome films.

In some conditions, a polarising filter can reduce the effect of haze in your pictures. It is well worth trying in hazy situations if you have colour film in your Minolta.

Photographers are often advised to keep a skylight filter permanently mounted as a see-through lens cap. This is wise if you are in danger of dirtying or damaging your lens; in a boat, or on the beach, for example. You can confidently expose all types of film through it, without any distortion of colours or tones. However, the filter is a piece of flat glass. Even if you keep it scrupulously clean, it can induce flare if you take pictures with a bright light in or near the picture area. Thus, it is very important to fit a lens hood whenever you use a filter—especially if you keep the filter on all the time. Further, you should remove your UV filter for any shots against the light.

Colour film balance

Colour transparency films record the scene in the colours that reach the film. These colours, though, are strongly influenced by the colour of the light that falls on the subject. When you or I look at the world, we know what is white, and whatever the light source (within reason) we see it as white. However, in reality what we call white light is very variable. Look out of a window at dusk. See how blue everything looks. That is the colour of daylight when compared to the orange-biased illumination from normal tungsten light.

This difference in colour makes little difference on a black-and-white film. It affects a colour negative, but can be corrected in printing. It is vitally important on colour reversal film. For this reason, colour films are made to be exposed in specific lighting. Several types have been made, but now there are only two readily available in

35 mm cassettes: daylight (type D) and tungsten (type B).

Daylight films are balanced for what is called mean noon sunlight. That is, a mixture of direct sun and the light reflected from a blue sky; the sort of mixture that prevails on a bright summer day. In practice, most people prefer the results if there are a few clouds in the sky. These reflect yellowish sunlight into the shadows to counteract the rather cold look produced by the blue skylight. For a stronger effect, you can use one of the amber-coloured filters.

Electronic flash tubes are carefully constructed to produce daylight-coloured light. So you can use daylight-type film with electronic flash. Older units, however, may be rather too blue. You may prefer the pictures through a pale amber or yellow filter (81A or CC10Y are common choices). You can tape a suitable gelatin filter permanently over the 'window' of your flashgun. Ordinary clear flashbulbs are quite the wrong colour—much too yellow. In fact, type F film was once made especially for them. To allow use with daylight film, most flashbulbs are now blue coated. They often produce more attractive transparencies than does electronic flash.

Type B films are balanced for studio-type tungsten lights. These bright bulbs are not as yellow as ordinary house lighting, but much more so than daylight—or even plain flashbulbs. A lot of modern studio-type light fittings (spotlights and so forth) use tungsten-halogen bulbs. These are made exactly the same colour. Although they are not so carefully colour controlled, most projector lamps are about the right colour.

Recently, most manufacturers have discontinued type A colour film. This film was balanced for exposure in Photoflood type lamps. Such overrun bulbs are a little more blue than the studio lamps.

The difference, however, is slight. For most uses, type B film is quite satisfactory in Photoflood lighting. If not, you need a very pale amber filter. 81A is recommended.

If you were to expose daylight film to a scene lit entirely by tungsten lighting, you would get bright orange-coloured transparencies. Conversely, were you to use tungsten-light film in normal daylight, the results would be blue. It is quite possible to change the colour of the scene by fitting a filter to the camera lens.

Colour negative film

The final colour can be adjusted during print making from colour negatives. Thus, the filtration is not so critical. None of the fine tuning methods discussed in the next few pages are needed. However, professional negative materials are balanced either for tungsten illumination, or for daylight. For best results, you should filter them just as you would a transparency film. Failure to do so, though, is not a total disaster.

Amateur negative films are often called 'universal'. In most cases, they are balanced for daylight exposure. If you expose such film by tungsten lighting, it is best to use a blue filter. This makes the negatives easier to print; and many commercial printing houses produce orange-yellow prints from uncorrected tungsten-light pictures.

Colour-balancing filters

To take neutral coloured transparencies in daylight on type B (tungsten) film, you need an orange filter. The correct colour filter is often designated an 85B (Wratten number). An 85A filter is not quite so strongly coloured. It is designed for exposing type A (Photoflood) films by daylight.

To use daylight film in artificial (tungsten) lighting, you need a strong blue filter, an 80A or 80B. These filters absorb so much light that they can be considered only as a last resort. Whenever possible, use a type B film for tungsten lighting.

Smaller differences

Daylight varies in colour from the red of early morning sun to blue of a late dull evening. To get neutrally balanced transparencies, you need coloured filters to colour the light reaching the film exactly as the film expects it. The two most commonly used are a pale straw, skylight (1A) or 81A, to 'warm up' overblue scenes, and the pale blue 'morning and evening' filter to cool down the red light from a low sun.

In the same way, tungsten lighting can be very different. Photoflood lamps produce much less yellow light than, for example, normal domestic lighting. To achieve totally neutral results, your film must be exactly matched to the light source.

Of course, this is not important with negative film. You can alter the balance drastically in whatever way you want when you come to make a print.

Colour temperature

The most convenient way of categorizing the colour of white light is by its colour temperature. This is the temperature to which a perfect radiator (or black-body radiator) must be heated to emit light of just that colour. The temperature is always measured in kelvins (K) on the absolute scale. This scale starts at 0 K at absolute zero, the lowest possible temperature, which is just below −273°C. Thus, for example, 100°C is equivalent to 373.15 K.

The temperatures we are interested in range from about 2500 K to 12 500 K. The higher the temperature, the bluer the light. Note that this is the opposite to the way we usually categorize colours as warm or cold. The important points on this scale are 3200 K (tungsten studio lamps) 3400 K (Photofloods) 3800 K (clear flash-bulbs and 5400 K (mean noon daylight).

Unfortunately, the numerical effect of a filter on the colour temperature depends on the original colour temperature. For example, a filter that allows you to use tungsten (type B) film in daylight alters the colour temperature from 5500 K to 3200 K, a reduction of 2300 K. The same filter would convert tungsten light from 3200 K to 2250 K, a reduction of 950 K. To get round this problem, colour temperatures are often converted to mireds, by dividing the kelvin value into a million. Thus: mired value 1 000 000 K.

This produces a roughly linear scale. So that filters can be given individual mired-shift values. Thus they alter the mired value of the light by about the same whatever colour it starts off. This is used to label some sets of colour balancing filters. In fact, they are labelled in decamireds. Thus, an R6 is a 60 mired-shift red filter; B4 a 40 mired-shift blue, and so on.

To use the mired-shift system, you need to know the colour temperature of your lighting, and that for which the film is balanced. Most of the usual ones are noted in the table, with their equivalent mired values. The filter table gives the mired-shift values of the commonly used colour filters.

This is fine for most photography. However, just as with an exposure table, the interpretation leaves a lot to the imagination.

APPROXIMATE COLOUR TEMPERATURES OF SOME LIGHT SOURCES

Source	*Colour Temperature*	*Mired Value*
Skylight	12000–18000	85–56
Cloudy dull	6250	160
Electronic flash	5500–6500*	182–154
'Photographic' daylight (Daylight film balance)	5500	182
Blue-coated flash bulbs	5500	182
Mean noon sunlight	5400	185
Morning or evening daylight	5000	200
Flashcube or magicube	4950	202
Clear flashbulb	3800–4200	238–263
3400K Photolamps (Type A film balance)	3400	294
Tungsten studio lamps (Type B film balance)	3200	312
Tungsten halogen studio lamps	3200	312
Household lamps 250 watt	3000	333
Household lamps 100 watt	2900	345
Household lamps 40 watt	2650	377

* Most small modern units have a tinted discharge tube to bring them close to 5500K and sometimes lower.

MIRED EQUIVALENTS OF COLOUR TEMPERATURE

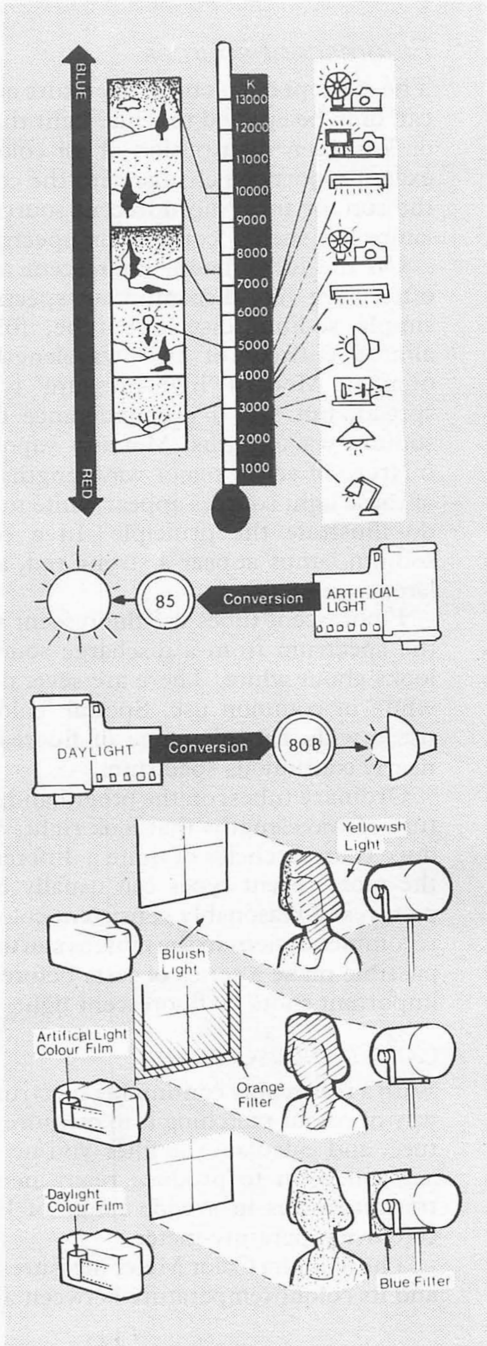
K	0	100	200	300	400	500	600	700	800	900
1000	1000	909	833	769	714	667	625	582	556	526
2000	500	476	455	435	417	400	385	370	357	345
3000	333	323	313	303	294	286	278	270	263	256
4000	250	244	238	233	227	222	217	213	208	204
5000	200	196	192	189	185	182	179	175	172	169
6000	167	164	161	159	156	154	152	149	147	145
7000	143	141	139	137	135	133	132	130	128	127
8000	125	124	122	120	119	118	116	115	114	112
9000	111	110	109	108	106	105	104	103	102	101
10000	100	99	98	97	96	95	94	93	93	92
11000	91	90	89	89	88	87	86	85	85	84
12000	83	83	82	81	81	80	79	79	78	77

COLOUR TEMPERATURE

The colour of 'white' light can be expressed as its colour temperature. Natural sources vary from 10–12 000 K for the light from a clear blue sky to below 4 000 K for evening sun. Most pictures are taken in overcast days at 6500–7500 K or sunlit at 5500–6500 K. Light direct from the sun is around 5000 K. Daylight film produces neutral pictures at around 5500–6000 K.

Artificial light sources cover a smaller range of colour temperature. The usual sources are electronic flash at 5500–6000 K and tungsten lights at 3200 or 3400 K. Tungsten-balanced film is intended for 3200 K.

Conversion filters allow you to use the 'wrong' film. They absorb light, leading to longer exposures, especially the D-1 (80B) filter.



Mixed lighting shows on any colour picture. You must filter one of the light sources to match the other, and use suitable film.

Fluorescent sources

The concept of colour temperature and thus mired values can only be applied to white light that consists of a more or less even distribution of all colours. Of course, the exact proportions change with the colour, but light from the sun, or from incandescent sources, such as tungsten lamps has such a 'continuous' spectrum.

On the other hand, fluorescent and discharge lamps often have very discontinuous spectra. The light from a simple sodium discharge tube, for example, consists almost entirely of two wavelengths (in the yellow-orange). Modern 'high-pressure' types have a broader spread, but still a preponderance of the characteristic sodium wavelengths. Mercury vapour lamps produce a mixture of seven major wavelengths. Of course, neither of these light sources appear white to the eye though they do illustrate the principle. In a colour transparency, sodium lamps appear a strong red, and mercury vapour lamps green.

Fluorescent tubes use fluorescent substances to fill out the spectrum from a discharge source so that the light looks about white. There are several different colours of white in common use. Special 'colour matching' tubes use a wide enough range of fluorescence to produce a nearly continuous spectrum.

Ordinary tubes, on the other hand, just produce a mixture of wavelengths that look right. Such tubes can produce transparencies of quite a different colour. However, the more recent types can usually be relied on to give pictures of reasonably consistent colour. Follow the filter recommendations in the table as starting points. Wherever possible make a series of tests before you take any really important shots by fluorescent light.

Colour measurement

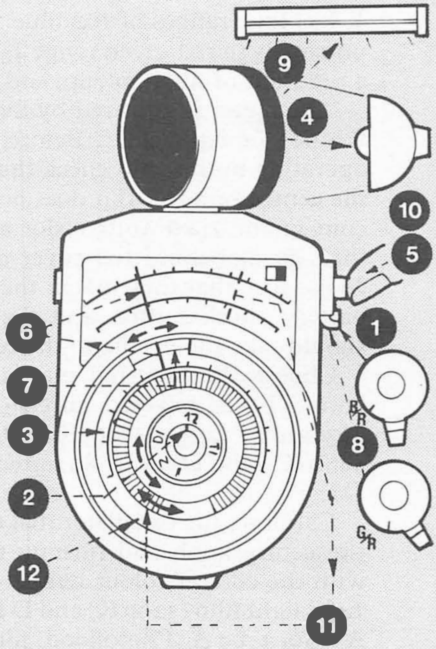
With a reasonably continuous spectrum, the most accurate way of colour matching is to measure the colour temperature, and calculate the filter you need from that. If you are called on to produce really neutral colour balance transparencies in a wide range of lighting, you need a colour temperature meter.

The Minolta Color Meter measures incident-light level, and its colour temperature between 2500 K and 12 500 K.

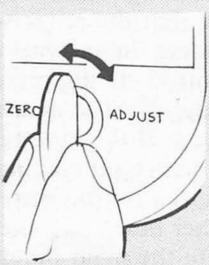
THE MINOLTA COLOR METER.

The Minolta Color Meter has four blue/red ranges, and a green/red range to match colour film to most light sources, or with simple operation:

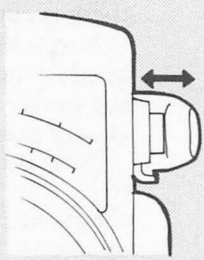
1. Select suitable blue/red function.
2. Turn centre dial to select colour range, D2 covers normal daylight, T2, normal tungsten.
3. Lift up dial, set red triangle against film type.
4. Take incident-light reading.
5. Press and release button.
6. Align main red index to needle.
7. Read LB value against index. Translate that to filter with scale on reverse.
8. For unusual sources *then* choose green/red scale.
9. Point to light source.
10. Press and release.
11. Rotate black dial to align red index to reading.
12. Read off CC number, and convert on scale (at back).

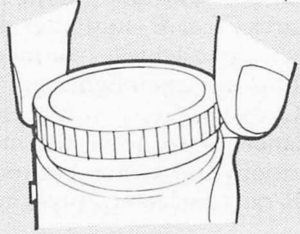


To adjust zero *before* inserting batteries, turn the coin slot.



Check zero by depressing reading button.





Five PX-625 type batteries go behind the light measuring cell.

It has four ranges of red/blue measurement, and (rather unusually) a red/green range as well. The meter dials give a read-out of filter colours and values.

The meter is powered by five 1.3 v mercury cells type RM625 or equivalent. Before fitting them, depress the operating button and check that the meter needle goes to the centre zero (0). If it does not, adjust the setting with a coin in the ZERO ADJUST slot at the back. The batteries then go in behind the cover at the back of the sensor. Make sure that they match the + – codes. Pressing the battery check button and the reading button together should take the needle to the red BC area.

Choose the blue-red metering range with the centre knob: T1 is 400–300 mired (2500–3330 K); T2, 363–263 mired (2750–3800 K); D1, 270–170 mired (3700–5880 K); and D2, 180–80 mired (5560–1250 K). For most D1.

Calibrate the calculator dial to your film type by lifting the centre knob and turning until the red arrow aligns with the correct colour temperature. B is for type B artificial light film (3200 K) and D for daylight-type (5500 K). A is for type A (Photoflood) film (3400 K) and F for flash type (3800 K); these two film types are now rare.

To check the light intensity, turn the mode selector to I, make sure that the range selector is at × I, and take a normal incident light type reading by depressing the operating button. If the meter reads more than 132 lux there is enough light to measure the colour temperature.

Next, select B/R (blue-red measurement) and take another incident-light reading. As you release the button, the needle locks. If the meter needle goes off the scale, choose another blue-red metering range and meter again.

Now rotate the main index dial to align the red index line on its rim with the meter needle. The figure under the main index dial shows the colour balancing change you need. The table on the back of the meter converts the figures (Y or B) into filter designations. This is the filter you need to achieve neutral colour balance in normal daylight or tungsten lighting.

Occasionally, you may need to adjust the red-green balance. If so, leave the main index in its correct B/R position, and switch the meter to B/G (do not alter the B/R range selector), press and release the reading button in the normal way to take the reading. Now rotate the black ribbed CC filter dial to align its red index to the metered value (between +50 and −50) on the scale just beside it. The magenta or green CC filter value is then shown in the centre of the CC filter cut out. Again the actual values are shown on the table on the back of the meter.

The Minolta Color Meter is primarily intended for selecting filters needed for accurate colour balance control. If you are using the 'wrong' film with a balancing filter, you must set the meter to account for that. Thus with Type B film and an 85B filter, set the film-type scale to D. Alternatively, if the light is bright enough, take all your readings through your 85B (A–D conversion) filter.

If you want to measure colour temperature, choose the correct range, set the film-type index to your first estimate of the colour temperature; set the main ring so that the LB filter index is at zero, and take a reading. Adjust the film-type scale accordingly, reset the light balancing filter to zero. Carry on adjusting until the meter indicates that you need no correcting filter for the light source. Then you can read off the approximate colour temperature.

Light-balancing filters

Much paler than conversion filters, these are just what you need to make small corrections in colour temperature. The amber (red) filters have positive mired-shift values; they are commonly graded in the Kodak Wratten 81 series. The blue filters, with their negative mired-shift values are in the 82 series. The code letters for each designate its strength. Some filters of this type are calibrated in decamireds. Thus, an R1.5 filter makes a mired shift of 15.

Colour-compensating filters

Other colours of pale filter are available as colour-compensating filters. These are graded in density units from the palest 0.05 to 0.5. They come in six colours: red (R), blue (B), green (G), cyan (C), yellow (Y) and magenta (M). They are coded with colour and density. Thus CC15M is a 0.15 density magenta filter. These are the units used for the red-green scale on the Minolta Color Meter.

M.W.—K

Polarized light

Light travels in straight lines, but oscillates or vibrates across the line of movement as it travels. Normally, the vibrations occur in all directions. In some circumstances, the vibrations can be restricted to a single plane still across the direction of travel. The light is then plane polarized.

No natural light source produces polarized light directly. Light becomes polarized either by reflection, or by passing through a polarizing substance. Most non-metallic substances can polarize light that is reflected (and incident, of course) at an angle of around 35° from the surface. As the angle becomes greater or smaller, so the polarizing effect reduces.

Polarizing substances are transparent only to rays polarized in one plane. They absorb light polarized at right angles. Filter manufacturers produce such filter or screen material in sheets.

A polarizing filter transforms normal light into polarized light. It also restricts the passage of light polarized at right angles to its plane of polarization; so, if you rotate a polarizing filter in a polarized light beam, it will appear alternately light and dark. When the plane of polarization is neither parallel, nor across the plane of the filter, some of the light is transmitted.

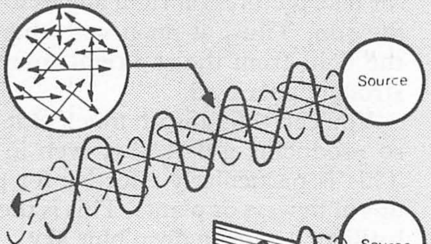
If polarized light is diffused, or reflected from a dull surface, it loses its polarization.

Polarizing filters in practice

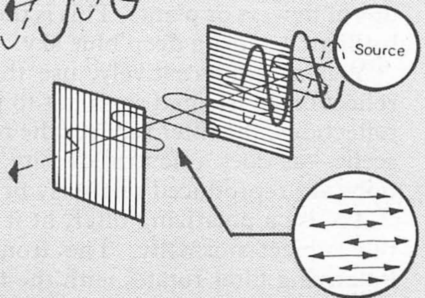
With a polarizing filter on the lens, you can control the amount of already polarized light that reaches the film. With careful camera placing, this can subdue reflections from water, glass, etc. For example, if you take a picture at an angle of between about 20° and 60° to a sheet of glass, you will see significantly more through it with a polarizing filter in place. So, you can, for example, photograph the contents of a shop window.

More subtly, you can suppress the unnoticed reflections from shiny ground cover, such as wet grass, thus increasing the colour saturation in your pictures. The most striking effect is with a blue sky. The blue light is reflected from particles in the atmosphere, and in certain directions is polarized. Most strongly so when you look

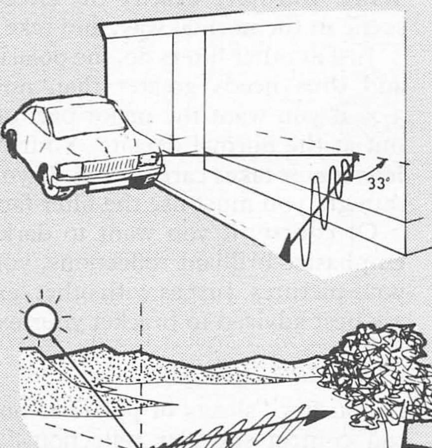
POLARIZED LIGHT



Light from all normal sources vibrates at random, so it is not polarized.

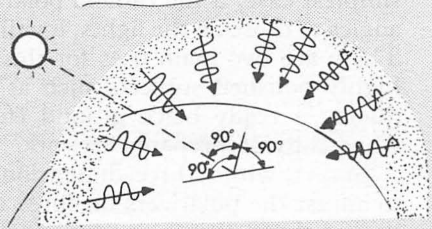


A polarizing screen absorbs all the light except that vibrating in its plane of polarization—producing plane polarized light. A second screen set with its polarizing direction across the plane of polarization absorbs the polarized light.



Light is polarized too when it is reflected obliquely from non-metallic surfaces. Thus, you can control reflections if you shoot from the right angle, and absorb the polarized light with a screen on the camera lens.

The plane of polarization is always parallel to the polarizing surface, so you must rotate the screen to suit.



Light reflected from a blue sky is polarized if you look at right-angles to the direction of the sun. So, you can selectively absorb the light, thus darkening the sky in a colour or black and white picture.

(or take pictures) at right angles to a line between you and the sun. Thus, at noon with the sun directly overhead, the light from the sky right round the entire horizon is strongly polarized.

You can thus absorb much of it with a polarizing filter, so producing a dark sky, even in colour transparencies. This is particularly effective for portraits, and for close ups of flowers or plants. This is the way to picture oranges brilliant against a deep blue sky.

You can, alternatively, use the polarizer to enhance reflections. Oriented so as not to interfere with polarized reflections, the filter reduces the rest of the light from the scene—as does a neutral density filter. Thus, the reflections are reproduced relatively brighter.

To use a polarizing filter, fit it on your lens, and view the subject normally. The front ring of the Minolta Polarizing filter rotates with the filter. As you turn it, so the image on your Minolta's viewing screen changes. When you have exactly the effect you want, meter the scene in the normal way, and take your picture.

Just as other filters do, the polarizer absorbs some light, and thus needs greater than normal exposure—about $3\times$ if you want the major part of your subject to come out at the normal density. Your Minolta's through-the-lens meter takes care of that. If you use a separate meter, though, you must use the filter factor.

Of course, if you want to darken the background or emphasize brilliant reflections, you have to underexpose your pictures. Just as with other 'experimental' shots, you are best advised to bracket your exposures in that case.

Polarized lighting

If you have sheets of polarizer on your lights, then you can control specular reflections, even from metal surfaces, irrespective of their angle of reflection. In the simplest case, if the camera polarizer is oriented at right angles to those on the lights, it will absorb all bright spots. There are two main uses for this technique: in lighting highly polished subjects such as jewellery, and in producing a really black ground from glossy black paper when copying prepared artwork.

In fact, with a three-dimensional subject, it is difficult to adjust the polarizers on three or four lights together;

and the filter on your camera. In practice, you can usually set up the scene and light it normally. Then screen whichever light causes undesirable reflections, and suppress them with your polarizing filter.

Black-and-white films

Coloured filters have a special effect on black-and-white materials: they alter the relative tones that different coloured subjects are reproduced. In general terms, a filter absorbs light of a complementary colour: thus reducing the amount that reaches the film, and so producing a darker toned image in the print. Because it is normal to increase your exposure to take account of the overall light absorption, you also reproduce lighter parts of the scene the colour of the filter.

For example, a magenta (red-purple) filter can change a picture of a fuchsia bush radically. The filter absorbs green light, so the leaves come out much darker—almost black. At the same time, the dangling flowers come out much paler. The contrast is striking, transforming an otherwise grey and grey scene into strong black and white. All the other coloured parts of the picture come out more or less normally. Picturing flowers is one of the most important uses of strong coloured filters. Often, without a suitable filter it is difficult to distinguish flower from leaves in a black-and-white picture. Of course, for strict botanical record, you should not distort the tones.

The most noted use of a contrast filter is to overcome the excess sensitivity to blue exhibited by most monochrome materials. This results in unfiltered skies appearing blankly white. A yellow filter (Y48) darkens the blue, allowing clouds to stand out in realistic contrast. That is why a yellow filter is often called 'sky' or 'cloud' filter. To overemphasize the clouds, you can use a deep yellow, orange (O56), or even a red (R60) filter.

Exposure and filters

A filter absorbs part of the light that would otherwise reach your film. Thus, you need to increase the exposure to produce a normal-density picture. Each filter is given a factor, a number by which you must multiply the exposure time to get a normal result. If you wish instead to change the lens aperture, remember that × 2 means open up 1 stop; × 4, 2 stops; × 8, 3 stops; × 16, 4 stops; and so on.

A minolta through-the-lens meter works quite well with pale filters, and perfectly with neutral-density and polarizing filters. You can meter through the filter, or shoot on 'automatic' without any problems. Strong coloured filters, on the other hand, can mislead the meter. For most purposes, you can follow the through-the filter reading with all but deep red filters. With the R60, give an extra increase of 1/2 stop with a CdS-celled camera, or 1 stop with a silicon-celled metering model.

If you are doubtful about the exposures, it is better to meter without the filter, and then convert your camera settings on 'manual' by the filter factor. If you use one colour often, you can quite quickly determine how you should bias the exposure controls for readings taken through that filter. Use the exposure factor dial to shoot on 'automatic'. For example, you may find that the XD dial should be set to + 1 for automatic exposure through a red filter.

Neutral-density filters

Exposure with fast (400 ASA, 27 DIN) film is virtually fixed on a bright day. Even in the brightest conditions, your Minolta can be set to a short enough shutter speed, and small enough aperture (around 1/500 at *f* 16) to expose the film properly; but that does not give you much control over picture sharpness.

If you want to use differential focus, or to blur a moving subject, you need much wider apertures or much longer shutter speeds. Bright days imply harsh sun. To overcome the harshness, you may need fill-in flash. With electronic flash, that necessitates a shutter speed of between 1/45 and 1/100 second on a focal plane shutter Minolta. Again this is impossible if too much light is available.

The answer is to fit a neutral-density filter to your camera. That reduces the light intensity without changing its colour. So, you can choose a longer shutter speed; or a wider lens aperture. Neutral-density filters, which do not change the colour or tones of your picture, are commonly calibrated in density units. You can combine several filters, and calculate their effect by adding together their densities.

EXPOSURE AND NEUTRAL-DENSITY FILTERS

Density	*Filter factor*	*Exposure increase (stops)*
0.1	$1\frac{1}{4}$	$\frac{1}{3}$
0.2	$1\frac{1}{2}$	$\frac{2}{3}$
0.3	2	1
0.6	4	2
0.9	8	3
1.0	10	$3\frac{1}{3}$
1.2	16	4
1.5	32	5
2.0	100	$6\frac{2}{3}$
3.0	1000	10

Exposure and neutral-density filters

Neutral-density (ND) filters are essential for Mirror lenses. The maximum apertures (*f* 5.6, *f* 8 or *f* 11) are too wide to produce correctly exposed pictures with fast film in bright sunlight. RF Rokkor lenses are provided with 0.6 density ND filters. These produce the effect of stopping down by two stops. Thus, for example, the 500 mm *f* 8 Rokkor passes the light as if it were an *f* 16 lens.

Because a neutral-density filter does not affect the colour, you can be quite sure that your Minolta will meter accurately through it. So, you can continue to shoot on automatic without loss of confidence.

Filter materials and mounting

Minolta filters are manufactured from dyed glass. They are supplied in screw mounts. These fit 46, 49, 52, 55, 67, or 72 mm filter threads. Naturally, the greatest selection are available in 49 and 55 mm mounts, as these are the sizes you need for virtually every MC or MD Rokkor or Celtic lens between 20 mm and 300 mm. The new small light Rokkors styled to go with the XG and XD cameras have 49 mm filter threads. If you have both types of lens, you can use 55 mm filters with a 49/55 mm stepping ring. If you have older 52 mm thread lenses, you can buy a 52-55 mm stepping ring. Thus, 55 mm filters will serve most of your needs.

The largest filters you will need are 72 mm, for the 17 mm *f* 4, 200 mm *f* 2.8, 300 mm *f* 4.5, 400 mm *f* 5.6 (APO), 24-50 mm *f* 4 and 100-500 mm *f* 8 lenses. The

Mirror lenses and the 600 mm APO-Rokkor take small filters close to the camera mount. The 250 mm *f*5.6, 500 mm *f*8 and 800 mm *f*8 RF Rokkors take 39 mm screw in filters; the 1000 mm *f*6.3 RF Rokkor 49 mm screw in; 600 mm *f*6.3, and 1600 mm *f*11 lenses take slot-in filters. The two fisheye lenses have a set of filters built-in. You select one by rotating a ring at the front of the lens. All the lenses that have internal filters must always have a filter in position. For normal use, select a UV-absorbing filter.

MINOLTA FILTER INFORMATION TABLE

Filter number	Available sizes (filter-thread diameters in mm)							Exposure Compensation for cameras requiring it			
								Daylight		Tungsten	
	40.5 mm	46 mm	49 mm	52 mm	55 mm	67 mm	72 mm	Filter factor	Stop's increase	Filter factor	Stop's increase
L37 (UV)			☐*				☐*	1	0	1	0
L39 (UV)	☐	☐		☐	☐	☐		1	0	1	0
Y52 (Yellow)	☐	☐	☐*		☐		☐*	2	1	1.5	½
R60 (Red)			☐*	☐	☐		☐*	6	2½	4	2
O56 (Orange)			☐*	☐	☐		☐*	2	1	1.5	½
GO (Green)			☐*	☐	☐			1	0	1	0
Polarizing			☐		☐			3	1½	3	1½
A12 (85)			☐*	☐	☐		☐*			2 ·	1
B12 (80B)		☐	☐*	☐	☐		☐*	2	1		
1A				☐	☐	☐	☐*	1	0	1	0
1B (Skylight)			☐*					1	0	1	0
ND4X		☐	☐*	☐	☐		☐*	4	2	4	2

* Minolta Achromatic coated.

It is important to note that the exposure compensation for filters is not generally necessary with through-the-lens metering cameras (such as the Minolta SR-T 101, et al.) or those on which the filter attaches over the meter cell (e.g., the Minolta Hi-matic F, et al.) The only exception is the R60 red filter which requires an exposure increase of one half stop (+½EV) for cameras having CdS-type meter cells (Minolta XG, XE, SR-T and Hi-matic cameras and AE finder for XM/XK camera) and one stop (+1 EV) for silicon-type cells (XD camera and AE-S finder for XM/XK camera).

The exposure compensation figures in the table are intended for use with cameras (e.g., the SR-1s, et al.) that do not have TTL or such 'lens-side-eye' metering. 'Filter factor' is an indication of how many times the exposure without a filter must be multiplied to provide proper exposure when a given filter is used. 'Stops' increase' indicates how many stops (EV steps) exposure must be increased over the metered or no filter value to compensate for the filter factor. For example, the Y52 yellow filter has a filter factor of 2, which means that exposure must be doubled. The 'Stops' Increase' for daylight figure is 1, which means that the lens is opened one stop, e.g., from *f*11 to *f*8, or the shutter speed halved, e.g., changed from 1/250 to 1/125 sec., for proper exposure. In tungsten artificial illumination, only 1½ times exposure increase is necessary and is obtained by opening the lens a half stop, e.g., from *f*8 to between *f*5.6 and *f*8.

Filters made bv other companies may be optical plastic, or (seldom now) gelatin cemented between glass. Either type is a direct replacement for an equivalent glass filter. For occasional use, you can buy sheets of gelatin filter. These are fragile, and easily destroyed. Once dirty, they can seldom be cleaned; however, for occasional or experimental use they are ideal.

Always use a lens hood with a screw in filter. That reduces the possibility of flare. Whenever possible, avoid using more than one filter at a time. Multiple layers of flat glass or gelatin can build up reflections, and dull your image with flare. Also, more than two screw-in filter mounts can produce vignetting (cut-off) with wide-angle lenses.

Special effects filters

Normally, you want as little interference as possible to forming a perfect image. Occasionally, though, you may want to modify that image. For this purpose, you can obtain a number of special-effects devices to screw into your filter mount. They all resemble plain glass filters, but have modified surfaces.

Thrity or forty years ago, practically every picture of a woman was diffused and hazy. This effect was grossly overused, and thus went out of fashion. However, a judicious amount of haze can be a real improvement.

You can make your pictures look slightly unsharp, or diffused by shooting through a soft-focus screen. These come in various forms, with etched or sand-blasted patterns on them. Some have a clear centre. With these, the effect is considerably reduced as you stop-down. However, in general, the effects you get are determined by the diffuser manufacturer. To obtain more control, you can make your own diffusers. The simplest way is the smear a faint film of grease on a redundant or perhaps scratched, UV or skylight filter. A little experiment will show you just how much you need to produce the pictures you want. If you move your filter a little way away from the front of your lens, and leave a clear centre, you can confine the diffusion to the edges of your picture.

None of these devices, though, produce the luminous image quality that you can achieve with an optically altered soft-focus lens. Thus, the 85 mm *f*2.8 Vari-Soft

Rokkor is the best choice for this type of photography.

Bright points flaring out into stars of light are popular. They add sparkle to backlit or night scenes. In fact, such brilliant additions can be a mjor part of the composition. They are formed by etched lines on a star screen. The screen is covered with a series of parallel lines, commonly two at right angles, but sometimes three or four sets. Each set produces flare lines. So, two sets produce a four-pointed star of light from each point of light, three pairs a six-pointed star, and so on.

Again, you can mimic the effect with home-made screens. Scratch straight parallel lines on a suitable piece of glass clear acrylic sheet (such as Lucite or Perspex). Of course, this too will add some overall flare and diffusion.

A single subject against a dark background can be surrounded with replicas of itself. Maybe a red rose, or a pretty face can benefit from this technique. To achieve it, you fit a multiple-image prism on your camera lens. These devices have three or more facets cut at different angles. If one of them is optically flat, then you get a normally placed image of part of the scene, repeated with displaced images from the other faces. If all the facets are angled, then all the images are displaced.

With all these effect attachments, you can see the results on your Minolta screen. None of them affect the exposure meter reading. So, you compose and focus your picture in the normal way, rotate the effect device on the lens if necessary, and expose in your normal way.

There are many other ways that you can manipulate the image in your camera. Often they can improve your pictures. However, no special effects can be a substitute for good composition and timing.

INTERCHANGEABLE LENSES

Perhaps the most telling reason for using a single-lens reflex is the simplicity it offers in using different lenses. The viewfinder shows you how each lens pictures your subject, how large each part is, and how much can be sharply focused. The Minolta SLRs use a bayonet lens mount, which makes lens changing simple. If your camera has a built-in through-lens meter, then it is coupled automatically to whatever degree the lens caters for.

For example, XD models allow you the full range of automatic-exposure functions with all MD-Rokkor lenses.

View and perspective

Normal lenses take in a fixed section of the view in front of the camera. If you want more in your picture, then you must go further back; less and you must go nearer. Moving around to get just the right picture is an integral part of photography. However, there are times when that is just not possible, or convenient. Then, the only way to cover a wider angle of view is to fit a wide-angle lens; or the only way to concentrate on an important detail is to fit a longer-focus (telephoto) lens.

Even more important, moving around alters the relative sizes of different parts of your picture. The closer you go to any particular subject, the larger it becomes in relation to the rest of the scene. If you can choose the angle of view, ie select the lens, you can choose the viewing distance, and thus the relative sizes of the parts of the scene, This has the effect of altering the apparent perspective in the picture. With part of the subject nearby, reproduced through a wide-angle lens, the perspective is very abrupt, producing a strong sense of depth. Conversely, when nothing was close by, as with a long-focus lens shot, the picture appears flattened, with all the parts compressed together.

Image size and focal length

From any particular viewpoint, the *size* of image that a lens produces depends on two things: the size of the subject (naturally) and the focal length of the lens. All other things being equal, image size is directly proportional to focal length. Thus, for example, if a 50 mm lens produces an image 10 mm high, a 100 mm will produce one 20 mm high. This is true whatever camera the lens is fitted to. Set the zoom lens of the 110 SLR to 50 mm, and it will reproduce the scene in front of you exactly the same size on the film, as will the 50 mm standard lens on any of the 35 mm models. In the same way, a 50 mm wide-angle lens reproduces the scene exactly the same size on a 60 × 60 mm ($2\frac{1}{4}$ in square) roll-film camera.

So, a 50 mm lens can be telephoto, standard, or wide-angle; it depends on how large the film is. It stands to reason that if you take a smaller segment of the image, you will cover a narrower angle. That is just what happens. The 25–50 mm lens fitted to the 110 SLR is equivalent in angle of view to a 50–100 mm lens on a 35 mm SLR and it has the same effect on your pictures.

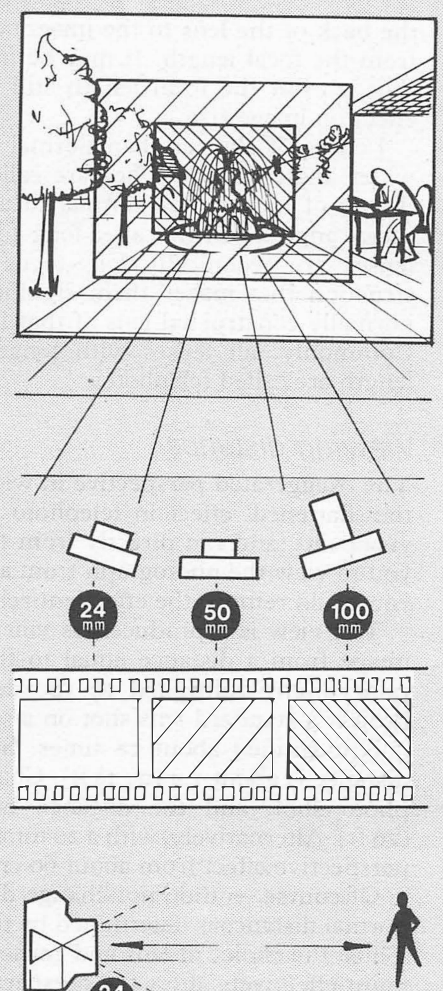
The reason is quite simple. For all normal purposes, you look at the entire image blown up to a convenient size (as a print or on a screen). Thus the size of image on the film is unimportant. It is the angle of view that decides what your picture looks like. That angle is decided by the focal length of the lens for any particular film size. Because most of the Minolta SLRs are 35 mm, we will discuss lenses in terms of that format. The pictorial effects of the zoom settings on the 110 SLR are an exact equivalent at the same angles of view.

Angles of view are normally measured on the diagonal of the film format. This convention most closely equates the angles of both square and rectangular formats.

The focal length of a simple lens is the distance at which it forms a sharp image of a distant object. The shorter the focal length, the smaller the image: and, of course, the more of the subject that is included within any particular frame. SLR lenses, including the Minolta range, are complex constructions made from four or more glass elements. The complexity is necessary to produce really sharp pictures.

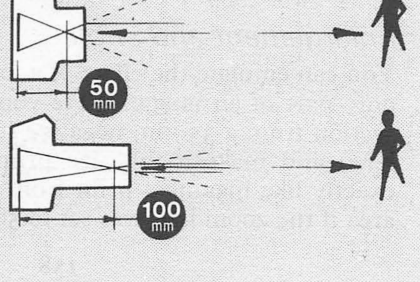
With complex lenses, the back focus (distance from

ANGLES OF VIEW



When you stay in the same place, changing your lens changes the amount of the scene that appears in your picture.

Of course, the wider-angle the lens, the more you get in, and the smaller each component is reproduced.



The focal length determines the distance between the rear node of the lens and the film. This clearly determines the angle from which the lens forms an image on the film.

the back of the lens to the image) can be quite different from the focal length. It may be much longer, or much shorter. But the focal length still has exactly the same effect on image size.

Lenses of shorter than normal focal length produce wider angle images. They are called wide-angle lenses. Those of longer than normal focal length have narrow image angles, and are called long-focus lenses. Telephoto lenses are technically long-focus lenses with a construction that makes them significantly shorter than a normally constructed lens of that focal length would be. Commonly, all lenses with longer than normal focal length are called telephotos.

Viewing distance

The exaggerated perspective in wide-angle pictures, and the 'flattened' effect in telephoto shots result from the viewpoint, and not directly from the lens. In fact, were you to view the photograph from an equivalent distance, you could remove the effect entirely.

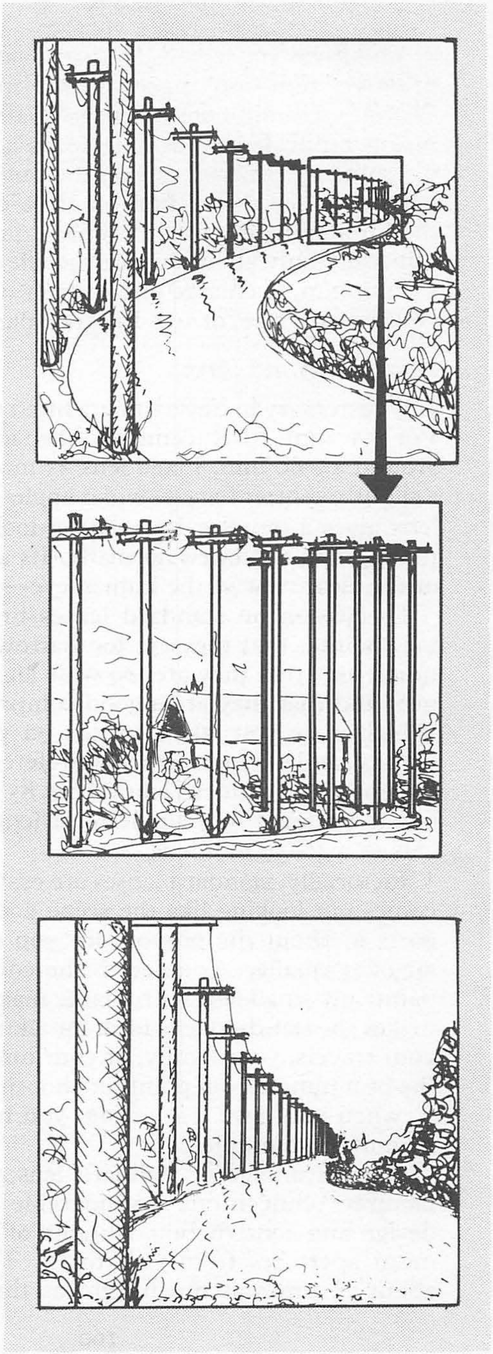
The view is reproduced as you saw it if you view an image from a distance equal to the focal length of the camera lens multiplied by the degree of enlargement. Project a standard lens shot on a screen 1 m (3 ft) wide; it is magnified about 28 times. So the correct viewing distance is about 1.4 m ($4\frac{1}{2}$ ft). Change to a 300 mm telephoto shot, and the distance becomes about 8.4 m (26 ft). Alternatively, with a 20 mm shot, you get a natural perspective effect from about 60 cm ($2\frac{1}{2}$ ft).

Of course, you do not change distances like this. The normal distance is determined by the screen or print size. Thus, the choice of lens and consequent change of viewpoint effectively alters the perspective of the picture and is a major influence in producing the results that you want.

Enlargement and angle

You can emulate the effect of a long-focus lens by taking only part of an image. Were you to take a 13 × 17 mm section from a 35 mm negative (taken with the standard lens) and make a full size print, the result would be exactly like making a print from the whole 110 negative area if the zoom lens was set to 50 mm.

VIEWPOINT AND PERSPECTIVE



A normal lens produces a picture in the proportions you expect, because it encourages you to take a normal viewpoint.

Use a long-focus lens to magnify a distant part of the scene, and you produce a much more cramped 'stacked-up' picture.

Conversely, with a wide-angle lens, you have to go much closer to produce an interesting foreground. Combined with the much smaller image of the rest of the scene, this exaggerates the apparent depth in the picture.

This gives you a considerable advantage if you work on negative film—or make prints from transparencies. Within the limitations of image quality, you can produce results equivalent to as long-focus a lens as you choose. To some extent, you can do the same by copying transparencies (see the section on close-up work). However, the limitations imposed by image quality mean that you can really only about double the effective focal length on 35 mm film, ie enlarge one-quarter of the picture area to your normal size, or to a full transparency.

The standard lens

It is customary to buy a camera fitted with a standard lens. For 35 mm SLR cameras, the accepted standard is around 45–60 mm. Fixed lens 35 mm models often have a slightly shorter focus—wider angle—lens. The standard lens gives a more or less natural-looking view when the photograph is viewed normally. Its angle is roughly that of the clear view of the human eye—about 45–55°.

Discussion on standard lenses brings three different viewpoints: that they are too narrow and angle to be of much use; that they are too wide an angle to be of much use; and that they are a good compromise for most use. Which view you take depends on your type of photography, and on your personal preference. I tend to prefer a slightly longer-focus lens (about 85 mm) for most shots, but if confined to a single focal length would probably choose a 40–50 mm lens.

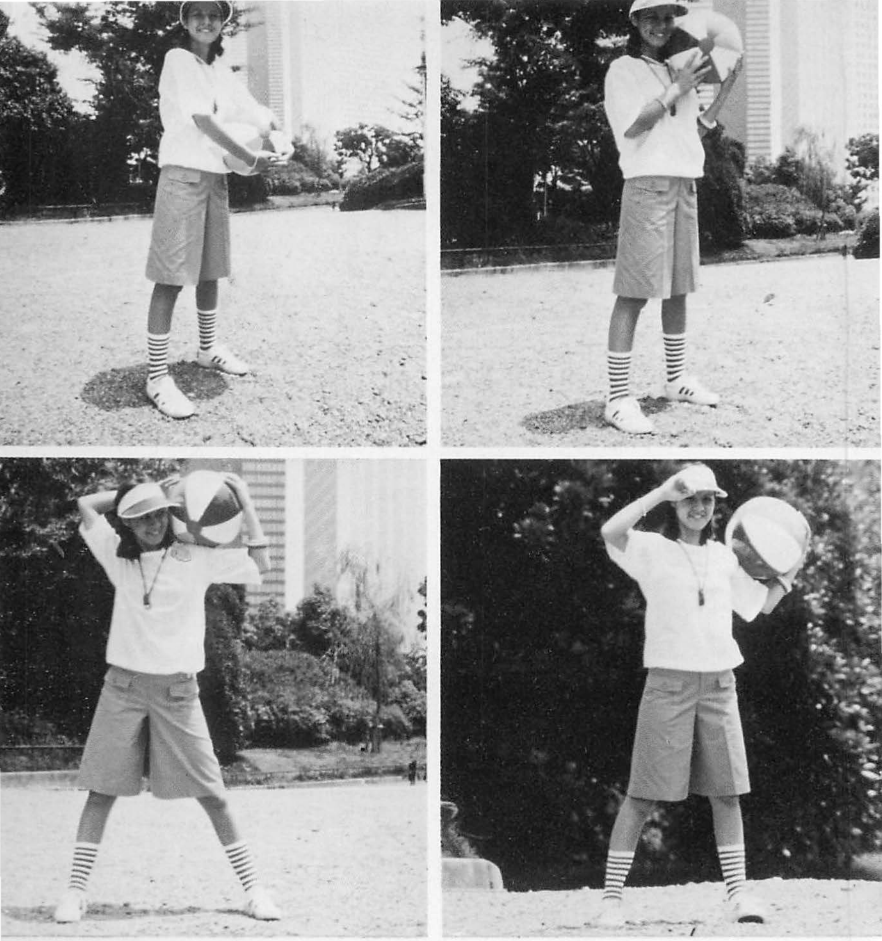
Pictorially, standard lenses are easy to use. The picture comes out looking like the scene you first saw; different parts in about the proportions you expect, and with an air of normality. Coupled to the convenience of a comparatively small lens with a large maximum aperture, this makes the standard lens ideal for taking pictures to record your travels, your family, or your interests. It is certainly the best jumping-off point for choosing other lenses; even if, when you have a selection, you hardly ever use your 45 mm or 50 mm lens.

One advantage of standard lenses is that the manufacturers concentrate considerable resources on their design and construction. Minolta offer a choice of maximum apertures from $f1.2$ to $f2$. The $f1.2$ lens passes about $2\frac{1}{2}$ times as much light as the $f2$ model. This is

ROUND TERRACE
The 75 mm *f* 4 MC fisheye Rokkor produces the characteristic circular images. It allows you to transform a normal scene into a rotund fantasy – *Clyde Reynolds.*

THE ROKKOR LENS RANGE
From a fixed viewpoint, the focal length determines image size *Left to right, top to bottom*, 1600 mm, 800 mm, 400 mm, 300 mm, 200 mm, 135 mm, 100 mm and 85 mm.

Left to right, top to bottom. 50 mm, 35 mm, 28 mm, 24 mm, 20 mm, 17 mm, 16 mm, 7.5 mm. (All from colour transparencies.)



VIEWPOINT AND LENS

Above. Changing viewpoint alters the relationship between parts of the subject. See how with progressively longer-focus lenses the background is magnified as the photographer moves to keep the girl the same size in each picture.

CURVED-FIELD LENSES

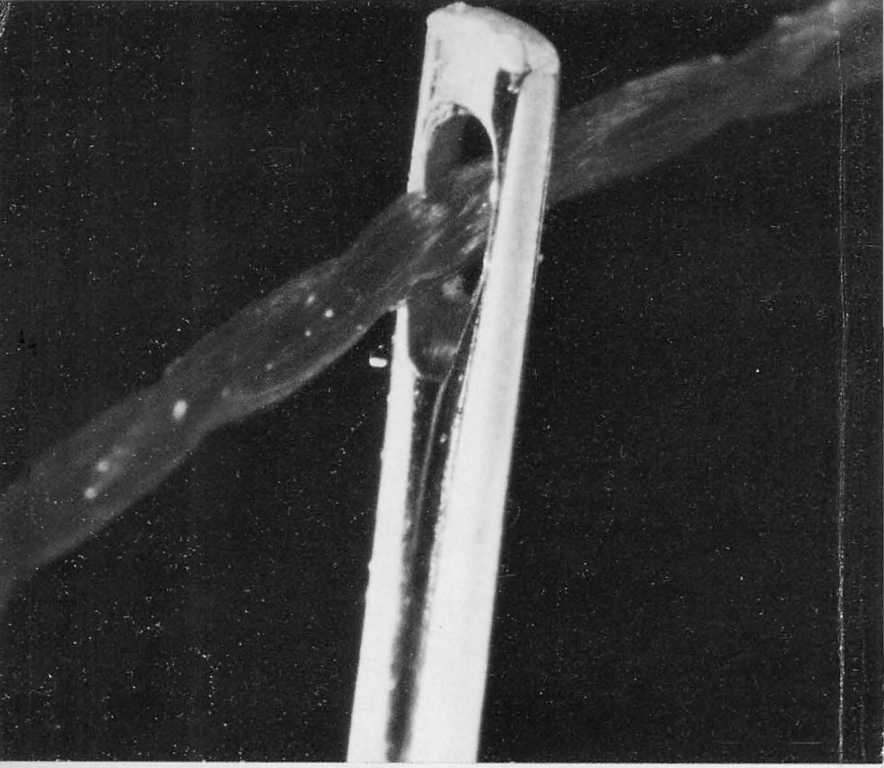
Opposite. The field curvature control on the 24 mm *f* 2.5 VFC Rokkor allows you to curve the 'plane' of sharp focus to match the subject curvature (*bottom*).

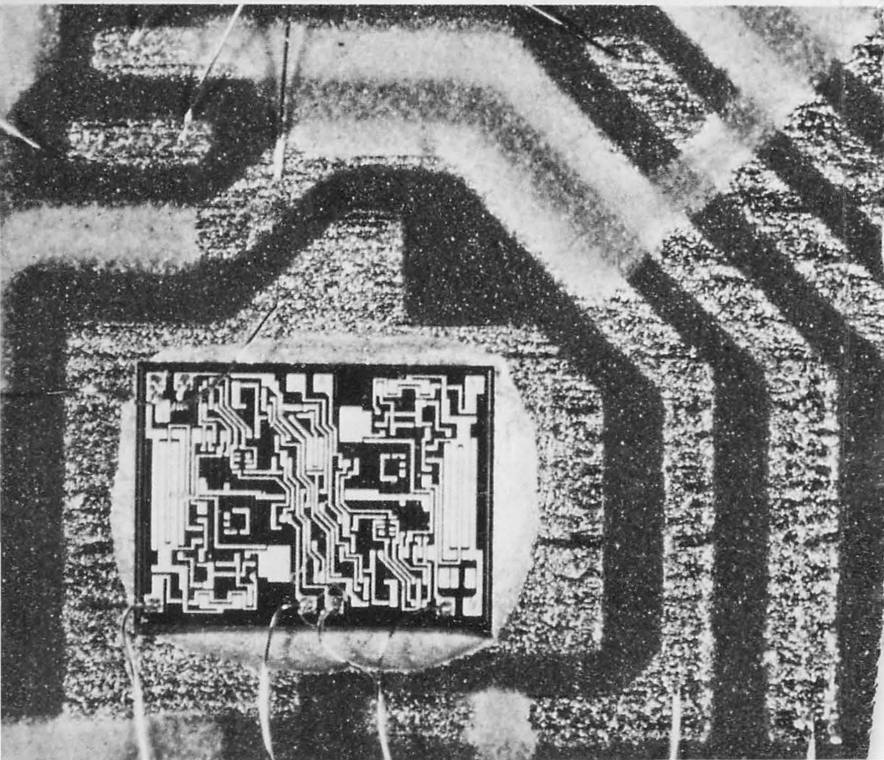

"BLACK & WHITE"
CAMUS
RARE
J&B

"BLACK & WHITE"
CAMUS
RARE
J&B

VERTICALS
If you have to tilt your camera up, the verticals converge, which can look odd (*top, left*). Of course, if you just straighten the camera, you trim off the top (*above*). Use the 35 mm *f* 2.8 shift CA Rokkor, and you include the top without the need to tilt the camera (*right.*) – *Clyde Reynolds.*
Opposite. Combine the shift with a curved field, and you stretch the zone of sharp focus diagonally across the scene. With the right selection of shift and curve, you can take otherwise impossible shots.

REALLY CLOSE
Overleaf. Minolta SLRs equipped with extension bellows are ideal for close-ups. The microcircuit is reproduced 5x life size, with a 24 mm Rokkor reversed. The needle and thread shows a similar magnification with a Leitz Photar 25 mm *f* 1.9 lens. (Both from colour transparencies.)





useful for existing light photography. It means, for instance, that you can take hand-held pictures in quite dim room lighting. With an $f2$ lens, even with 400 ASA film, you are restricted to static subjects even in normally bright house lighting.

Some older Minolta standard lenses are 53, 55 or 58 mm, thus having a slightly narrower angle than the current range which are 45 mm and 50 mm. The difference is not enough to be really significant in choosing a lens. These lenses are similar in function; but, naturally, do not benefit from the latest developments in lens technology. There is, however, no reason to replace any Minolta lens as long as it couples conveniently with your camera. The original 55 mm $f1.8$ lens fitted to the SR-2 can still take excellent quality pictures in virtually all conditions.

Minoltas Achromatic coating has long been among world leaders. So, all Rokkors are remarkably flare-free.

When deciding on your standard lens, choose the smallest maximum aperture that will meet all your needs. There is no point in carrying round the extra bulk (and bearing the extra cost) of the $f1.2$ lens if you never open up further than $f2.8$. If you contemplate working indoors without flash, to 50 mm $f1.4$ lens is a good choice.

The tiny 45 mm $f2.8$ Auto Rokkor was available for a short time. It has never been made with meter coupling.

The 45 mm $f2$ MD Rokkor lens is the smallest now available. It is admirably suited to the new small camera bodies, and carries on the trend toward choosing wider-angle lenses for standard equipment. This lens is the natural first choice of standard for XG and XD cameras, and probably a better basis for a series of lenses than any of the slightly longer-focus alternatives. It is the standard equipment on XD-5, XG-1 and SR-T100X cameras dating from mid 1978 onward.

When choosing your standard lens, do not overlook the 50 mm $f3.5$ MD Macro Rokkor. This lens has the same angle of view as the wider-aperture examples; but sacrifices light-passing capability to close focusing. It is the most useful standard focal length lens for any photographer who sticks to normal daylight or flash photography, and must be considered the first choice 50 mm lens for anyone who thinks that the 50 mm lenses have severely limited use in normal photography.

50 mm f3.5 Macro Rokkor

The lens is mounted in an extra-long double-helicoid focusing mount. This extends it by up to 25 mm, thus allowing you to focus down to 0.23 m (9 in) unaided. At this extension the subject is pictured one half life size on the film. The 50 mm *f*3.5 MD Macro Rokkor comes with its own 25 mm extension tube. With this tube in place, it focuses from 0.23 m-0.20 m (9–8 in). At the closest point it reproduces the subject life-size (see the chapter on *Shooting at Close Range*). The extension tube, called the Life-Size Adapter, is MC-coupled.

The lens barrel is engraved with magnification ratios. The white figures for the lens unaided, and the orange ones for the lens with its Life-Size Adapter. Between the two columns of figures is a line which acts as an index for the exposure factor scales. These, white for lens alone, and orange for lens and adapter, are engraved on the front of the focus ring. When you use an external exposure meter, or a flashgun, these figures represent the exposure increase in stops that you need because of the extra lens extension. With through-the-lens metering, of course, you can ignore them altogether.

Wide-angle lenses

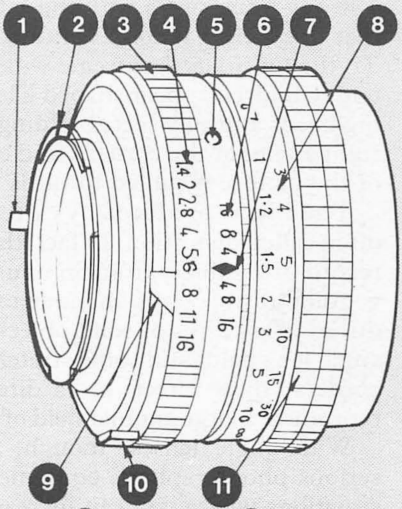
Lenses with an angle of view greater than about 60° are labelled wide angle. Of course, some photographers use such lenses for virtually all their shots.

Wide-angle lenses demand close viewpoints. Without them, the subject is so tiny that it becomes lost. The wider the angle (shorter the focal length) the closer the view you need. The viewpoint then introduces the characteristic imbalance between nearby parts of the subject and the background. The effect is heightened because, effectively, the shorter the focal length, the greater the depth of field. For example, the 17 mm lens at *f*8 can reproduce everything from 0·6 m (2 ft) to infinity adequately sharp. So, the foreground and background can both be seen clearly.

As wider and wider angle lenses have become readily available, so photographers, especially photojournalists, have used closer and closer viewpoints. This has led to the acceptance among photographers, critics and journalists that the steep perspective reveals a close view, giving

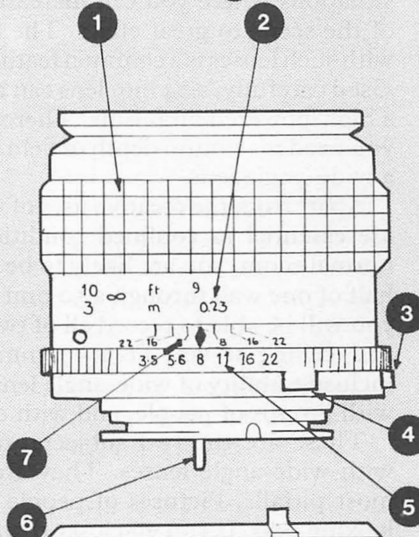
Most current Minolta lenses have both MD and MC links for meter couplings. The 50 mm *f*1.4 Rokkor is typical of the whole range.

1. Automatic diaphragm pin.
2. Minolta 3-claw bayonet.
3. Aperture control ring.
4. Aperture (*f*-number) scale.
5. Lens mounting index.
6. Depth-of-field scale.
7. Aperture/focus index.
8. Focus scale.
9. MC coupler.
10. MD coupler.
11. Focus grip.



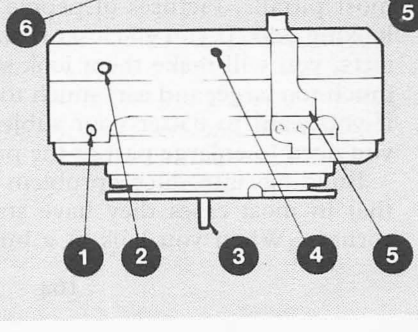
The 50 mm *f*3.5 MD Macro Rokkor focuses to 0·23 m (9 inches) unaided, to give half life size reproduction on the film.

1. Focus grip.
2. Focus scale.
3. MD coupler.
4. MC coupler.
5. Aperture scale.
6. Automatic diaphragm lever.
7. Aperture/focus index.



The lens is supplied with an MC coupled auto-diaphragm extension tube—the Life-Size Adapter, which reduces the minimum focus distance to 0.20 m (8 inches).

1. Mounting bead.
2. Lens-release button.
3. Automatic diaphragm lever.
4. Lens-mounting index.
5. MC transfer arm.



a strong sense of 'in with the action'. I am not at all sure that this feeling is communicated to the non-cognoscenti. To the unititiated, extreme wide-angle pictures just look odd. Children appear shaped like Indian clubs, with great big heads and tiny feet; buildings no longer seem to have right angles at the corners, and everything near the edges of the picture is pulled towards the corners of the frame.

The effects produced by extreme wide-angle lenses are often called distortion. In fact, they are mostly an accurate record of a subject from an unusual viewpoint. The only genuine distortion is the inevitable widening effect produced in pictures of solid objects at the edges of a wide-angle lens field, and some stretching of anything near the corners; these effects are a direct result of the need to reproduce a large angular field of view on a flat area of film.

Wide-angle lenses, though, are a vital part of any serious photographer's equipment. There are numerous situations where you can increase the emphasis on parts of the scene to great effect. The 'long low look' induced with such lenses is a common feature of car advertisements. Used carefully, a 24 mm lens can make a mini car look like a high-powered limousine. There are occasions too, when you need maximum depth of field. In either case, you need a wide-angle lens.

Apart from the creative uses of wide angles, these lenses are essential in confined conditions. For example, in a normal room, you are likely to be able to picture less than half of one wall through a 50 mm lens. In the same room, you will be able to record all of two walls, with some floor and ceiling if you fit a 17 mm lens instead. The all inclusive ability of wide-angle lenses is particularly useful with groups of people, and with city buildings.

These are the two subjects most commonly covered with wide-angle lenses. They are also the two with the most pitfalls. Pictures of people are especially prone to looking odd. If you go closer than about 6 ft to your subjects, you will make them look strange; noses come out much too large, and ears much too small. Keep well back if you want to flatter your subjects; even if that means you need to enlarge part of the picture later.

Buildings introduce a problem because everyone *knows* that in most cases they have straight sides and square corners. When you look at a building, your brain processes the information from your eyes in the light of that knowledge. Although your eyes form images of a series of irregular quadrilaterials, you see neat rectangular buildings. Unfortunately, when you see a picture of the same irregular quadrilaterials, your brain does not automatically transform them into a normal building. Your first reaction is to wonder why anyone should build something at a crazy angle like that, one end higher than the other, and tapering towards the top.

The effect is produced whenever you take a picture with the camera angled to a wall. It is, however, much more pronounced with wide-angle lenses, because their enforced close viewpoint necessitates much greater angling. The only way to picture a building with square corners and parallel sides is to have the camera back exactly parallel with the wall.

In artistic convention we can accept that horizontal lines converge toward a vanishing point. That is how we convey perspective. We do not, though, accept that vertical lines, too, converge. Thus, in photography, it is much more important to keep the camera exactly vertical than it is to keep it parallel to a wall in the horizontal plane. However, wide-angle lenses tend to exaggerate the horizontal convergence. That is why you have to study the viewfinder image with great care if you are to avoid rather odd-looking pictures of buildings.

The Minolta range of 'straight line' wide-angle lenses stretches from 35 mm to 17 mm. There are two non-linear fisheye lenses as well.

Wide-angle construction

The shorter the focal length of a lens, the higher its optical power. Thus, a 50 mm lens is 20 dioptres and a 17 mm lens 58 dioptres. Because of this, the optical construction of wide-angle lenses is more complicated. The wider the angle, the greater the problem.

As well as optical strength, there are two other problems. The first is directly related to the angle of view. Irrespective of focal length, it is much more difficult to make a lens to cover a wider angle. The image naturally tends to fall on a curve rather than a flat plane, and flattening it gets more difficult as the angle increases. Other problems (aberrations) add to the complication.

The second problem is that in an SLR, the mirror needs room to move; so, the back focus of the lens must be great enough to allow that. Minolta lenses do not normally protrude back beyond their bayonet flange whatever their focal length.

As a lens normally focuses just one focal length away, wide-angle lenses need special construction. This con-construction, called reversed telephoto, or retrofocus, moves the lens well forward from the point at which it appears to be optically. This has very little effect on the image produced by the lens. A 20 mm lens is a 20 mm lens however it is constructed. It does, though, mean that if you reverse the lens, the effect is the same as adding extra extension. There is more about this in the chapter on *Shooting at Close Range.*

All these considerations demand that wide-angle lenses need a considerable number of elements—11 or 12 are quite common in the really wide lenses. Such lenses are difficult to make, and consequently tend to be expensive.

35 mm lenses

Considered by many to be a better everyday focal length than 50 mm, 35 mm lenses are no longer the first choice accessory that they were. Basically, if you use a 50 mm lens, a 35 mm one is not really a wide enough alternative. If, on the other hand, you are looking for a wide-angle lens to use for most of your photography, then look carefully at 35 mm lenses.

The main use of 35 mm lenses is to include more in your pictures. They do not provide you with aggressively steep perspective—but do give a useful increase in depth of field at normal apertures and distances. As with standard lenses, choose the smallest maximum aperture lens that will comfortably cover your needs.

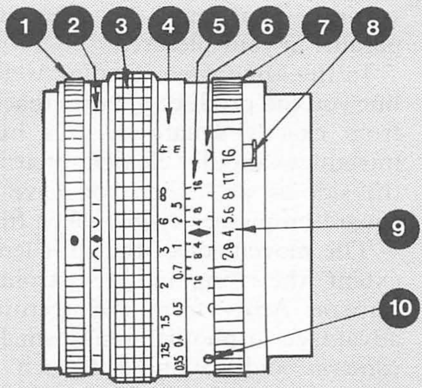
The 35 mm f2.8 Shift CA Rokkor

The Shift Rokkor lens can be moved up and down or side to side relative to the camera. As it moves, it alters the picture without the camera moving. This is useful in picturing buildings and townscapes. As we have just discussed, tilting the camera up produces pictures with converging vertical lines. With the shift lens, you can raise the image while keeping the camera back exactly

VARIABLE FIELD CURVATURE

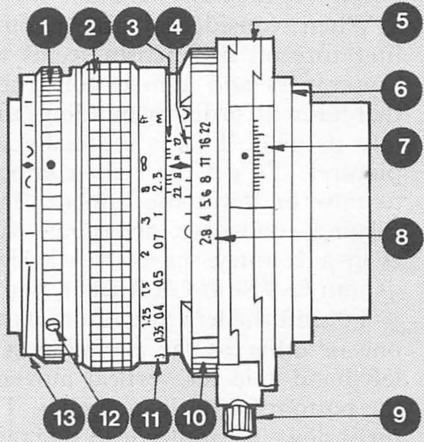
The 24 mm f2.8 VFC Rokkor allows you to mould the 'plane' of sharp focus more readily to the contours of your subject. It is also a fine normal wide-angle lens.

1. Field curvature control.
2. Field curvature scale.
3. Focus ring.
4. Focus scale.
5. Depth of field scale.
6. Curvature indicator.
7. Aperture ring.
8. MC lug.
9. Aperture scale.
10. Mounting index.



The 35 mm f2.8 shift CA Rokkor combines variable field curvature with a shift of up to 11 mm. This produces a rising- or cross-front action. The diaphragm is coupled for automatic operation.

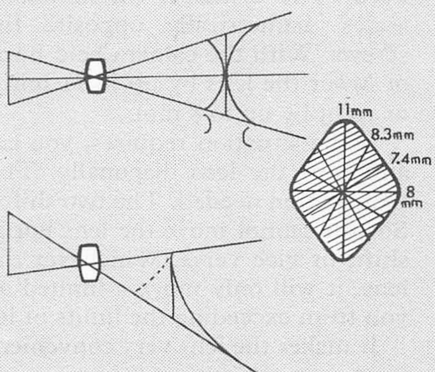
1. Field curvature control.
2. Focus ring.
3. Depth-of-field scale.
4. Curvature indicator.
5. Shifting mount.
6. Lens mount.
7. Shift scale (vertical scale on side).
8. Aperture scale.
9. Rise/fall lock (cross lock on bottom).
10. Aperture ring.
11. Focus scale.
12. VFC release button.
13. Field curvature scale.



Operating the VFC control on either lens allows you to curve the field.

The 35 mm shift CA Rokkor has links which provide a diamond-shaped shift area.

Combining shift and curved field provides a sloped near-planar field of sharp focus, which can extend the sharpness from close by to infinity.



vertical. That way, the sides of the building remain parallel in your picture.

In the same way, standing well away from the centre line you can produce pictures that look as if they are taken from exactly square-on to a building. This, though, introduces another element of artificiality. If you can see the side as well, then you have the contradiction of a square-on picture visibly taken from one side.

The movement of the shift lens mimics (to a limited extent) the rising and cross front movements of a view camera. Apart from architectural uses, it is also an advantage in photographing small subjects, boxes, toys, cameras and so on. For such subjects, the artificial 'square-on with sides showing' view is quite acceptable. Often it is the most suitable.

When considering the photography of buildings, literature on shift lenses seems to concentrate on high skyscrapers and similar constructions. I find, though, that it is with ordinary buildings that the lens really comes into its own. This is especially so in horizontal format pictures. To get the right composition, you often need to raise or lower the camera. Tilting it produces converging—or worse, diverging—verticals. They can mar even a country scene with a single cottage. With the 35 mm *f* 2.8 Shift CA Rokkor, you can avoid the problem.

To shift the lens away from its central axis, you release one or other of the clamping screws. The one on the left-hand side for vertical movements, and the one on the bottom for horizontal ones. Then, you push the lens up or down or from side to side to obtain the distance you need. The distances (in millimetres) are indicated on scales diametrically opposite the relevant clamping screws. With the camera held horizontally you can raise or lower the lens by up to 11 mm, or move it to the left or right by up to 8 mm.

If the situation requires, you can loosen both clamps and shift the lens diagonally. This is not a movement that is often needed. The two shifts are coupled together. So you cannot move the lens horizontally at full vertical shift, or vice versa. Whichever direction you move the lens, it will only move a limited amount. This prevents you from exceeding the limits of lens coverage.

It makes the lens very convenient to use. You can shift it while viewing your subject, and be quite sure that you will get excellent image quality without vignetting wherever you move the lens.

The 35 mm *f* 2.8 Shift CA Rokkor has another special feature: it can be made to reproduce objects sharply either on a plane (as a normal lens), or on a curved surface. The curved field function is introduced by turning a ring at the front of the lens. This is a particularly useful feature for close-up work. Many common subjects, such as flowers or animals, are roughly dome or bowl shaped. By altering the curvature to suit them, you can picture the entire surface sharp, instead of being confined to a plane.

Of course, the advantages of manipulating the field of curvature are not confined to close-ups. There are plenty of middle distance subjects—up to about 10 m (30 ft) away, which follow a curved shape; and which can be reproduced with greater overall sharpness this way, especially if the lens aperture is of necessity kept fairly wide open. The interiors of buildings are an obvious example: corners and alcoves can benefit from the concave field; pillars, furniture, tombs and so forth from the convex one (centre toward the camera).

Combining the outwardly curving field with the shift facility produces an approximation to swinging the lens on a view camera. It confines the curvature to one side of the field. Thus, the surface of sharp focus runs diagonally away from or toward the film plane. Of course, it is still a curve, but the effect resembles that of swinging the plane of sharp focus by swinging the lens. With your main subject close to one side of the picture this can considerably extend the effective depth of field.

Using the inwardly curving field has less effect, but may be more suited to some subjects. In fact, if you travel a lot, the Shift Rokkor is undoubtedly the best reason for carrying a 35 mm Minolta lens with you. Unfortunately, it costs rather more than an XM with AE finder and *f* 1.7 standard lens. The CA Shift Rokkor has an automatic diaphragm, but this is not meter coupled. So it must be used with stop-down metering, or stop-down automatic operation (except on the XG cameras). However, away from its central position, the meters are innacurate. So when shifting, meter twist or set the camera manually.

The chapter on *Exposure* describes these procedures in detail.

28 mm and 24 mm lenses

Until recently any lens wider than about 35 mm was called ultra-wide and regarded as specialist equipment. Now, the first choice for an accessory wide-angle lens must come from this range. The angles of view are 75° and 85°.

For most ordinary photography, a 28 mm lens is the best choice. It lets you go in close enough to produce striking perspective effects, while not being too demanding. You can use a 28 mm lens for quite normal shots without having to concentrate too hard on avoiding wide-angle effects. It is a good step down from a 50–58 mm standard, too.

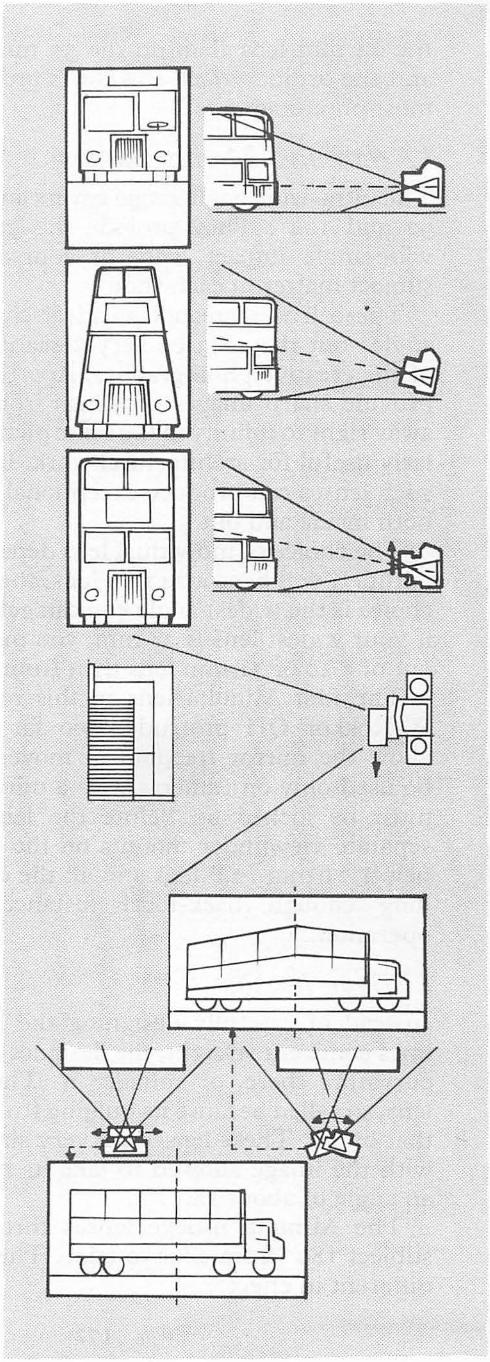
A 24 mm lens, on the other hand, needs rather more care. It reproduces things just half the linear size they are seen through the standard lens (from the same viewpoint) and encourages you to get extra close. However, used with a clear eye, this lens can do most of your wide-angle work. If you concentrate on making prints, a 24 mm lens is more useful than a 28 mm one. You can always print a little less, never a little more! Also, if you already use a 35 mm lens, then a 24 mm one is a much better complement to that.

The 24 mm f2.8 VFC Rokkor

A sign that 24 mm lenses are becoming more popular was the introduction of the 24 mm VFC Rokkor. This lens combines normal wide-angle performance with variable field curvature—as also on the 35 mm *f*2.8 CA Shift Rokkor. The VFC capability on this lens is particularly convenient for close-up shots. Wide-angle lenses give greater image size for the same extension, and reversing them provides considerable extension without any other equipment because of the retrofocus design. In fact, the 24 mm lenses give an image about 2.4 times life-size on the film when used with a reversing ring on the camera.

Because of its inherently large depth of field, the VFC feature is of less importance with normal-distance subjects. So, the VFC facility is less of an advantage on

USING THE 35 mm
SHIFT CA ROKKOR



Held horizontally, even with a 35 mm lens, the camera often misses the top of tall subjects.

If you tilt the camera up to include the top, the sides show convergence, which can spoil the picture.

Instead of tilting the camera, raise the 35 mm f2.8 shift CA Rokkor to include the top of the subject, and the sides remain parallel.

You can use the horizontal cross shift to take 'square-on' pictures, avoiding unwanted foreground obstacles.

Straight subjects are a problem in normal panoramas. The swing of the camera between shots makes them bend in the middle.

You can take two shots with a shift lens, using the two extremes of movement thereby producing a geometrically perfect panorama.

the 24 mm lens than on the 35 mm CA Shift Rokkor; and the ordinary *f*2.8 Rokkor is probably the choice for most photographers.

17 mm and 21 mm lenses

The ultra-wide angle range covers angles of view between 92 and 104°. They provide the greatest potential for wide-angle impact, and, of course, include the most subject matter in each shot.

These lenses are not an ideal choice as a first wide-angle; but they can be very versatile tools in the hands of the creative photographer. Apart from their ability to provide sharp images of things from a few centimetres away right to infinity in the same picture, they are particularly useful for architectural work. Used with discretion, such lenses can produce exceptional records of buildings both inside and out.

The choice of individual lens depends on your existing outfit. If you have a 24 mm lens, then obviously the best choice is the widest angle you can get. On the other hand, if your widest lens is 28 mm, you may well get more use out of a 20 or 21 mm lens than from a 17 mm one.

The first Minolta lens in this range, the 21 mm *f*4 W-Rokkor QH protruded too far into the camera to allow the mirror freedom of movement. This lens can be used only on cameras with a mirror lock. The mirror must be locked up before the lens is mounted. The separate viewfinder mounts on the accessory shoe. The newer 21 mm *f*2.8 lens and all the current lenses have a long enough back-focal distance to allow normal operation.

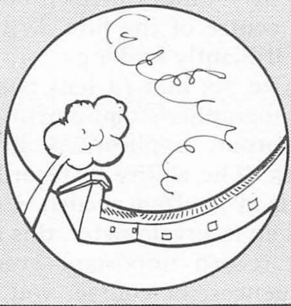
Fisheye lenses

Instead of carefully designing the lens so that straight lines come out straight, the designer can leave the natural curvature there, or enhance it. The result is a fisheye lens, so called because its bulging front elements resemble that organ. These lenses are very short focal length, and with the image allowed to take its natural curves, cover an angle of about 180°.

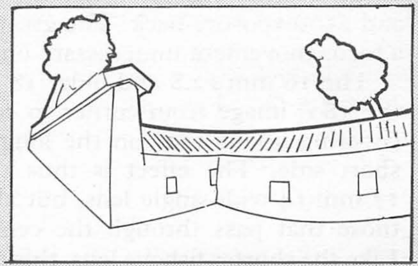
The Minolta fisheye lenses throw an image of the subject 180° from edge to edge. They are, though, quite different in effect.

ULTRA-WIDE ANGLE LENSES

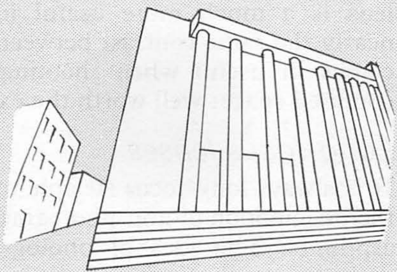
With the very widest angle lenses, the picture is quite unusual. The 7.5 mm fisheye produces a totally circular image, 180° across. To do this, it must curve all lines that do not run directly along radii of the circle.



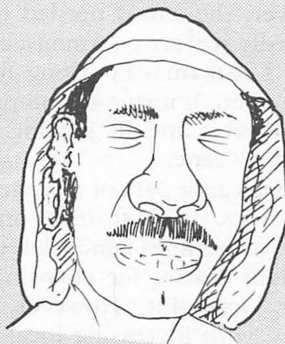
The 16 mm fisheye, too, curves the lines. Its 180° coverage, though, is from corner to corner of the normal 35 mm frame.



The 17 mm *f*4 covers a smaller diagonal angle, and reproduces straight lines straight. It can still exaggerate the perspective wildly, and produce quite strange pictures.



With any really wide-angle lens, when you go close enough to fill the frame with a face, you get a very odd-looking picture, with big nose and little ears.



The 7.5 mm f4 lens produces a circular image, on just the centre of the film. With the right subject, this can be brilliantly striking.

The 7.5 mm f4 lens is not an essential part of most photographer's equipment. It does, however, have very important applications in scientific and surveillance work. The ability to record everything from horizon to horizon is often needed. Coupled with a power winder and an intervalometer, this lens on an XG or XD camera can record important events automatically. For long sequences, of course, you need an XM-motor camera and 250-exposure back. The great depth of field renders a focus movement unnecessary on this lens.

The 16 mm f2.8 and older 18 mm f9.5 lenses record the 180° image from corner to corner of the film, thus covering about 150° on the long side and 100° on the short side. The effect is thus rather like that of the 17 mm f4 wide-angle lens, but all straight lines (except those that pass through the centre) come out curved. Like the shorter fisheye lens, this effect can be striking on occasions. However, I find that the straight-line 17 mm lens is a much more useful instrument. It provides nearly the same contrast between near and far, and also comes in useful when shooting normal pictures in a confined space: well worth the extra cost.

Long-focus lenses

It is always long-focus (telephoto) lenses that first catch the imagination of non-photographers, and photographic aspirants. The idea of photographing distant scenes, animals, people, and so forth is immediately appealing. However, the lenses needed to picture things that 'you can hardly see' are enormous, costly, weighty and difficult to use. The main uses of long-focus lenses are in obtaining a large enough image of comparatively distant but easily seen objects; and in picking out individual parts of a confusing scene.

By enlarging part of a scene, you appear to flatten the perspective, piling features on top of one another. This effect is sometimes beneficial. Certainly, obtaining it is an important reason for choosing a long-focus lens and a distant viewpoint. However, as the depth of field is reduced with increasing focal length, your main subject is more often shown in isolation against a blurred background.

All this really applies to lenses of more than three times the standard focal length—say 180 mm and longer. Lenses of around double the normal focal length are as often chosen because they flatten perspective as because they magnify a subject.

The most important use of these lenses is in portraiture. As we discussed previously, you cannot often flatter your subject if you go much closer than 6 ft or so. From that distance, you get about a three-quarter-length portrait with the standard lens. To get a nice tightly cropped head and shoulder shot, you need a longer-focus lens. One in the 85–105 mm region is probably best.

85 mm and 100 mm lenses

Considered 'ideal' for portraits, these lenses are very nice for general photography as well. They produce pictures that cover a smaller angle than the theoretical limits of the human eye. However, when you first see a scene, you concentrate on part of it. Often, an 85 or 100 mm lens reproduces more closely what you actually saw than does any other lens.

Conveniently, Minolta supply the 85 mm *f* 1.7 Rokkor. This has a large enough aperture for all normal use. In fact, this lens is well worth considering in place of a 50 or 58 mm one as a 'standard'. It is not so long as to restrict depth of field too drastically. The 85 mm is an ideal lens for portraits, and for much landscape photography. If you already have a 50 or 58 mm lens, the 85 mm, with an angle of view of 29° may not seem to offer very much more. Its main asset is its *f* 1.7 maximum aperture. To add to your choice, Minolta also offer an *f* 2 85 mm MD Rokkor. This is a small, light lens. Very convenient, and only 1/2 stop slower than the *f* 1.7 version. A good choice if you work in any but the lowest lighting.

If you consider moving to 100 mm, with a 24° angle, you must be satisfied with a moderate maximum aperture. The 100 mm *f* 2 Rokkor was discontinued some years ago and you now have to drop a stop (from the 85 mm *f* 1.7 Rokkor) to the 100 mm *f* 2.5 MD Rokkor, or more to the 100 mm *f* 3.5 Macro Rokker, which is really useful if you also have an interest in close-up photography.

However, if you are neither especially concerned with maximum aperture, nor close focusing, the 100 mm *f* 2.5 MD Rokkor is your best choice in this range.

The 85 mm f2.8 Vari-Soft Rokkor

Minolta make a special 85 mm lens, which can give soft defocused images. The 85 mm *f* 2.8 Vari-Soft Rokkor introduces a controllable amount of spherical aberration to the image. It consists of a conventional four-element, Tessar-type, lens, backed with a pair of meniscus lenses, one convex and one concave, which can move relative to the other elements.

The image is given progressively a softer quality by moving the softness control ring away from an '0' setting to '1', '2', or '3'. This ring moves the lens elements relative to one another. When set on '0', the lens produces a normal sharp image. Stopping down the lens reduces spherical aberration. Thus, the defocused effect is greatest at full aperture.

This lens is an attractive alternative to a normal 85 mm lens. The addition of a degree of softening is a pleasant way of treating some subjects. Portraits can be given a luminous, almost translucent quality—and (often more important to your model) slight defocus can hide many imperfections in the skin. Wrinkles, particularly, seem to melt away. Landscapes taken in the morning can benefit from a little reduction in sharpness. Be careful, though. Soft-focus is not the answer to all your problems. It is a technique that was grossly over used in the 1930s. It is possible now to overdo it again to just the same degree.

100 mm f3.5 MC Macro Rokkor

The 100 mm Macro Rokkor is very similar in concept to the 50 mm Macro lens. Its unaided 50 mm of focus travel reduces its minimum focus distance to 0.45 m (18 in), again giving $\frac{1}{2}\times$ (half life-size) reproduction. This lens, too comes with an MC life-size adaptor to reduce the focus distance to about 40 mm (15 in) and give 1 × magnification.

Just as on the 50 mm lens, the extending lens barrel carries magnification factors, this time on the back part. Again, the orange figures apply when the lens is mounted on its life-size adapter. The exposure factors for use with

35 mm *f* 2.5 MC
VARISOFT ROKKOR

The 85 mm *f* 2.8 Varisoft Rokkor lets you soften your pictures at will.

1. Filter ring.
2. Focus ring.
3. Focus scale.
4. Depth-of-field scale.
5. Softness index.
6. Softness ring (sharp).
7. Aperture index.
8. Aperture scale.
9. Softness scale.

Set to O, the lens gives normal sharp Rokkor performance. On 3, the elements are separated, and produce a very soft image, sharpening with decreasing lens aperture.

100 mm *f*3.5 MD
MACRO ROKKOR

This lens focuses down to 0.45 m (1.5 feet) unaided to reproduce subjects 1:2.

1. Filter ring.
2. Focus ring.
3. Distance scale.
4. Magnification scale.
5. Depth-of-field scale.
6. Exposure scale.
7. Aperture ring (MD coupled).
8. Auto-diaphragm lever.
9. Magnification scale with life-size adaptor.
10. Adaptor exposure scale.

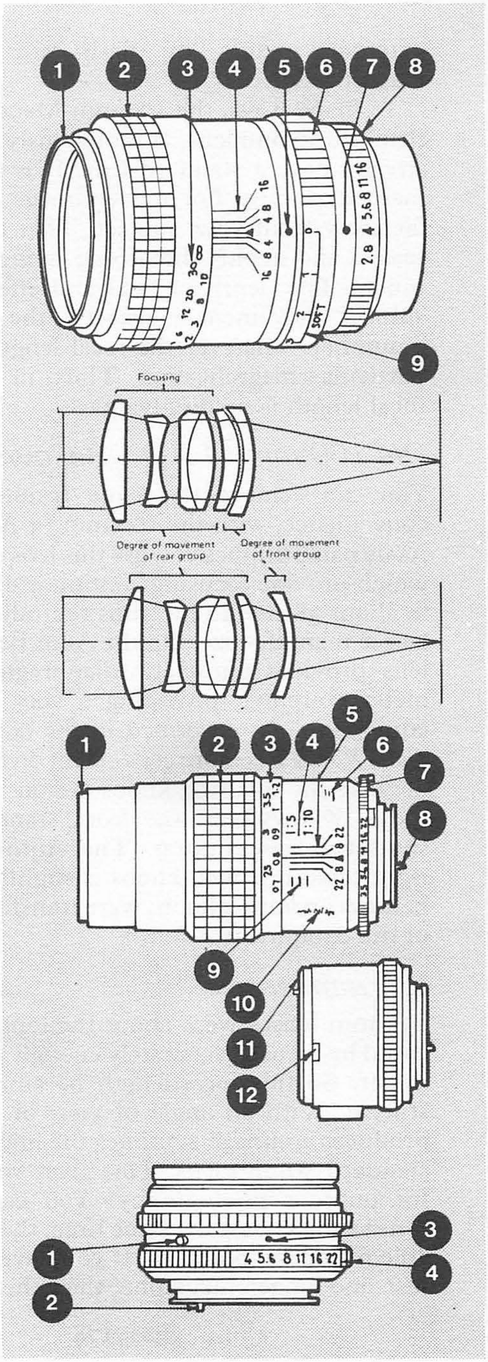
The life-size adaptor allows reproduction to 1:1.

11. MC Coupler.
12. Lens-release button.

THE 100 mm *f* 4 AUTO
BELLOWS ROKKOR

Focuses from infinity to greater than life-size magnification on any Minolta Bellows unit.

1. Mounting index.
2. Auto diaphragm lever.
3. Aperture index.
4. Aperture ring.



external meters or flash are engraved by the magnifications.

In many ways, the 100 mm Macro lens is more useful than the 50 mm lens. It is obviously a better choice if you already have a standard lens. It is also easier to use for many close-ups. For a given image size, you are twice as far away from your subject. That makes lighting much easier, and avoids disturbing living specimens quite so much. The depth of field and effect of any camera or subject movement is exactly the same at any given *f*-number, whatever the focal length of the lens, at any particular magnification. Thus, in close-ups the longer focal length is no disadvantage.

The 100 mm f4 Auto-Bellows Rokkor

You can achieve the same results, with a little less convenience, with the 100 mm *f*4 Auto Bellows Rokkor. As its name implies you use this lens on extension bellows, which provide focusing continuously from infinity down to about 38 cm (14 in), thus reproducing the subject just larger than life-size. On the Auto Bellows I and III, this lens provides automatic diaphragm operation, but no meter coupling, providing a very convenient piece of equipment. As described in the chapter on *Shooting at Close Range* it is more convenient on the Auto Bellows III, because the focusing knobs are on the left-hand side on these Bellows, and the front standard carries its own shutter release button. The Auto Bellows I with its right-hand operated knobs is slightly fiddly to use if the bellows operating knobs were transferred to the other side of the equipment.

135 mm lenses

135 mm lenses were about the longest focal length that could be focused accurately enough with a coupled range-finder. So this focal length became very popular. It is still so. With an angle of view of 18°, a 135 mm lens produces an image 2.7 times the linear size of that from a standard 50 mm lens. This gives you an important gain for outdoor photography. You can photograph quite timid subjects. At the same time, the 135 is not unreasonable for taking portraits. If you have a standard lens, and just one longer focus one, then the 135 is probably the

best compromise. If, however, you intend to have a range of longer focus lenses, it is probably less useful. You have more versatility with an 85 (or 100) and a 200 (or 180). The 135 mm is too near both to be of great help.

200 mm and 300 mm lenses

These are the longest lenses that can be easily hand-held. With their angles of 12° and 8°, they give you images four and six times the size of standard lens ones. Also they magnify any movement by the same amount.

So, with the 300 mm lens, you need a shutter speed six times as fast to freeze movement—or avoid camera shake. If you are fine with 1/60 second on the standard lens, you will need a 1/360 second (1/500 to be safe) with your 300 mm lens.

Such high speeds make it necessary to use wide lens apertures. For example, with 100 ASA film, you need *f*8 on a bright day, which takes you down to *f*4 in bright cloudy weather. That is just not possible with most 300 mm lenses, including the Minolta lenses. What is more, the depth of field is reduced to a few feet even for distant subjects.

High speed films are, therefore, almost essential if you are to make much use of 200 and 300 mm lenses. With 400 ASA film, you can conveniently use a 300 mm lens at *f*8 or *f*11 in most bright daylight. At a distance of 15 m (50 ft) you have a depth of field of well over 1 m (3 ft). That allows you to picture enough of a large animal sharply to produce a striking picture. You can focus closer so as to take a bitingly sharp picture of a small animal or bird.

Even so, as you can see, you need to focus accurately with long focal length lenses. The small depth of field helps to give a decisive image on the viewfinder screen. Unfortunately, though, the central rangefinder spot may not help very much. Microprisms do not work very well at apertures smaller than about *f*3.5 or *f*4. Split-image prisms are restricted to apertures wider than about *f*5.6. The screens fitted to Minolta cameras, too, are designed to work well with lenses between about 28 mm and 200 mm. Outside that range, the prismatic devices are less effective. Of course, on the XM, you can change to a different screen. However, none of the screens provide sure rangefinder operation with 300 mm f5.6 lenses or with longer focal lengths.

This is one situation where the generally applicable advice, to choose the lens with the smallest maximum aperture to suit your needs, may not apply. The 300 mm f4.5 lens can be focused effectively with the focusing aids on most newer Minolta cameras, while the f5.6 lens is much less easy to focus. Also, the restricted range of hand-held shutter speeds makes the widest available aperture useful. The most recent internally-focusing 300 mm f4.5 MD Rokkor is no heavier than the f5.6 lens. This is just as easy to hold and convenient to carry.

The first choice in this range for the travelling photographer must, though, be the 250 mm f5.6 RF Rokkor. This lens is smaller than the 85 mm f1.7 MD Rokkor, and as light as the 50 mm f1.4 MD Rokkor standard lens. Altogether a quite amazing piece of equipment, that should be highly prized by all Minolta enthusiasts. It operates just like the 500 mm f8 RF Rokkor described on the next page.

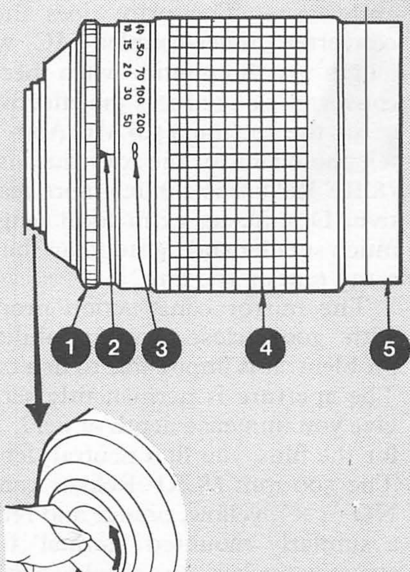
The 200 and 300 mm lenses are fine for some types of 'candid' photography. They let you take pictures from a discreet distance. They are also very good for wild-life work. Animals in captivity are usually close enough for these lenses. With wild animals, you get much better pictures if you can stalk your prey than if you shoot them from a great distance with a monster lens.

400 mm, 500 mm and 600 mm lenses

One time when 200 or 300 mm lenses can let you down, however, is in a wild-life park. Animals appear on all sides; but often they are too far away. For this, and for other static-sited photography, you need an even longer focus lens.

The choice is usually from 400, 500 or possibly 600 mm lenses. I find that 400 mm is most useful, because such a lens can just about be hand-held with reasonable confidence on a bright day (at 1/500 or 1/1000 second). Unfortunately, the only Minolta lens of this focal length is the 400 mm f5.6 MC Apo Tele Rokkor. This is a magnificent lens, using fluorite elements to give it apochromatic colour correction, and reasonably lightweight, but sadly it is priced beyond the pocket of most

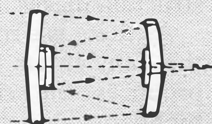
MIRROR LENSES



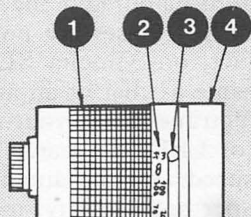
The mirror construction produces small, but wide, lenses. The 500 mm *f*8 lens is particularly convenient.

1. Mounting ring.
2. Focus index.
3. Distance scale.
4. Focus grip.
5. Screw-in lens hood.

Because of the large diameter, filters go behind the main elements. You screw them in with the key provided. The lens should always have a filter in place.

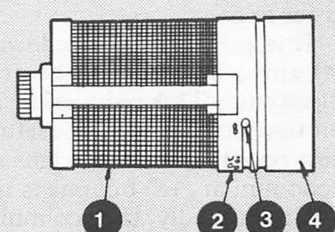


By using mirrors, the light path is folded to produce a tiny lens. The 250 mm *f*5.6 RF Rokkor is hardly bigger than an *f*1.2 standard lens.



The 800 mm *f*8 RF Rokkor has internal focusing.

1. Lens body.
2. Distance scale.
3. Focus lever.
4. Lens hood.



The 1600 mm *f*11 RF Rokkor is the longest of the currently available range.

1. Carrying handle.
2. Distance scale.
3. Focus lever.
4. Lens hood.

enthusiasts. The price does include a matched 2 × converter (meter-coupled MC) which doubles the focal length (to 800 mm) when necessary. Naturally, the converter also reduces the effective *f*-number to *f* 11.

So, the 400 mm *f* 5.6 MC Apo-Tele Rokkor is the ideal telephoto lens for the adventurous traveller. The 500 mm *f* 8 RF Rokkor is a much more reasonably priced alternative. Despite its extra focal length, this mirror lens is much smaller and lighter than the 400 mm lens, more like a 135 mm or 200 mm.

The mirror construction produces a short, fat lens with good close-focusing ability. It introduces one problem: it is impossible to fit a conventional diaphragm. The aperture is permanently set at *f* 8, which does not give you immense depth of field. If the light is too bright for the film, you fit a neutral-density filter into the lens. The 500 mm *f* 8 RF Rokkor comes with 39 mm screw ND (4 ×), yellow, orange and red filters. It is fitted with a similarly mounted 'normal' filter. The optical construction makes it essential to always have a filter in place.

As there is a mirror in the centre of the front element, the light enters in a doughnut-shaped glass area. This produces the characteristic ring-shaped out-of-focus highlights in pictures.

Because there is no diaphragm, there is no need for auto-diaphragm or meter-coupling connections. So mirror lenses are normally categorized as 'manual'. In fact, on Minolta SLRs, their operation is exactly the same as that of an auto-diaphragm meter-coupled lens. You just focus your subject, and align the meter needle (or LED) for manual exposure by adjusting the shutter speed. All the automatic models work properly in the aperture priority mode. Of course, you cannot use shutter speed priority automation, but the XD will give you aperture priority automation even when the switch is set to S.

It is possible to stop down a mirror lens by blanking off three-quarters of the front area with suitably cut black card. This reduces the aperture by one stop (to *f* 11 on the 500 mm) with a useful gain in depth of field. It is also possible to use the lens with a teleconverter (to give 1000 mm at *f* 16) but one is not supplied with it.

Undoubtedly, the 500 mm *f* 8 RF-Rokkor is the prime choice for anyone who wants a really long-focus lens. It does call for careful use; the image is so magnified that frontlit subjects look more like cardboard cut-outs than solid things. Also, the effect of even the slightest haze or heat shimmer in the air is quite drastic, ruining the image quality. You cannot, either, shoot through a window—that totally destroys the resolution.

Whenever possible, you should use the lens on a tripod. The slightest shimmer in your camera will be transferred into a definite blur, and you will lose the true optical quality of the lens.

A companion to the 400 mm *f*5.6 Apo-Tele Rokkor is the 600 *f*6.3 lens. This, supplied too with a 2 × converter is highly corrected lens capable of producing magnificent image quality when mounted on a solid tripod.

Real monsters

Beyond 600 mm are the lenses that must be considered for specialist use only. The 800 mm *f*8, the (discontinued) 1000 mm *f*6.3 and the 1600 mm *f*11 Rokkor lenses all use mirror construction, like the 500 mm lens. So they are relatively short and wide. For example, the 800 mm *f*8 RF Rokkor is 125 × 166 mm (5 × 6½ inches) while the 800 mm *f*6.3 Leitz Telyt, of which some have been made with a Minolta mount, is 132 × 796 (6 × 31 inches). The mirror lens weighs 2 kg (4½ lb), while the all-glass lens, but half a stop faster, weighs 6.9 kg (15 lb).

Lenses of these focal lengths are, of course, virtually restricted to tripod work. On a really bright day with fast film, it is worth attempting hand-held shots with the 800 mm *f*8 RF Rokkor; but these are unlikely to be more than adequately sharp.

Even more than with the 400–600 mm lenses, the air is a major source of poor image quality. Haze and shimmer can reduce both definition and contrast in the image. In general, you can take acceptable pictures only on really clear days. Even then, only high-contrast subjects can give you pictures with any impact. With the sun shining (which is virtually essential) avoid shooting across roads or other smooth dry areas. The hot air rising will destroy all definition. In fact, the most acceptable use for such lenses is in picturing relatively small timid subjects—

animals and birds, for example, from a moderate distance, say 5–25 m (15–80 ft).

Such lenses are, though, still no substitute for getting as close as possible to your subject. Pictures taken through them often look like cardboard cut-outs; just as does the view through binoculars or a telescope. However, sometimes there is no alternative.

Telescopes

The ultimate monster lens is a telescope. In fact, some of the smaller mirror construction telescopes are sold ready equipped to use on Minolta cameras. For others, you can make a simple connector by attaching a suitable telescope adapter to an extension tube. Mount both the camera and the telescope on suitable supports. The principles of using them differ little from using an RF Rokkor lens. The image quality may be less than you expect. Looking through a telescope, your eye compensates for any optical defects. The camera is not so forgiving.

Once the telescope is coupled to the camera, the built-in meter works in the stopped-down mode. As you have no automatic diaphragm, any of the Minolta X cameras give you correct automatic exposure. Of course, they do not take any account of the reciprocity law failure that can be induced by the long exposures you may need.

Zoom lenses

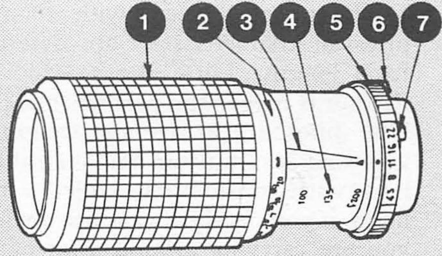
Zoom lenses allow you to vary the focal length (within limits). That gives you two advantages. A single zoom lens can replace two or more prime (fixed focal length) lenses; and you can choose exactly the focal length you want for each picture. Minolta have supplied zoom lenses for their SLR cameras since 1962. You should always consider whether such a lens fits your requirements best.

There is no difference between a picture taken with a prime lens, and one taken through a zoom set to the same focal length. With modern computer-aided lens technology, zoom lenses produce pictures of quality indistinguishable from that of prime lenses, except in the most critical work. For all ordinary photography, you can be absolutely confident with a zoom lens.

ZOOM LENSES

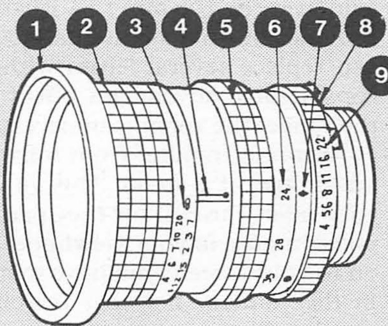
The 75–200 mm *f*4.5 MD zoom Rokkor is an example of the one-touch zoom lens.

1. Zoom and focus control.
2. Distance scale.
3. Infra-red focus index.
4. Focal lengths.
5. Aperture ring.
6. MD coupler.
7. Aperture scale.



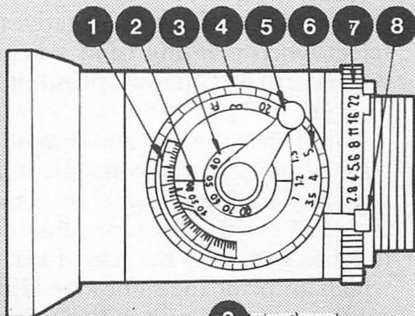
The 24–50 mm *f*3.5 MD Zoom Rokkor has separate zoom and focus controls.

1. Lens hood.
2. Focus control.
3. Distance scale.
4. Infra-red focus index.
5. Zoom ring.
6. Focal-length scale.
7. Focal-length and aperture index.
8. MD coupler.
9. Aperture scale.



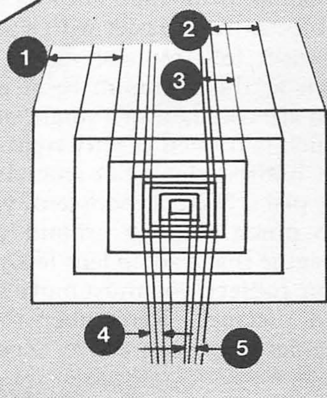
The 40–80 mm *f*4 MC Zoom Rokkor has its control box on the side.

1. Infra-red distance calculator.
2. White-light index.
3. Focal-length scale.
4. Focus ring.
5. Zoom lever.
6. Distance scale.
7. Aperture ring.
8. Macro-focus control.



Each zoom lens covers a range of angles of view.

1. 24–50.
2. 35–70.
3. 50–135.
4. 75–200.
5. 100–500.



The main problem with zoom lenses is that their physical characteristics are determined by the longest focal length. Thus, the 75–200 mm *f*4.5 MD Zoom Rokkor is bigger and heavier than the 200 mm *f*4 Rokkor. The difference in size and weight is quite acceptable if you consider the zoom lens as an alternative to the 200 mm lens, with considerably added versatility. On the other hand, if you nearly always use the lens at around 100 mm, you are carrying around a lot of extra weight for little gain over the 100 mm *f*2.5 Rokkor. A teleconverter could provide for your occasional 200 mm shot. Thus, if you can replace several lenses with a single zoom, that is a considerable advantage; but if you use just one end of the range, the zoom is unnecessary.

Accurate framing from a fixed viewpoint is the main advantage of a zoom lens in use. This, of course, is particularly useful on transparency film. As the picture you compose in your viewfinder is the picture you project on to your screen, you have to make all your adjustments in the camera. For that reason alone, zoom lenses are worth having.

They are useful with negatives, too. Although you can select when printing from a negative, it does mean that you have to do your own printing, or use an understanding printer.

I find that the 75–200 mm or 80–200 mm *f*4.5 zoom lens is particularly convenient at organized functions, such as weddings. I can choose a suitable camera position, and then use the zoom to adjust from shots of individuals to large groups. That way, I can get a series of negatives which all print the same size. Taking pictures of moving subjects, too is easier with a zoom lens. You can take two or three full-frame shots of, for example, a horse race; each at the optimum focal length. With a prime lens, you are confined to a single shot; or two shots, neither of which is framed exactly right.

Children playing or animals, too, move around all over the place. With a zoom lens, you can follow them without too much running around yourself. However, do not imagine that a zoom lens lets you remain static. Whatever your subject, you must move to choose the best viewpoint and distance. Remember that it is the distance that decides the perspective. Zooming in or out does not change the relationship between parts of the subject at all.

Zoom lenses have a pictorial effect all their own: the zoom burst. You produce it by zooming during an exposure. As you change focal length, the centre of your pictures stays more or less the same, while the rest forms a blur radiating from the centre. Each bright spot in the subject becomes a line of light, each patch a wedge of colour, and so on.

Of course, you need quite a long exposure time if you are to move the zoom control during it: 1/8 second is about the shortest that works with any ease. Your camera must be very firmly mounted, otherwise you will introduce unwanted camera shake as well.

Zoom bursts work well when there is an obvious subject in the centre of the picture—a motor boat, for example; or with totally abstract light spots against a dark background. They are one of the effects that are much better in colour than in black and white. A red rally car picked out against a green background, for example, looks very good, but a grey blob with radiating grey lines has little value.

Choosing a zoom lens is a little easier than choosing a prime lens. There are fewer to choose from. Basically, you should decide just what range you need, and choose the smallest lens that suits your need. There is no point in carrying round all 2 kg ($4\frac{1}{2}$ lb) of the 100–500 mm *f*8 zoom Rokkor when the 700 g ($1\frac{1}{2}$ lb) 75–200 mm lens is all you need.

The problem is complicated by short focal length zooms. The 40–80 mm *f*2.8 MD Zoom Rokkor, for example, weighs as much as the 35 mm *f*2.8 and the 100 mm *f*2.5 Rokkors put together; and does not quite reach either of them. Of course, the zoom replaces the standard (50 mm) lens as well. However, that does add an enormous weight and bulk to your equipment. In fact, the 40–80 mm lens is so bulky as to deter some people from taking their camera along when fitted with one. This lens has been discontinued in favour of the much smaller and lighter 35–70 mm *f*3.5 MD Zoom Rokkor. This is probably the best single lens for all normal photography. It is slightly wider angle than the 25–50 mm lens fitted to the 110 Zoom SLR, you can always enlarge part of the image from the 35 mm camera. The 24–50 mm

$f4$ MD Zoom Rokkor, is a wider angle still, and is acceptably small and light. It makes a good substitute

Teleconverters

As an alternative to another lens, you can convert one you already have with a little behind-the-lens device. A teleconverter is a negative lens, comprising normally from four to seven elements, mounted in a tube. Most converters double the focal length, but some treble it; yet others offer a zoom effect between doubling and trebling the focal length. Minolta make a special 2 × converter for use with the 400 mm $f5.6$ and 600 mm $f6.3$ Apo Rokkors. Many independent companies market teleconverters in Minolta mounts. Most of the better ones are MD-coupled.

When a converter doubles the focal length of a lens, it alters nothing else. The lens remains focused on the same distance, and lets through the same amount of light. That light, however, is spread over four times the image area. Thus, the image at any particular diaphragm setting is only one-quarter as bright, just as if the diaphragm had been closed down by two f-stops. Thus, a 50 mm $f2$ lens becomes effectively a 100 mm $f4$. The new 'effective' f-number is the number set on the diaphragm ring multiplied by the 'power' of the converter. Thus, a 3 × converter changes $f2.8$ to about $f8$.

The relationship between the f-numbers remains the same. Thus, changing the diaphragm from $f4$ to $f5.6$ with a 2 × converter fitted is effectively changing from $f8$ to $f11$; still halving the light. So, all the through-the-lens meters work just as well with a meter-coupled converter fitted between the camera and lens.

The focusing distance is a particular advantage gained from using a teleconverter. For example, with a 2 × converter mounted, the 50 mm lenses still focus down to 0.5 m (1.65 ft) while the 100 mm $f2.5$ lens can only manage 1 m (3.3 ft).

So, where is the disadvantage? Most converters give you a considerably worse image than you get with an equivalent prime lens. Modern five and seven-element converters, especially those designed with a particular lens in mind, are much better than earlier models; but you are still well advised to stop down at least two stops from the full lens aperture to ensure really good image quality. This means that with the 200 mm $f4$ lens, $f8$ is the widest aperture that you can use with confidence. With a 2 × converter, that means that your 400 mm combination is limited to $f16$ as a maximum aperture.

Despite this, it is well worth having a converter. It is easily pocketed, and gives you a boost when you need it. Still, a converter is not a good substitute for a prime lens. If you use a certain focal length often, you are well advised to get a lens, not to rely on a converter.

Converters normally work best with long-focus lenses. With standard lenses, they can only be regarded as producing average quality medium telephotos. They are not at all good with wide-angle lenses. Within the same limits, teleconverters work well with zoom lenses. However, the image quality of a zoom lens is never quite as good as that of an equivalent prime lens, and the converter magnifies any problems as it magnifies the image.

Choosing your lenses

Minolta offer an enormous range of lenses; between 30 and 40 are usually listed. Obviously, no one needs them all; but choosing a set is difficult. The best approach is to aim for a complementary set, each lens about double the previous in length.

Most photographers have a standard lens. That is logical. Standard lenses are good for much work, and they offer the best value for money. An $f1.2$ or $f1.4$ lens lets you work in virtually any lighting. To supplement this, the best choice of wide-angle lens is 24 or 28 mm. If you work mainly in prints and make your own choose the 24 mm. You can always crop out a little in your prints. For transparencies, the choice is personal: buy the one that gives you the pictures you like better.

The ideal doubling long-focus lens is a 100 mm. This is fine for portraits, and for most pictorial shots. The prime choice at this focal length is the 100 mm $f3.5$ MC Macro Rokkor. This lens focuses unaided down to under $\frac{1}{2}$ m. Combine that with a 200, 250, or 300 mm lens and a 2 × converter for the occasional really long shot, and you have a really versatile outfit.

The only problem with that basic outfit is that it leaves out three excellent and useful lenses. The 35 mm Shift CA Rokkor, and the 85 mm *f* 1.7 MC Rokkor or 85 mm *f* 2.8 MD Vari-Soft Rokkor. With a 35 mm and an 85 mm you can do most normal-range photography. In this case, though, a 45 or 50 mm lens is scarcely needed (and the 100 mm lens even less so). The best choice, if you want one, could be the 50 mm *f* 3.5 MD Macro Rokkor which, like the 100 mm lens, produces life-size close-ups with its adaptor. With a 35 and 85 mm start, you can expand to a 17 or 20 mm ultra-wide lens instead of a 24 or 28 mm example, and a 200 or 300 mm telephoto (or the 250 mm RF Rokkor)—with a 2 × converter to fill the occasional gap.

Choose Minolta Rokkor lenses for your really wide-angles, and Minolta Rokkor or Celtic lenses (if they are available) for moderately wide or moderately long lenses. If you want really long-focus lenses, independent makes are worth considering. You are not likely to use a 400, 500 or 600 mm lens very often, and if you get a big heavy one, you will not want to take it anywhere.

The 500 mm *f* 8 RF Rokkor is an ideal choice for portability. However, if you want a conventional lens, the excellent Apo Rokkors are rather heavy. A cheap, light preset-aperture 400 or 500 mm lens is often the answer. Such lenses usually produce quite good quality pictures. You need ideal weather and a great heavy tripod to benefit from Rokkor quality with monster lenses anyway.

Zoom lenses are a good solution to the problem of lens choice. The 75–200 mm lens is an excellent basis of an outfit. Combine it with, say 21 and 35 mm lenses, or a 24–50 mm zoom, and a 2 × converter for the occasional extra long shot, and there is little more you need. In fact, as long as the maximum apertures are acceptable, the two zooms produce a nearly faultless combination.

Similarly, the 50–135 mm lens covers much of the needs of many photoenthusiasts. Combine this lens with the 24–50 mm zoom, and add a 2 × converter for occasional use up to 270 mm, and you have an outfit to cover 95% of all possibilities.

Of course, you want to choose exactly the combination of equipment that suits your specialist needs. Do think about the combinations: you are the one who has to carry your outfit across the world from one picture to the next.

On the next few pages is a list of most of the Minolta lenses, with a little information about each. Just as with their cameras, Minolta are continually refining their lenses. So yours may not be quite the same as those in the list.

However, although the size and weight—even the number of elements may change, the photographic effect of each lens is determined by its focal length and maximum aperture; and its image quality assured by Minolta.

MINOLTA ROKKOR LENSES

	Focal length	Aperture		Angle of view	Min. focus		Meter coupled diaphragm	Filter	Construction		Size		Weight		Notes
		min	max		m	ft		mm	E	G	mm	in	g	oz	
FISHEYES	7.5	4	22	180	0.5	1.75	Auto MD[2]	B/I	12	8	68 × 63	$2\frac{3}{4} \times 2\frac{1}{2}$	345	12	Fixed focus
	16	2.8	22	180	0.3	1	Auto MD[2]	B/I	11	8	70.5 × 63.5	$2\frac{3}{4} \times 2\frac{1}{2}$	440	$15\frac{1}{2}$	
	[1]18	9.5	22	180	0.45 fixed	1.5	Manual	—	7	5	60 × 48	$2\frac{3}{8} \times 1\frac{7}{8}$	240	$8\frac{1}{2}$	Fixed focus
ULTRA WIDE	17	4	16	104	0.25	0.8	Auto MC	72	11	9	75 × 53	3 × 2	325	$11\frac{1}{2}$	
	[1]20	2.8	22	95	0.25	0.8	Auto MC	55	10	9	64 × 43.5	$2\frac{1}{2} \times 1\frac{3}{4}$	235	9	
	21	2.8	16	92	0.25	0.8	Auto MC	72	12	9	75 × 66.5	$3 \times 2\frac{1}{2}$	510	18	
	[1]21	4	16	92	0.9	3	Manual	55	8	4	60 × 20	$2\frac{3}{8} \times \frac{3}{4}$	166	6	No reflex viewing
	24	2.8	22	84	0.3	1	Auto MD[2]	55	9	7	64 × 49.5	$2\frac{1}{2} \times 2$	215	8	
	24	2.8	22	84	0.3	1	Auto MD[2]	55	9	7	67 × 50.5	$2\frac{5}{8} \times 2$	340	12	VFC
WIDE ANGLE	28	2	22	75	0.3	1	Auto MD[2]	55	10	9	65.5 × 61	$2\frac{1}{2} \times 2\frac{3}{8}$	340	12	
	[1]28	2.5	16	75	0.5	1.75	Auto MC	55	9	7	63 × 61	$2\frac{1}{2} \times 2\frac{3}{8}$	365	13	
	[1]28	2.8	22	75	0.3	1	Auto MD[2]	55	7	7	64.5 × 43.5	$2\frac{1}{2} \times 1\frac{5}{8}$	240	$8\frac{1}{2}$	C
	28	2.8	22	75	0.3	1	Auto MD	49	7	7	64 × 43.5	$2\frac{1}{2} \times 1\frac{5}{8}$	180	$6\frac{1}{2}$	
	[1]28	3.5	16	75	0.6	2	Auto MC[3]	55	7	7	63 × 45	$2\frac{1}{2} \times 1\frac{3}{4}$	245	$8\frac{1}{2}$	
	28	3.5	22	75	0.3	1	Auto MD	49	5	5	64 × 40.5	$2\frac{1}{2} \times 1\frac{5}{8}$	160	6	
	[1]35	1.8	16	63	0.3	1	Auto MC	55	8	6	66 × 67.5	$2\frac{5}{8} \times 2\frac{5}{8}$	415	$4\frac{1}{2}$	
	35	1.8	16	63	0.3	1	Auto MC	55	8	6	66 × 67.5	$2\frac{5}{3} \times 2\frac{5}{8}$	415	$4\frac{1}{2}$	
	35	1.8	22	63	0.3	1	Auto MD	49	8	6	64 × 48	$2\frac{1}{2} \times 1\frac{3}{4}$	235		
	[1]35	2.8	16	63	0.4	1.25	Auto MC[3]	52, 55	7	6	63 × 45	$2\frac{1}{2} \times 1\frac{3}{4}$	215	$7\frac{1}{2}$	
	[1]35	2.8	22	63	0.3	1	Audio MD[2]	55	5	5	64.5 × 41.5	$2\frac{1}{2} \times 1\frac{5}{8}$	205	7	C
	C35	2.8	22	63	0.3	1	Auto MD[2]	55	5	5	64.5 × 41.5	$2\frac{1}{2} \times 1\frac{5}{8}$	205	7	C
	35	2.8	22	63	0.4	1	Auto MD	49	5	5	64 × 38.5	$2\frac{1}{2} \times 1\frac{1}{2}$	165		
	35	2.8	22	63	0.3	1	Auto	55	9	7	83.5 × 71.5	$3\frac{1}{4} \times 2\frac{3}{4}$	560	20	Shift CA
	[1]35	4	22	63	0.4	1.25	Manual preset	52, 55	5	4	60 × 34	$2\frac{3}{8} \times 1\frac{3}{8}$	182	$6\frac{1}{2}$	

[1]Discontinued lens; [2]MC also; [3]non-MC also; S Manual preset also; C Minolta Celtic version also available in some countries