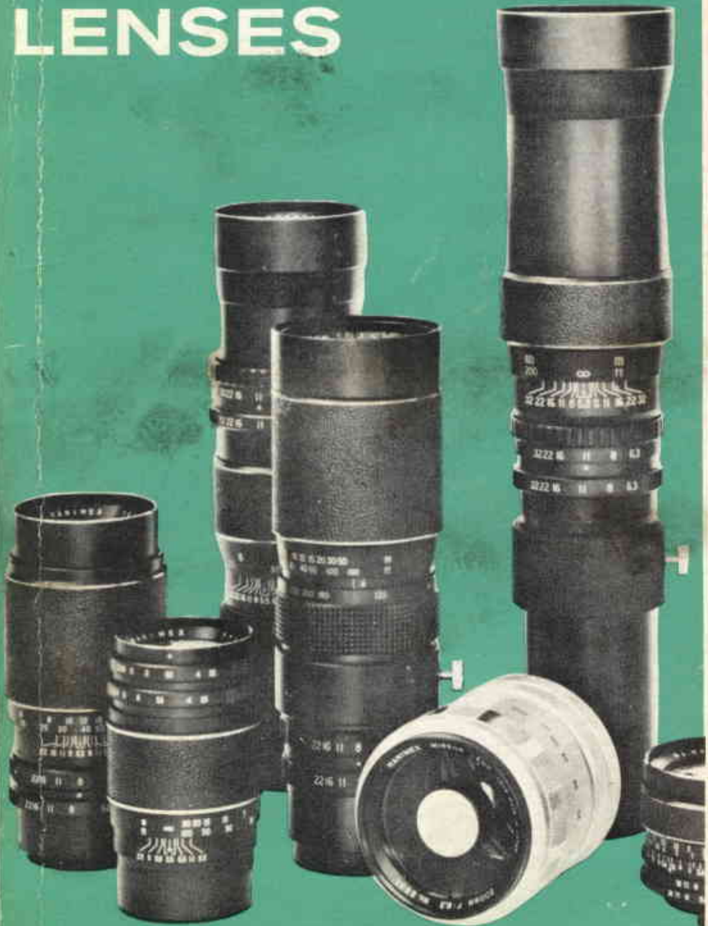
A GUIDE TO HANIMEX LENSES



A HANIMEX PUBLICATION

Technological progress in lens manufacture in Japan has been so dramatic that from the factories of Japan's largest manufacturer of precision-built accessory lenses, Hanimex is able to present a remarkable range of lenses for all brands of single lens reflex 35 mm. cameras, at unusually attractive prices.

Japan's optical "know-how" has effected many economies in the production of top-grade lenses. The use of computers in optical design and automated machinery in manufacture means that the buyer of Hanimex lenses is acquiring a product which might easily have been beyond his means not so very long ago.

The fact that Hanimex lenses are of the highest optical standards, whilst available at economy prices, is borne out by the phenomenal volume of sales to both professional and amateur photographers throughout the world—and by the numerous expressions and examples of satisfaction from these tens of thousands of users.

This book has been specially written in such terms that even the most inexperienced camera owner may understand the correct application of the various Hanimex lenses to different subjects and situations, thereby ensuring that he is able to extract the full potential from his camera and the maximum enjoyment from the vast spectrum of photography.

To fully appreciate the benefits which can be gained from the various interchangeable lenses comprising the outstanding Hanimex range, the photographer should have an understanding of the characteristics of the 35 mm. single lens reflex camera system. For this reason, part of the first chapter is used to introduce the reader to the versatile features of this increasingly popular camera design.

CONTENTS

THE MOST VERSATILE CAMERA

The wise camera buyer looks ahead. It is false economy to provide only for one's present level of technical knowledge or for a presently limited subject interest. A camera suitable for family record pictures may not have the capacity for more sophisticated projects such as sports action.

Because the fundamental aspects of photographic technique are relatively simple and quickly mastered, it is almost certain that the new photographer will become more adventurous as he gains confidence. Will a camera with permanently mounted lens permit a satisfactory expansion of his subject interests? Decidedly not!

Such a camera may be fitted with a limited range of accessories to extend its application, but only to a degree which will compromise the photographer's creative requirements.

For ultra close-up pictures of flowers in the garden, close-up attachment lenses may be used, but, with a fixed lens camera, the photographer will largely be shooting blind because cameras of this simpler type do not have a viewfinder which clearly defines the area covered by close-up attachments.

At the opposite end of the scale, we are often faced with the need to magnify the image of distant subjects when it is not possible to reduce the physical distance between camera and subject. This calls for a telephoto lens, but such a lens cannot be fitted to the fixed lens camera.

These problems are answered by what is surely the most versatile and creatively satisfying camera . . . the single lens reflex with lens interchangeability. This type of camera is the most suitable choice for all but the most occasional photographer.

The Single Lens Reflex Principle

Simple fixed lens cameras employ a direct-vision optical viewfinder which defines the area of coverage of the lens to a degree of similarity which is adequate for general snapshots. However, due to the fact that this viewfinder is physically separated from the lens which records the image on film, it is obvious that there must be some discrepancy between what the photographer sees through the viewfinder and what the lens actually records.

This discrepancy is negligible when photographing subjects located at 10 feet or more from the camera, but it assumes greater proportions at closer range and becomes quite serious at distances shorter than 3 feet (i.e., when close-up attachments are used).

We refer to this problem as *parallax error* and it is this error which often causes the inexperienced photographer to make close portraits in which the subjects' heads are cut off.

The better class of fixed lens camera has a bright-line frame within the viewfinder, which is continuously adjusted as the lens is focused at different distances. This feature is known as *automatic parallax correction* and it is relatively effective. Nonetheless, it ceases to operate when it is most needed . . . at ultra close range when the normal close focusing capacity of the lens has been extended by the use of close-up attachments.

The superiority of the single lens reflex camera is self evident when it is explained that the viewfinder of such a camera is not a direct vision type, but that it receives its image of the subject through the camera lens.

This is achieved by the location of an inclined mirror behind the lens, in association with a roller-blind shutter situated immediately in front of the film. A shutter of this type is known as a *focal plane shutter* and, because it is so placed, it permits light to pass through the lens and to be reflected from the reflex mirror upwards to a groundglass focusing viewfinder screen.

All this is possible without any danger of light reaching the film accidentally, for the reflex mirror acts as a protective screen.

Above the groundglass focusing screen, most single lens reflex cameras have a permanently sealed prism which redirects the viewfinder image to the viewing window at the rear of the camera body. This facilitates eye-level viewfinding.

Unlike the direct vision optical viewfinder, which shows a clear image even though the lens may not be correctly focused on the subject, the reflex-focusing viewfinder of the single lens reflex camera does not show a crisply defined image until the lens is focused precisely.

The relationship between the subject's image on the focusing groundglass screen and its eventual registration on film, is so critical that when the sharpest possible image is achieved in the viewfinder, by rotation of the focusing mount of the lens, one is assured of an identically sharp image on film.

The only qualifications to this statement are that (a) the camera must not move at the moment of film exposure, (b) the shutter speed selected must be sufficiently brief to arrest subject movement, and (c) the film must not be given an overexposure (i.e., evaluation of the subject's illumination must be accurate).

Thus it can be appreciated that the single lens reflex camera makes possible the ultimate level of critical accuracy in focusing. This, in turn, improves the "enlargeability" of the resultant negatives or slides.

At this point, you may be asking: "How does the light finally get through to the film?"

The answer is that when the shutter release is triggered, the reflex mirror flips upwards in perfect synchronisation with the opening of the focal plane shutter, and returns to the viewfinding position immediately after the exposure of the film.

All this takes place in such a small fraction of a second that the viewfinder is blacked-out for no longer than the blink of an eyelid . . . so rapidly, in fact, that the photographer will barely be conscious of its happening.

In addition to its unexcelled system of viewfinding and focusing, the single lens reflex camera offers the infinite advantages of lens interchangeability. Exactly what does this mean to you?

Why Interchangeable Lenses?

If your present camera has only a fixed lens, or if you own a single lens reflex camera but as yet have only the standard lens, you will already have made some simple observations. If you wish to obtain a bigger image of the subject, you must approach it from a closer distance. This is often not possible because of some physical obstacle between the camera and the subject. Haven't you wished you had a lens to magnify the image of that distant subject . . . something to bridge the physical distance? You're stuck way back in the spectator area as Jack Brabham flashes past the winning post and even though you know that his car will come out no bigger than a flea on your film, you press the trigger. Wouldn't it be great to have a place right on the edge of the track so that your picture clearly identified the driver?

Short of obtaining a special pass giving you privileged entry to the track, your only real answer is a telephoto lens (and a suitable Hanimex lens is not actually expensive).

You've also found that sometimes you can't fit everything into the picture. To cover a wider field, you must move away from the subject, but if you already have your back to a wall or are standing on the edge of a precipice, there's not much you can do. Maybe you're trying to photograph a tall building in a rather narrow street, or a large group of people in a small room. When you simply cannot increase the camera-to-subject distance, the only answer is a lens with a wider angle of view.

With access to a choice of several interchangeable lenses and a single lens reflex camera of the type which accommodates the entire range of Hanimex lenses, you can actually increase your camera's field of coverage or magnify distant objects, without moving from the one camera position (very handy when you are caught in a crowd).

What Focal Length Means

In order that we may identify the magnifying power of a lens and understand its relationship to the image size delivered by the standard lens of the camera, each lens bears an inscription which indicates its maximum light-gathering capacity (or "speed") and its *focal length.*

As an example, let us examine the 1:4.5/200 mm. Hanimex telephoto lens. It has a speed of $f/4.5$ and a focal length of 200 mm. (or 20 cm.), but just what does this mean?

The focal length of a lens is that distance from its optical centre to the film plane of the camera when the lens is focused on infinity.

Infinity is, of course, infinite distance, meaning everything beyond the most distant calibration of the focusing scale of the lens. It is sometimes indicated by the letters "INF," but more generally by an odd-looking symbol which resembles the figure 8 lying on its side (horizontally).

The speed of the lens is, in this case, indicated by the ratio of 1:4.5, which simply means that the physical diameter of the adjustable iris diaphragm, at its maximum opening, may be divided 4.5 times into the focal length.

This "speed" is also called the "f/number" and so you will see that when the diaphragm of the lens is closed to smaller diameters (or apertures) the relative values of these settings are also obtained by dividing the physical diameters into the focal length of the lens.

For convenience in setting different exposure values, the f/numbers calibrated on Hanimex lenses have click-stop positions on the adjusting ring. However, if the exposure evaluation calls for an intermediate position between two marked f/numbers, it is quite possible to set any desired intermediate position.

Knowing how the f/numbers are determined, you will be able to see that the smallest f/number indicates the largest opening of the exposure control diaphragm, and vice-versa.

The *standard* lens of a 35 mm. camera is in the region of 45 to 58 mm. in focal length, but for the purposes of simple explanation we will generalise a little by categorising standard lenses into a 50 mm. focal length grouping.

Most modern 35 mm. single lens reflex cameras have a standard lens of $f/1.8$ or $f/2$ speed, which means that they have a fairly large physical diameter (remembering that focal length divided by maximum aperture equals "speed").

It is obvious that lenses of long focal length cannot be as fast as the standard lens because they would become unbearably cumbersome. For instance, to have a speed of $f/1.8$, a 180 mm. lens would need a diaphragm opening to 100 mm. (4″) width, whilst a 400 mm. lens would have an aperture over 220 mm. wide (almost 9″). Do you see why longer lenses are not so fast?

Image Magnification

Taking the image size produced by the standard lens of 50 mm. focal length as our yardstick, we can quickly and simply gauge the effect of any other Hanimex interchangeable lens by dividing 50 mm. into its focal length.

Thus we see that a 400 mm. Hanimex telephoto lens delivers an eight times larger image of the subject than would the standard lens from the same camera position.

Naturally this great magnification results in a greatly reduced angle of view. Whereas the 50 mm. standard lens covers a 45° angle of view, a 400 mm. telephoto lens encompasses only a 6° angle.

The widest coverage of field is obtained with the Hanimex 28 mm. wide-angle lens with a breath-taking 74° angle of view. However, it must be understood that a lens of focal length shorter than the 50 mm. standard lens will deliver a proportionately *smaller* image of the subject. In the case of the Hanimex 28 mm. lens the image size would be almost half the size (an approximate magnification of 0.5x being indicated).

Automatic and Preset Diaphragms

Being interested in interchangeable lenses, you will already be acquainted with the rudiments of exposure control, no doubt understanding that under a given level of illumination each shutter speed will require a complementary setting of the lens diaphragm or aperture.

In case this point still perplexes you, here is a simple explanation.

Our aim is to subject the film to a uniform degree of exposure, regardless of the lighting conditions. Let us compare this aim with the filling of a bucket under a water tap. If we turn the tap to its maximum capacity, we will fill the bucket much more rapidly than if we had reduced the water to a mere trickle.

Similarly, if we open the lens diaphragm to its maximum diameter (i.e., smallest *f*/number) the light from the subject will flood in and quickly over-expose the film unless we restrict the duration of the flow. We do this by setting a relatively fast shutter speed so that the exposure period is brief. Conversely, if we set a small lens aperture to obtain extensive depth of sharply defined image (depth of field) we need to keep the shutter open for a longer period to maintain a uniform exposure of the film.

At this point, let us reconsider the reflex viewfinding principle. To obtain the brightest possible image on the groundglass to facilitate accurate focusing and observation of the subject, it is desirable to have the lens aperture wide open to its maximum light gathering capacity.

If we are to close it to a lesser value immediately prior to the exposure of the film and then re-open it promptly in readiness for the next picture, some form of mechanical aid would make things much easier, wouldn't it?

Fortunately, Hanimex lenses are fitted with one of two devices to achieve this end. The first and simpler form is known as the *preset diaphragm* and is employed on the lower priced lenses. It should be noted that a preset diaphragm is used to reduce the cost of manufacturing the mechanical aspects of the lens and its use does not imply inferior *optical* quality, a point borne out by the fact that lenses of very long focal length are, for both mechanical and economic reasons, rarely fitted with any other form of rapid diaphragm control.

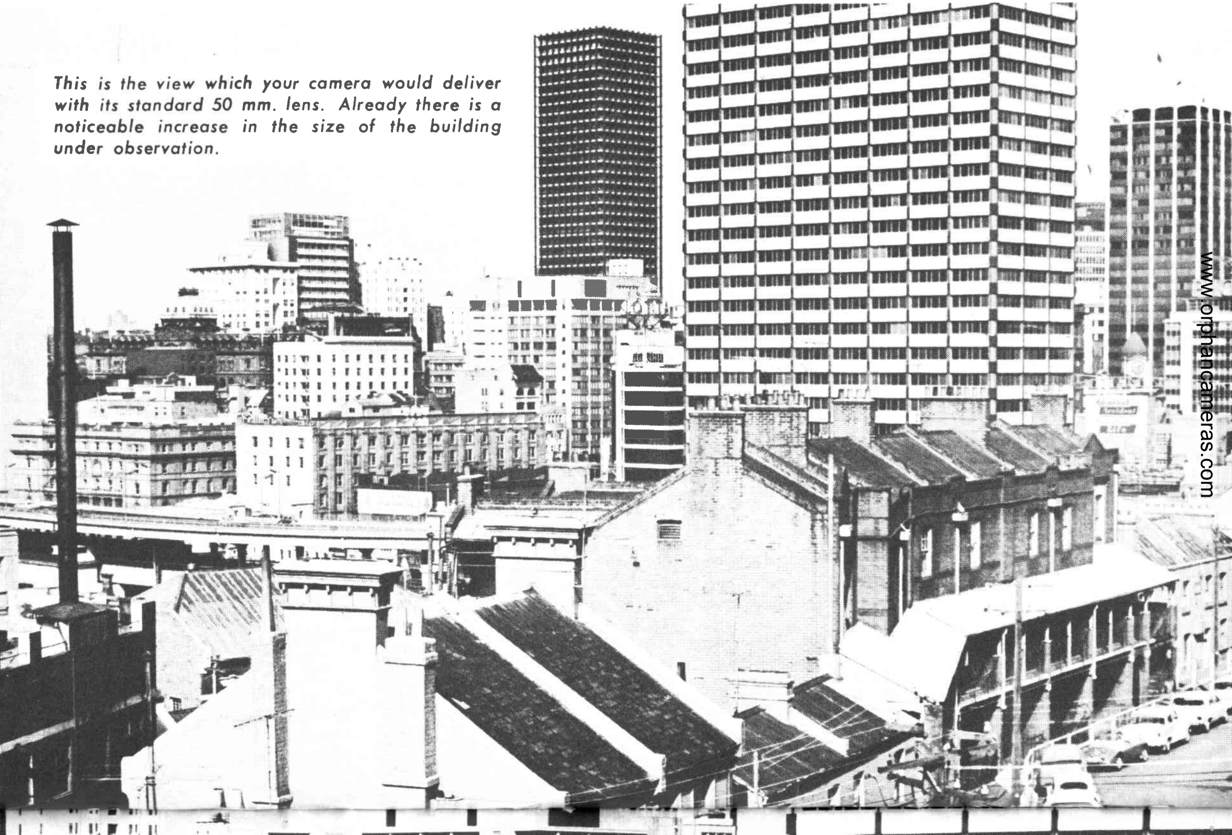
On the lenses having a preset diaphragm, you will find two rotating rings, each bearing the same *f*/number calibrations. The ring furthest from the camera is used to set the *f*/number necessary for correct exposure of the film, whilst the second ring is an over-rider, permitting the lens to be opened to its full speed for viewfinder clarity and which will stop at the *preset* aperture when rotated in the reverse direction just prior to exposure of the film.

This final closure of the diaphragm may be accomplished without error, and simply by feel, whilst the photographer continues to observe the subject in the viewfinder.

The more sophisticated device is known as the *fully auto-*

Tucked away amongst the skyscrapers is a relatively small building (arrowed). On the following pages, see how its image is magnified, using longer and longer focal length lenses from the same camera position. This view was taken with a Hanimex f2.8/35 mm. wide-angle lens.

This is the view which your camera would deliver with its standard 50 mm. lens. Already there is a noticeable increase in the size of the building under observation.



Better isolation of the subject is provided by the Hanimex f3.5/135 mm. lens which gives some $2\frac{1}{2}$x magnification of the image on the previous page.

Now the building has assumed quite large proportions when the camera is fitted with a Hanimex f5.5/300 mm. lens, delivering a 6x magnification of the standard lens image. With an even longer lens, from the same camera position, we could look right into the individual offices of this building.

matic diaphragm and, as its name suggests, does the whole job automatically. The photographer preselects the aperture necessary for correct exposure, but the lens will remain wide open until the shutter release is triggered. At that moment, a tripping device within the camera depresses a diaphragm closure pin at the rear of the lens, closing the diaphragm to the preselected *f*/number and releasing it to maximum aperture immediately the exposure has been made.

Relationship of f/numbers

The aperture control ring of a lens is engraved with a set of *f*/numbers which might, for example, run like this:

2 2.8 4 5.6 8 11 16 22

Why were these particular values chosen instead of other intermediate values? After all, the iris diaphragm has a continuous movement and, as the diameter or aperture is varied, we can calculate a tremendous range of *f*/number calibrations.

Again the answer is simple and underlines the arithmetical logic of correct exposure.

Each of the *f*/numbers engraved on your lens has an arithmetical relationship to the others. In photographers' jargon, each of the marked settings is called a "stop." As we close the diaphragm down, each stop will deliver only half as much light to the film as the stop immediately before it (i.e., "stopping down" from *f*/2 to *f*/2.8 reduces the passage of light by 50% and therefore requires *twice* the period of open shutter in order to maintain a uniform exposure of the film).

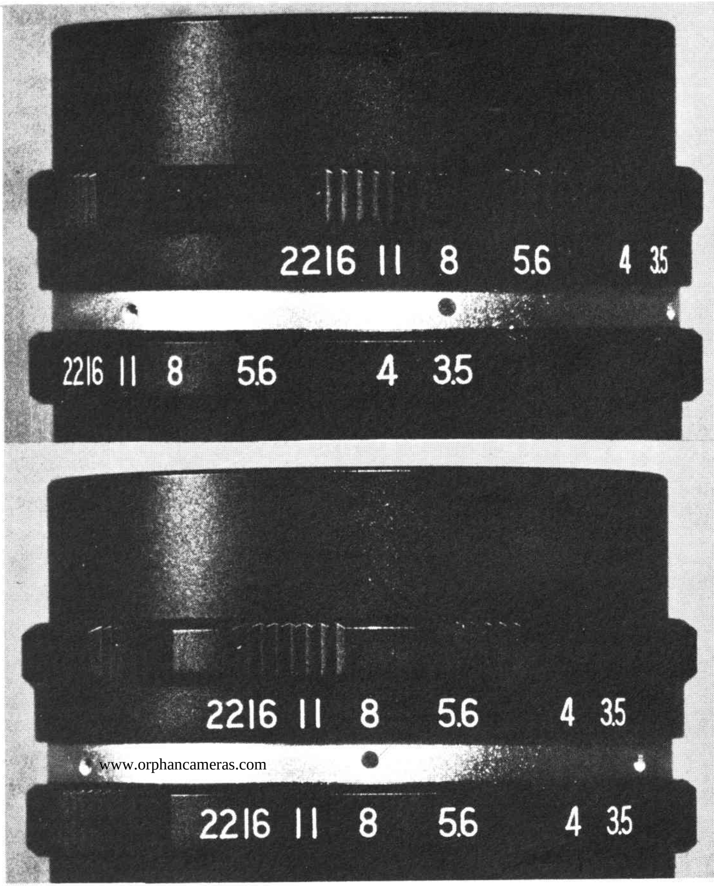
Under a given lighting condition, we therefore have a complete set of uniform aperture/shutter speed combinations, of which the following is an example:

Shutter Speeds (in fractions of a second)

1/500	1/250	1/125	1/60	1/30	1/15	1/8	1/4
f/2	2.8	4	5.6	8	11	16	22

It will also be noticed that every *second f*/number has an even more obvious arithmetical progression and if we break the sequence into two levels this is easier to follow:

2	4	8	16
2.8	5.6	11	22



The preset diaphragm mechanism of a Hanimex f3.5/135 mm. lens is shown here at its two typical settings. In the top picture, the front aperture ring is set to f/8 whilst the rear aperture ring is set to f/3.5. In this position, the lens is open at its full speed of f/3.5 whilst the preset exposure has been selected as f/8. After focusing, the rear ring is turned gently, without taking one's eye from the viewfinder, and it will automatically stop at the preset aperture (as seen in the lower illustration) for exposure of the film.

See how each is twice the number of the previous one on its own level? On one level, each jump is an exposure variation of not one but *two* stops and instead of doubling the duration of exposure we must increase it fourfold.

If, under a given lighting condition, the necessary exposure at $f/2$ is 1/500th second, we must give *four* times the exposure (1/125th second) if we close down *two* stops to $f/4$.

Naturally, the entire procedure of adjusting the exposure period works in reverse if we move from a small aperture to a larger one.

The basic rule to remember is that as we "stop down" to smaller apertures *each* marked f/number requires *twice* the exposure duration of the "stop" before it, and vice-versa as we "open up" the diaphragm.

CHOOSING THE RIGHT LENS

Just as each camera type is more suited to some picture situations than it is to others, so, too, is each type of interchangeable Hanimex lens. There is no such thing as a single all-purpose lens . . . hence the extensive range offered by Hanimex in order to equip the individual photographer with the lenses most suited to his subject interests.

Undoubtedly, after experiencing the delightful expansion of your camera's potential which even one additional lens brings, you will then wish to add others to your camera kit.

It will therefore be useful if we now examine the lenses in several categories to determine which one will be of the greatest value for the immediate future. Let us group the complete range into four categories as follows:

(a) wide angle .... 28 to 35 mm.
(b) standard .... 45 to 58 mm.
(c) medium telephoto .... 105 to 200 mm.
(d) long telephoto .... 300 to 600 mm.

Before considering the various applications of each category, it is worthwhile learning a few basic facts about the optical layout of a sophisticated modern lens.

Optical Design

Whilst we have seen that focal length is based on lens-to-film distance, this general rule of thumb has two principal variations. Part of the marked focal length of a lens is not contained in the physical length of the lens itself. It is, in fact, the distance which lies between the film and the back of the lens.

Obviously there must be space within the single lens reflex camera to allow the up and down movement of the reflex mirror. Depending on the design of the camera body, this distance must be in the region of 35 to 40 mm.

It can thus be seen that a wide-angle lens having a focal length of 28 to 35 mm. would foul the mirror unless its physical layout could be such that the physical lens-to-film distance was actually greater than its optical focal length.

Fortunately it is possible for a lens to be constructed in this fashion and this particular design is known as a *retrofocus* system.

Simple cameras have simple lenses of limited capacity, generally employing either a single glass element (meniscus lens) or two elements mounted with concave surfaces facing each other (doublet lens).

Lenses of this simple construction do not produce the clarity of detail (called "definition") which the enthusiast demands.

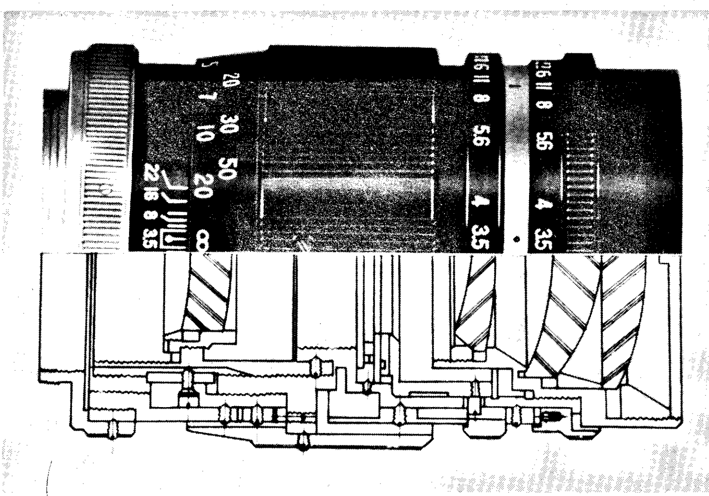
A single glass element, such as a common magnifying glass, will certainly produce a recognisable photographic image, but with several unacceptable faults such as soft focus, darkened corners (vignetting) and bleeding of colours. It cannot deliver uniform brightness over the entire area of view.

However, the introduction of a second glass can achieve a degree of correction of these faults which we call "optical aberrations." For optimum correction, it is common practice to combine as many as seven individual glasses, each of which is so designed and ground that the total correction of aberrations is of a very high order.

The need for such sophisticated designs is greatest with lenses of high speed (smallest f/numbers) and so we need not be concerned to find, for example, that the Hanimex $f8/600$ mm. telephoto lens has only three glass elements (these being quite adequate for its speed), whilst the Hanimex $f2.8/28$ mm. retrofocus wide-angle lens contains sever elements.

At the same time, we can appreciate why the faster lenses of small physical size are not less expensive than some of the telephoto models.

Returning to the variations on the focal length rule of thumb, we find that in the telephoto categories there are two optical constructions . . . the *long-focus* lenses and the *true telephoto* lenses. It is less expensive to manufacture a long-focus lens, which employs the simpler optical design. This type of lens is physically as long as its marked focal length (minus the depth of the camera body for reasons already understood).



Cutaway section of Hanimex f3.5/135 mm. preset lens clearly shows optical layout comprising four glass elements, intricate construction of focusing mount, location of iris diaphragm (aperture control). This "inside view" provides a fuller realisation of the complexity of construction and the excellent value represented in Hanimex lenses.

All Hanimex telephoto lenses are of the true telephoto type, in which the optical construction is such that the physical length is actually less than the optical focal length. This is done in order to minimise the problems of manoeuverability which obviously arise when the natural balance of the camera is affected by the weight and length of a longer lens.

Lens Coating

In the optical construction of a lens, some of the glass elements have air-space on either side whilst others may be cemented together. At each air-to-glass surface, transmitted light is lost by reflection and this causes a reduction in the light-gathering capacity or speed of the lens in addition to scattering light inside the lens barrel, with the result that definition of the film image is impaired, and contrast reduced.

In the early days of photography the problem was quite serious, but modern technology has provided us with a most effective means of combating the breakdown in light transmission through a highly corrected (multi-element) lens. This is the technique of coating each glass-to-air surface with a microscopically thin anti-reflectant film (commonly magnesium fluoride applied by evaporation and condensation in a vacuum chamber).

This coating is extremely hard and virtually permanent unless careless cleaning introduces abrasion. It is recognisable by a purple to blue tint, which is noticeable when light is reflected from the front surface of the lens.

Sometimes called "blooming," this coating process is also used in the manufacture of binoculars.

Whereas earlier lenses lost up to 30% of transmitted light, the modern coating technique has reduced light loss and internal reflections to as little as 2%, which is quite negligible.

Four Lens Categories

The average focal length of the standard lens supplied with a 35 mm. single lens reflex camera is 50 mm., which is approximately equal to the diagonal measurement of the 24 × 36 mm. film frame.

This standard lens is probably the best all-rounder, despite its limitations. Firstly, it takes in a fairly broad angle of view (about 45°), which delivers a perspective relationship between various elements of the scene which is pleasing to the eye.

Of all focal lengths it is the one most suited to the economical manufacture of high speed characteristics and to the achievement of a large maximum aperture within comfortable physical limits. For this reason, the standard lens offers the greatest potential for photography under unfavourably low levels of subject illumination.

It is ideal for photographing groups of people where space is not restricted, for street scenes and medium distance scenics.

Because of its greater light gathering capacity (speed) it delivers the brightest image in the reflex focusing viewfinder and because of its large aperture it extracts the maximum benefit from microprism focusing aids and split-image devices with which most 35 mm. single lens reflex cameras are provided in the centre of the groundglass screen. These critical focusing aids are inclined to black out when focusing is done at small apertures.

The standard lens is unsatisfactory when we wish to record clearly the finer details of distant subjects and also when it is desired to encompass a wide field of view at short camera-to-subject distances.

Furthermore, it is not well suited to head and shoulders portraits due to the tendency of all shorter focal length lenses towards an unattractively exaggerated perspective diminution (i.e., the features closest to the camera appear to be distorted in size and perspective relationship).

The Wide-Angle Lens

Our own eyes do not see things in the same way as the camera lens. They are continually scanning the scene from side to side and from top to bottom and without turning the head from a fixed position it is possible for us to take in a very broad view of some 140° extent.

Even the 28 mm. wide-angle lens cannot equal this performance, but it does substantially increase the scope of the camera in relation to the standard lens coverage. As it is recording a so much wider field of view (74° angle approximately), it will, of course, proportionately reduce the image

On occasions, the photographer will wish to encompass a broad area of view from a comparatively short distance. In this set, the lower picture shows the coverage obtained with the standard 50 mm. lens, whilst the upper illustration demonstrates the tremendous potential of the Hanimex f2.8/28 mm. wide-angle lens from the identical camera position.

size and it is therefore unable to register distant objects in fine detail.

Being the shortest wide-angle lens in the Hanimex range, the 28 mm. lens exaggerates perspective diminution even more than does the standard lens. Whilst this renders it quite unsuitable for close portraits, it can also be of dramatic creative potential. Its characteristics of rapidly diminishing perspective can be used to great effect in emphasising the feeling of tremendous depth in a scene. It especially lends itself to the inclusion of foreground interests which create a framing of the more distant material and gives the viewer a strong feeling of participation and presence in the scene.

For home interiors it is excellent, because it will cover a substantial portion of a small room at necessarily short distances. For the same reason, the wide-angle lens is often used by candid cameramen photographing groups of people at social functions in the home or in small auditoriums.

In the photography of tall buildings over short distances, the wide-angle lens is particularly useful, but certain precautions must be taken. When the viewpoint is at ground level, there is a necessity to point the lens upwards and this causes the vertical lines of the building to converge towards the top. The effect may be acceptable in terms of artistic licence, but is not satisfactory from a documentary point of view (especially if one is making record pictures for architects or builders).

As the camera-to-subject distance increases, the degree of vertical convergence diminishes, but then, if we could significantly increase the distance, the wide-angle lens would not be necessary. The preventative step is to obtain a viewpoint which is approximately half the height of the subject. This can often by achieved by working from another building on the opposite side of the street.

Convergence of verticals is an inherent hazard when working with wide-angle lenses and it is particularly important to keep the film plane vertical by virtue of a level camera aspect.

Because the problem is magnified as the focal length of the lens is shortest, some photographers show preference for the 35 mm. wide-angle lens, which has a not so dramatic angle of view (64°) but is still significantly more panoramic than the standard lens.

Hanimex Wide-Angle Lenses

There is an interesting choice of four different wide-angle lenses in the Hanimex range. Two of these have preset diaphragms . . . the $f2.8/28$ mm. and the $f2.8/35$ mm. . . . two have fully automatic diaphragms, these being the $f2.8/28$ mm. and the $f2.8/35$ mm. models.

The two lenses of 28 mm. focal length have a nearest focusing distance of 18″, whilst the two 35 mm. lenses have a nearest focusing distance of 24″.

Smallest aperture setting of both 28 mm. and 35 mm. automatic diaphragm models is $f/16$, whereas the preset diaphragm models (even including the $f2.8/28$ mm.) stop down to $f/22$.

This broad selection of wide-angle lenses not only satisfies every requirement in terms of mechanical and optical specifications, but ensures that the purchase of a wide-angle lens is not beyond the financial means of the average amateur photographer.

Medium Telephoto Lenses

Because Hanimex telephoto lenses range from 105 to 600 mm. focal length with consequent magnification ratios of from 2x to 12x compared with the standard lens, it is suggested that we examine these lenses in two distinct categories . . . medium telephoto and long telephoto . . . especially as the application of those in the 105 to 200 mm. range does not have a close relationship to the uses of the really long models.

One of the great advantages of single lens reflex cameras is that the viewing image is enlarged in direct proportion to the magnification factor of the lens which has been mounted in place of the standard one.

Thus the application of a telephoto lens immediately reveals distant subjects in greater detail and often far more clearly than it can be discerned with the naked eye.

The medium telephoto lenses are best suited to portraiture, scenics in which it is desired to optically close the camera-to-subject distance when it is not possible to do so physically, candid studies and nature studies over moderate distances (when it is desirable that the camera be unnoticed by a timid subject), and sporting events at moderate range.

We have already learned that short focal length lenses, including the standard lens, are unsuitable for head and shoulders portraits and close head studies due to exaggerated perspective distorting the features which are closest to the camera.

It is for this reason that medium telephoto lenses between 105 mm. and 135 mm. focal length are especially popular for portraiture and are commonly referred to as "portrait lenses," although this is not their only application.

In the medium telephoto range, the 135 mm. lens is probably the most popular choice of amateur photographers as it provides almost 3x magnification, is still comparatively fast, yet it remains highly manoeuverable.

There are eight lenses in the Hanimex medium telephoto category, five of these being what we might term "portrait lenses."

At the foot of the focal length scale we have the preset f2.8/105 mm. model giving 2x magnification. This lens has a nearest focusing distance of five feet.

The angle of coverage is approximately 24° and, despite the doubling of focal length compared with the standard lens of the camera, this lens retains a comparatively fast light-transmitting speed and is very comfortable to handle.

As the 135 mm. lens is such a popular choice, it is not surprising that, in this single focal length, Hanimex offers four different models. One may choose between f/3.5 and f/2.8 speeds in either preset diaphragms or automatic diaphragms.

The 135 mm. lens gives a handy 2.7x magnification and covers an 18° angle of view. The nearest focusing distance is six feet for all models. The f/2.8 preset diaphragm model stops down to f/16, whilst the other three models have f/22 as their minimum aperture.

Next step in the medium telephoto range is to the 180 mm. and 200 mm. lenses. The 200 mm. model comes in both preset and automatic diaphragm versions, with $f/4.5$ speed, whilst there is a faster $f/3.5$ version available in both types also.

These 200 mm. lenses provide a 4x magnification factor, but if the photographer seeks $f/3.5$ speed at lesser cost, and is prepared to accept a slight reduction of magnification to 3.6x, the Hanimex $f3.5/180$ mm. can be recommended.

Whilst the $f3.5/200$ mm. Hanimex lenses have a five element construction, some saving is effected in the $f3.5/180$ mm. model by employing a simpler four element construction which still delivers excellent definition and reduces comparative weight by two ounces.

Camera Stability

It is well to enter a note of caution at this point of our discussion, for we have already been introduced to 4x magnification of the standard lens image and this is a significant degree which has other implications.

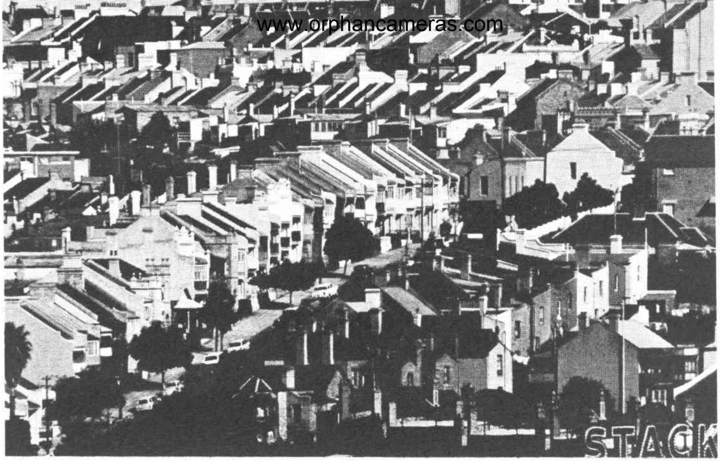
We noted earlier that when the reflex focusing screen is brought to its sharpest point by focusing the lens, the resultant picture will register equally sharp on film *with certain qualifications.* One of these qualifications was that the camera must not move at the moment of exposure.

The photographer is *not* the ideal support for his camera, especially when shutter speeds of long duration are employed (we call these "slow" speeds). However, most of us are able to handhold the camera quite satisfactorily for exposures under daylight conditions.

Any tendency towards unsteadiness at the moment of exposure becomes more serious as we increase the image magnification. The slightest camera shake will be magnified in direct proportion to the image magnification factor of the lens in use.

It is therefore of particular importance to take special precautions in this regard if we are using a telephoto lens. For static subjects it is advisable to use a tripod for mounting the camera, but this is not convenient for action subjects which are subject to sudden changes of pace and/or direction.

Bracing oneself against a wall, fence, tree or other solid support is strongly recommended. If this is not possible, your



Another interesting comparison is found in this set, which demonstrates how physical distance is dramatically bridged by the use of a Hanimex f6.3/400 mm. telephoto lens. In the lower picture, taken with the standard 50 mm. lens, the small area outlined was magnified eight times by using the 400 mm. lens. This small area then filled the entire picture. Physically, the same viewpoint could not have been obtained had the camera, with standard lens, been brought to one-eighth of the camera-to-subject distance. The elevated viewpoint shown here was not attainable at closer range.

body can become a more stable support if you drop to one knee and support your elbows on the other knee. You can even lie on the ground and use your elbows as a support in similar fashion to the classic position of a rifleman.

It is generally conceded that a 200 mm. lens is about the limit for handheld cameras. Longer lenses not only have an even greater magnification factor, with proportionate magnification of camera unsteadiness, but they affect manoeuverability. Some people can handhold a long lens satisfactorily, but most will require either a tripod or a stabilising mount for the camera, such as a shoulder brace modelled along the lines of a gunstock.

Long Telephoto Lenses

There are three Hanimex lenses in the "Big Bertha" category . . . the *f*5.5/300 mm., the *f*6.3/400 mm. and the *f*8/600 mm. models.

For reasons of economy, each is fitted with a preset diaphragm, as the technical problems associated with fitting fully automatic diaphragms to such long lenses result in considerably higher prices.

Each of these three lenses stops down to *f*/32, which is a smaller value than the minimum apertures of any of the shorter lenses in the range. Physical limitations make such tiny apertures impracticable for short focal length lenses, but for reasons of obtaining maximum depth of field (which we will examine in detail further on) the *f*/32 setting is necessary on long lenses and also physically practicable.

What are the principle applications of the really long lenses? Firstly, they enable the photographer to bridge physical obstacles of considerable proportions. It may be a small scene on the opposite bank of a river, or a situation (such as most spectator sports) in which a closer viewpoint cannot be obtained by reason of interference with the action, or size of the audience.

It may even be that a closer viewpoint would actually endanger the photographer's life, as in motor racing or the photography of dangerous animals in their wild state (although a 135 mm. to 200 mm. lens is generally adequate for photography in zoos).

The Hanimex $f5.5/300$ mm. lens provides a magnification factor of 6x and covers an angle of view of 8° only.

For a more dramatic effect, the $f6.3/400$ mm. lens might be chosen and this gives an 8x magnification with an angle of view of 6°.

The Hanimex $f8/600$ mm. lens with its 12x magnification is almost certainly a tripod job.

Lenses in the long telephoto category can be considered as absolutely essential for such subjects as surfboard riders in action, as there is no possibility of the camera-to-subject distance being reduced physically.

Focal Length and Perspective

It is sometimes said that a telephoto lens compresses perspective, but this is only a half truth. From a given camera position the perspective rendition is identical with every lens. You can prove this beyond doubt, simply by enlarging from a negative produced by a short lens: that section of the scene which equals the total coverage of a longer lens used from the same camera position.

Whilst this enlargement will not have the same technical quality as the already magnified image produced by the long lens, the perspective relationship of each element in the scene will be found to be identical.

However, it is certainly possible, and creatively useful, to dramatically alter the perspective rendition by changing the camera-to-subject distance when switching to longer lenses.

When we speak of perspective, do we really understand what is meant? Most people have seen trick photographs in which an angler holds a small fish much closer to the camera than his body (by extending his arm directly towards the lens) so that the fish appears to be much bigger than it is in fact.

From this simple example we see that things closest to the camera are registered in larger proportion than things at greater distance.

Imagine that you are looking down an avenue of trees which are all of uniform height and evenly spaced. If you fitted a 28 mm. wide-angle lens to your camera and took up a position from which the height of the first tree just fitted into the depth of the viewfinder in its horizontal aspect, you would note that the second tree was only about half as tall as the first tree, whilst the third tree's image would be only about one-third as tall as the first, and so on down the line.

The rate of diminution is more sudden between the nearer objects than it is between those more distant. This is not only evident in their relative height, but also in their spacing in depth, until these evenly spaced objects appear to be much closer together in the distance than they really are.

It is this optical illusion which gives the wide-angle photograph a very exaggerated perspective.

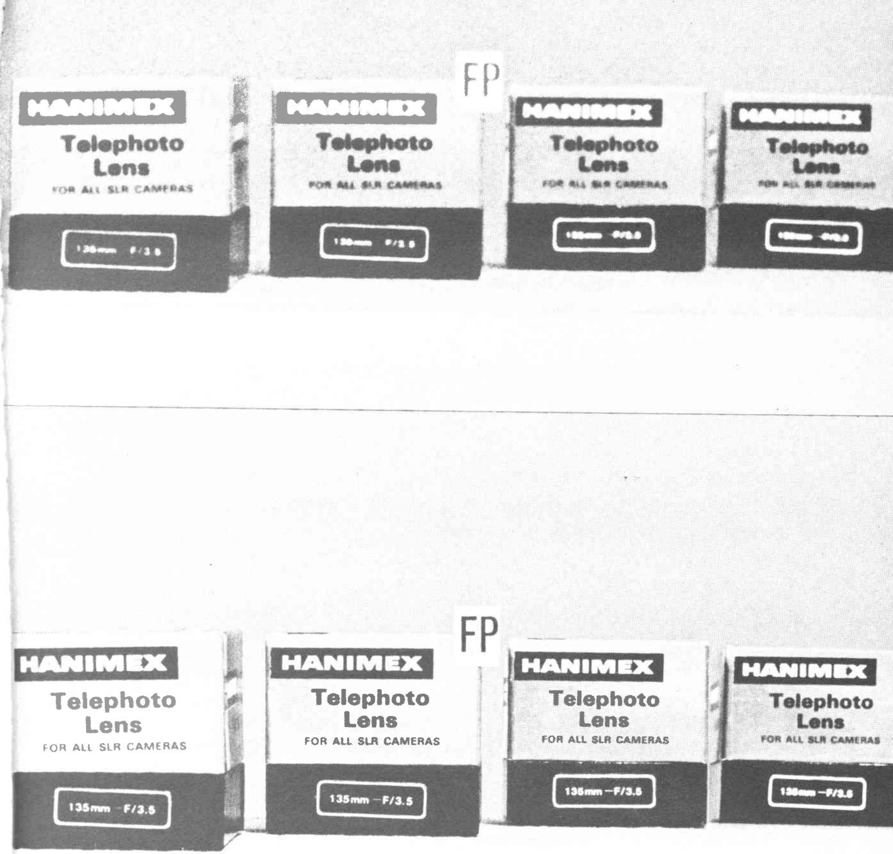
If we were to now fit the standard lens and take another picture from the identical camera position, the nearest tree would not even appear in the picture, but the perspective relationship between the remaining trees would actually be the same.

If we then used a telephoto lens, again from the same camera position, we would only record those few trees at the end of the avenue but, once more, the perspective relationship would be the same. It would simply *appear* to be different because the greater magnification would increase the apparent distance between the trees . . . we would finally see the space which was too small to be clearly defined in the wide-angle view.

For our next experiment, imagine a single tree standing in a field. Behind it, in the middle distance, is a farmhouse, whilst in the far distance is a small mountain range.

Again we start with a wide-angle shot after firstly moving in to the point at which the tree is just contained in the depth of the viewfinder. The perspective relationship between tree, farmhouse and mountains is just as we found it with the row of trees in our first example.

Now we fit a 135 mm. lens and we move the camera back until the tree is of the same viewfinder image size as it was in the wide-angle shot. Immediately we can note that the farmhouse appears bigger in relationship to the tree, the mountain has grown taller and the apparent distance between the three elements of the scene is reduced.



Here we see that so-called "telephoto perspective compression" does not exist when different focal length lenses are used from the same camera position and the resultant images are enlarged to identical size. The top picture was taken with a Hanimex f2.8/35 mm. wide-angle lens and enlarged to 22x linear dimension to obtain the same image size of the lower illustration taken with a Hanimex f3.5/135 mm. lens from the same camera position. Whilst the technical quality of the wide-angle shot has suffered by extreme enlargement, the perspective relationship between the two pictures is identical.

For both pictures, the lenses were set at f/16 aperture.

Moving much further back, we then fit the 400 mm. lens, still maintaining the same viewfinder image size for the tree. We will note that the size relationship of the three elements is such that the house is almost as large as the tree and the mountain has grown so much that we can now only include part of it . . . it seems to be right outside the back door of the farmhouse.

Thus we see that a long telephoto lens *does* compress perspective if we increase the camera-to-subject distance as we increase the focal length of the lens selected for the job. This little example may explain why more experienced photographers prefer medium telephoto lenses in the 135 mm. region for landscape photography, rather than the all-encompassing wide-angle lens which so many beginners choose.

Whilst the wide-angle lens will certainly record a sweeping panorama, the medium telephoto lens makes mountains look like mountains instead of molehills.

We can now understand that the word "perspective" is another way of saying *scale relationship.*

Does the telephoto lens really make the mountains bigger? No! It simply reduces the exaggerated scale relationship between foreground and background elements in the scene. By moving the camera further away from the foreground tree, we make the image of the tree *smaller in relationship* to the other elements, yet we hold its image size by using a lens of longer focal length.

SPECIAL PURPOSE LENSES

Included in the range of Hanimex lenses are several special purpose types which, because of their unique qualities, we have not yet discussed.

Fish-Eye Lens

First of these is the ƒ5.6/7 mm. 180° extreme wide-angle lens, commonly referred to as a "fish-eye" lens for reasons which are obvious.

Originally devised for photographic examination of tubular interiors in the ceramics industry, this lens was found to have interesting potential in artistic applications, whilst its astounding 180° angle of view made possible wide-angle pictures in previously restrictive situations.

Exaggerated perspective and linear distortion are inherent in a lens of this type, but can be turned to artistic advantage.

The fish-eye lens does not cover the picture area from corner to corner like the conventional wide-angle lens, but registers a circular image within the picture format.

In fact, all lenses register a circular image, but our camera is designed to extract a clearly defined rectangular section from this circle.

Due to its virtually infinite depth of field at all apertures, the Hanimex ƒ5.6/7 mm. fish-eye lens is of fixed-focus design and its sole adjustment is that of aperture.

Diaphragm adjustment is by the preset method with an aperture range of from ƒ/5.6 to ƒ/22. Due to the unique circular nature of the viewfinder image, it is not possible to observe the exposure meter needle of T.T.L. metering systems and a separate meter reading should be taken, either by hand meter or by prior observation with a conventional lens mounted on the camera.

In many respects, the fish-eye is a "fun" lens with which one is able to give full reign to creative experiments. Thus it cannot be said that there are correct or incorrect methods of application. The only caution which might be mentioned here is that the extreme wide-angle coverage of 180° often results in portions of the photographer's own anatomy encroaching on the picture area.

In particularly confined situations where even the widest of conventional wide-angle lenses cannot deliver sufficient coverage, the fish-eye lens never ceases to astound even the most experienced photographers with its all-encompassing ability.

f8/500 mm. Mirror Lens

For the many photographers dedicated to sports action or nature photography, this fine lens has very special attractions. The Hanimex Mirror Telephoto Lens is a modern adaptation of Maksutov's telescope which, by bending the optical path with a system of internal mirrors, makes possible a lens of 500 mm. focal length in a highly manoeuverable physical length of only 8 ins. (less than half the normal physical length of a conventional 500 mm. lens).

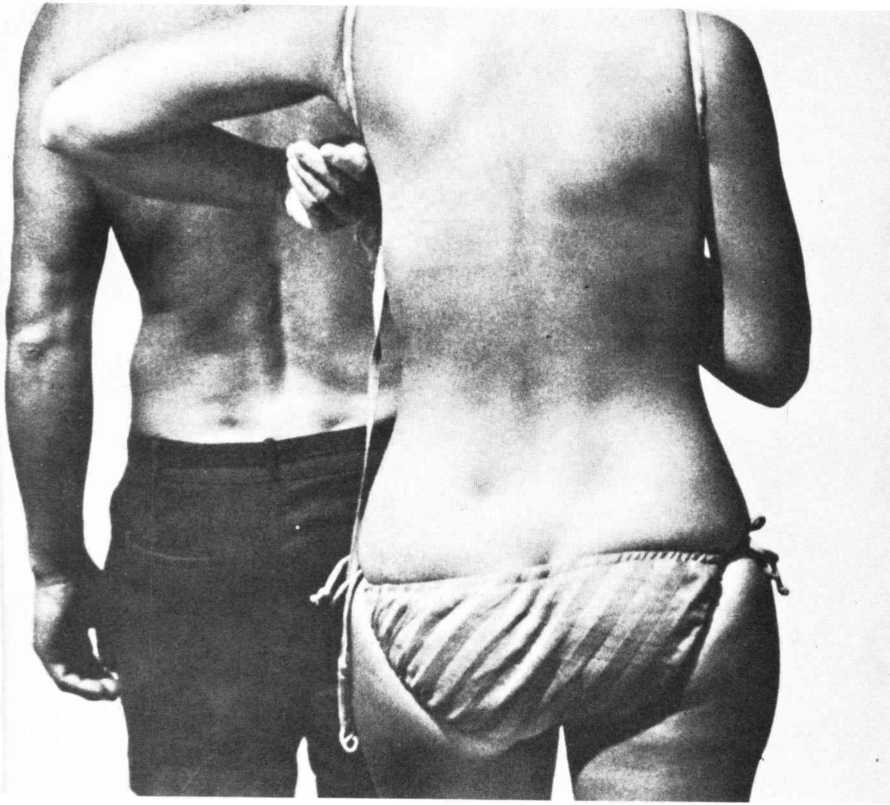
The mirror lens is more correctly described as a *cata-dioptric* lens, being a compound construction of both mirrors and glass lens elements.

Its unusual optical layout does not permit the inclusion of an adjustable diaphragm and it has a fixed aperture of *f*/8, with exposure control being either by shutter speed adjustment or one of the two neutral density filters supplied as standard equipment.

As a lens of this focal length is principally used outdoors, the speed of *f*/8 is quite adequate for focusing and clear viewfinder observation. The neutral density filters supplied with this lens have factors of 2x and 4x, giving reduced aperture values of *f*/11 and *f*/16 respectively. Provision is made to insert the filters in a slot at the rear of the lens barrel and this is made light-tight by a rotating spring-loaded cover plate.

The closest focusing distance is an advantageous 10 ft., making this an ideal choice for nature photography involving small birds (500 mm. focal length delivers 10x image magnification!).

Whilst lenses of this focal length should be used on a tripod or other firm support, the compact construction of the Hanimex Mirror Telephoto Lens makes it possible to successfully hand-hold exposures at 1/500th to 1/1,000th second shutter speeds.



A high-magnification telephoto lens which is, at the same time, compact and readily manoeuvrable, is very handy for candid human interest pictures such as this, enabling the photographer to operate at a discreet distance from the subject.

Enlarged from little more than half the total area of a 35 mm. negative, this "grab shot" was made with the Hanimex 500 mm. Mirror Telephoto Lens, the camera being hand-held. Remarkable definition has been achieved under the circumstances.

The two extremes of coverage achieved with the variable focal length Hanimex f4.5/90-230 mm. lens are seen in these comparison photographs, both of which were taken from the same camera position. The upper illustration shows the full picture area with lens set at 90 mm. focal length, whilst the lower one shows full picture area at 230 mm. setting of this very handy lens. Definition is excellent throughout the variable focal length range.

Definition is especially pleasing, as there is a complete absence of the residual secondary spectrum encountered in even the most highly corrected glass lenses of long focal length.

For tripod mounting, the lens is fitted with a solid tripod plate on a rotating collar which may be secured at the most convenient position in relation to the focusing calibrations.

In practice, the apparent limitations imposed by a fixed aperture are not particularly restrictive and the handling qualities of the lens are such that it has quickly become a favourite with professional photographers and advanced amateurs. The author has found it well suited to candid human interest studies which may be effectively recorded at a discreet distance. (See cover illustration.)

The front rim of the lens barrel is threaded to accept 77 mm. filters for special effects and/or colour-temperature balancing. A lens hood and metal cover plate are provided as standard equipment and the lens, with accessories, comes in a serviceable carrying case with felt lining.

f4.5/90-230 mm. Zoom Lens

The undoubted convenience of a telephoto lens having variable focal length is found in the Hanimex Zoom Lens, which has a speed of $f/4.5$ and a focal length which is adjustable over the range 90 mm. to 230 mm.

Lenses having variable focal length are popularly referred to as "zoom" lenses and were first introduced in the field of motion pictures.

The zooming action is achieved by the rotation of a control ring encircling the lens barrel. Focusing is generally done by extending the focal length to its maximum (230 mm.) and the subject is then framed in the viewfinder, at the desired magnification, by the variable focal length control.

Closest focusing distance of the Hanimex Zoom Telephoto Lens is 8 ft., and the aperture control ranges from $f/4.5$ to $f/22$. The lens is fitted with a tripod mounting plate on a rotating collar.

Two versions of this lens are available . . . the first being a preset diaphragm model with interchangeable adaptor mounts to suit all popular 35 mm. single lens reflex cameras, and the second is an automatic diaphragm model with fixed mount to suit the camera nominated by the purchaser.

The range of cameras to which this lens may be fitted is greater for the preset diaphragm model.

HANIMEX AUTO-ADAPTOR MOUNT LENSES

In addition to the comprehensive range of Hanimex lenses already discussed under the headings *Choosing the Right Lens* and *Special Purpose Lenses,* Hanimex offers a selection of a further seven lenses of unique design, in the most popular focal lengths.

These lenses we term Auto-Adaptor lenses and they differ from the previously mentioned Hanimex Automatic Diaphragm lenses in that their automatic adaptor mounts are freely interchangeable, permitting the use of one lens on various single lens reflex cameras having quite different automatic tripping mechanisms and camera mounting systems.

In the case of standard Hanimex Automatic Lenses, the mount is fixed and it is necessary for the buyer to specify the camera with which the lenses are to be used.

However, with the Hanimex Auto-Adaptor Lenses, a change of camera involves nothing more than the fitting of a suitable interchangeable adaptor mount to the Hanimex Auto-Adaptor Lenses the photographer has previously acquired. This instant adaptation is not only simple to accomplish, but it is also quite inexpensive.

The selection of fully automatic mounts available for these lenses covers the universal Praktica threaded mount common to Praktica, Pentax, Edixa, Yashica, Mamiya, Ricoh Singlex, Pentaflex and Pentacon cameras, plus Nikon, Minolta and Canon.

In this range of Auto-Adaptor Lenses there are two wide-angle models . . . the f2.8/28 mm. and the f2.8/35 mm., three medium telephoto models . . . the f3.5/135 mm. and f2.8/135 mm. and the f3.5/200 mm., one long telephoto lens . . . the f5.5/300 mm., and one variable focal length zoom lens . . . the f4.5/90-230 mm. telephoto.

A complete Table of Specifications is published in the Appendix and it will be found that these Hanimex Auto-Adaptor Lenses have similar optical characteristics to the

Hanimex Preset and fixed-mount Automatic Lenses in their respective focal lengths.

When ordering interchangeable mounts for the Hanimex Auto-Adaptor *Zoom* Telephoto Lens, it is necessary to specify this fact due to a slight difference in the mechanical coupling of the mounts to this lens.

UNDERSTANDING DEPTH OF FIELD

We have already seen that each different shutter speed of the camera demands a balancing *f*/number on the lens aperture scale. By this means, we control the volume of light reaching the film.

It might therefore be assumed that we always select the shutter speed first and then the complementary setting of the adjustable iris diaphragm of the lens. Certainly this is correct if the state of motion of the subject dictates a particular minimum speed of the shutter. However, there will be many occasions when the subject is in a stationary condition and we do not require a fast shutter speed.

In such cases, it can often be advantageous to make selection of the *f*/number the prime consideration and to balance the exposure by the shutter speed appropriate to that *f*/number or aperture.

In what way can one aperture be better suited to the subject than another?

Depth of Sharpness

Do we want every element of the scene registered in crisp detail from foreground to background or do we wish to have one plane sharply defined against a soft background?

The answers to these questions will become apparent when we learn that some apertures compress the depth of sharpness whilst others expand it.

When we focus on a selected plane (in a portrait it is on the subject's eyes) this will be the sharpest, most clearly defined plane in the depth of the scene. There will be a gradual falling off in clearly registered detail both towards the camera and behind the plane of focus.

The more we enlarge the photograph on the screen or on a bromide print, the more this falling off will become apparent.

Thus we have a zone of depth in which the various planes in the picture are acceptably sharp to the eye (although never quite as sharp as the plane on which the lens was focused) and beyond this zone the rendition of detail becomes more and more indistinct.

This zone of *apparent* sharpness is known as the *depth of field*. It is roughly twice as deep behind the plane of focus as it is in front of it and its extent is variable in response to three factors. These three factors are (a) focal length of the lens, (b) focused distance, and (c) physical diameter of the lens aperture in use.

Taking these factors in order, depth of field at any given distance is greatest with the shortest focal length lens and least with the longest focal length lens. This immediately indicates that focusing must be kept within finer tolerances when using long telephoto lenses than is the case with wide-angle lenses.

On the second factor we find that the depth of field zone is variable with any given lens as the plane of focus changes. The extent of the depth of field zone is reduced at the near focusing range of the lens and increases as the lens-to-subject distance increases.

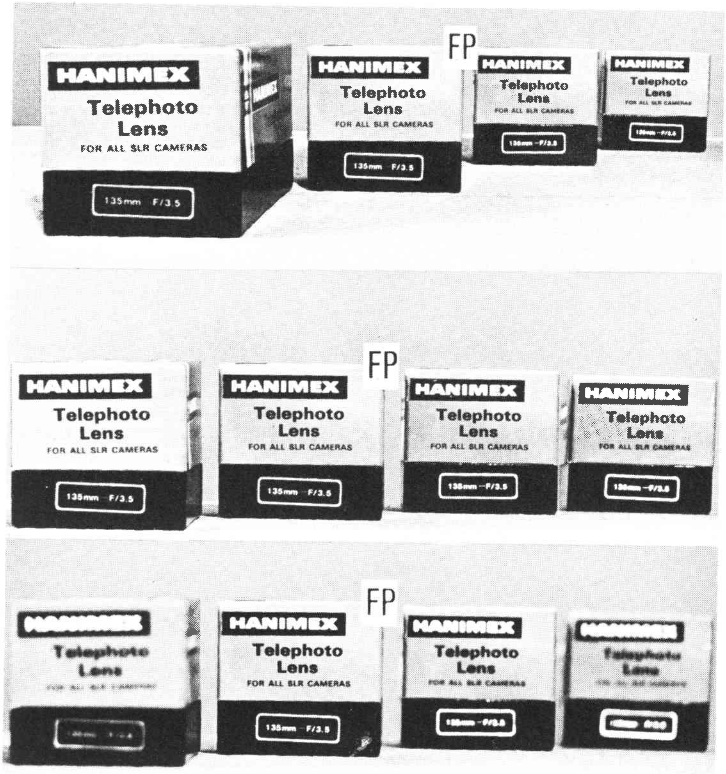
The third factor relates to the lens aperture and this is where there are many misconceptions. In any one lens, the depth of field increases as the aperture is stopped down to its higher *f*/numbers and decreases as it is opened up to the maximum diameter.

Regardless of the influence of focal length on depth of field, the extent of the zone in a given lens is therefore affected not only by focusing but also by the *f*/number selected.

You will, no doubt, hear it said that one cannot obtain the same depth of field with a long lens as can be achieved with a shorter lens. *This is not correct.*

You will note that the third of the influencing factors is "physical diameter of the lens aperture in use" . . . and we saw earlier that when we compare two lenses of different focal length the physical diameter of a given *f*/number is not the same.

If a 50 mm. focal length lens has a physical diameter of



The top picture was taken with a Hanimex f2.8/35 mm. wide-angle lens at f/16 aperture. Even though each box was aligned with the rear end of the box beside it, from left to right, the depth of field obtained was sufficient to register clear detail at each plane. Note the exaggerated perspective. The small card bearing the letters "FP" indicates the Focus Point.

The centre illustration was taken from greater distance using the Hanimex f3.5/135 mm. medium telephoto lens, also at f/16 aperture. Again, depth of field was sufficient to register clear detail at each plane. However, the perspective relationship suggests a lesser distance between each box, even though placement of the boxes remained unchanged.

In the lower picture, we see how depth of field has been drastically reduced simply by changing the 135 mm. lens from f/16 to f/3.5 aperture from the same camera position.

When the image size is held to the same approximate magnification by using different focal length lenses from varied camera positions, the depth of field obtained at a given aperture setting remains constant. At first glance, these two illustrations appear identical. However, different camera positions and different lenses used have given a slightly dissimilar perspective rendition. The top picture was taken with a Hanimex f3.5/135 mm. lens whilst the lower picture was taken from closer range using a standard 50 mm. lens, both lenses being set at f/16 aperture.

25 mm. (one inch) at the full diaphragm opening, the f/number value of that opening is $f/2$. However, a 100 mm. lens having a maximum diaphragm aperture of 25 mm. width would have an f/number at that setting of only $f/4$.

Despite the different f/numbers which make the 50 mm. lens so much faster from an exposure viewpoint, both lenses focused on a given distance would deliver the same depth of field when their diaphragms are opened to the *same physical diameter*. Of course, this would not be the case if both lenses were set to the same f/number value.

More Depth or Less?

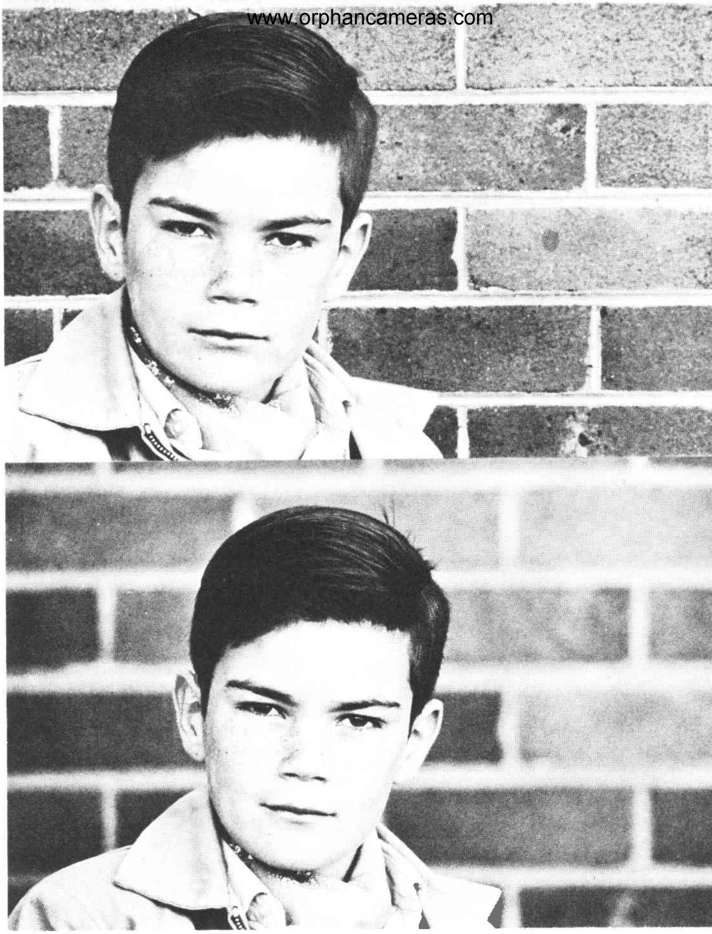
Is it desirable to always record the maximum depth of field? Not necessarily! Very much depends on the nature of the subject and its location.

Whereas a street scene is generally best when the depth of acceptable sharpness is greatest, a distant landscape in which most of the elements are at infinite distance and in a comparatively restricted plane might be adequately recorded with a larger aperture of the lens.

One usually strives for maximum depth of field when the subject itself is extensive in depth . . . for example, a three-quarter view of a train, a long building, a lizard, a crocodile. Then there are such subjects as room interiors, church interiors and most architectural examples, in which one wishes to record several different planes in clear detail.

In these cases, on which plane does one focus the lens? Remembering that the depth of field zone extends twice as far behind the plane of focus as it does in front of it, the lens should be focused on that plane which is situated at approximately one-third of the depth of the scene in the field of view of the lens, presuming that a small aperture has been selected.

We already know that the use of a fast shutter speed will call for a complementary increase in the lens aperture diameter and that this will necessarily result in a compression of the depth of field zone. This is an inevitable condition of high speed action photography but, strange as it may seem at first, it is often done intentionally with a stationary subject.



Application of one's knowledge of depth of field characteristics of any lens can be used to subdue unfortunate backgrounds, as shown in these comparison pictures. For both pictures, a Hanimex f3.5/135 mm. lens was used from the same camera position. In the top picture the aperture was set to f/22 and in the lower picture an aperture of f/3.5 was used. Note how the softening effect in the background, when the lens is used at a wide aperture, gives a greater visual concentration on the subject, and a feeling of third dimension.

The reason is that our subject may be located against an unattractive background and we are unable to change this association.

An appreciation of how depth of field can be controlled to creative advantage will help the photographer to subdue unsuitable backgrounds by keeping these outside the depth of field zone. We can do this by using a longer focal length lens, increasing the lens aperture diameter (using a smaller *f*/number) and by minimising the lens-to-subject distance.

At all times, the sharpness of the photograph remains dependent on a steady camera and it is especially important when using small apertures and slow shutter speeds, in the quest for maximum depth of field, that extra care be taken in relation to camera stability. At shutter speeds of longer duration than 1/60th second (even 1/125th second if you're over 30) a sturdy tripod should be used.

Depth of Field Scale

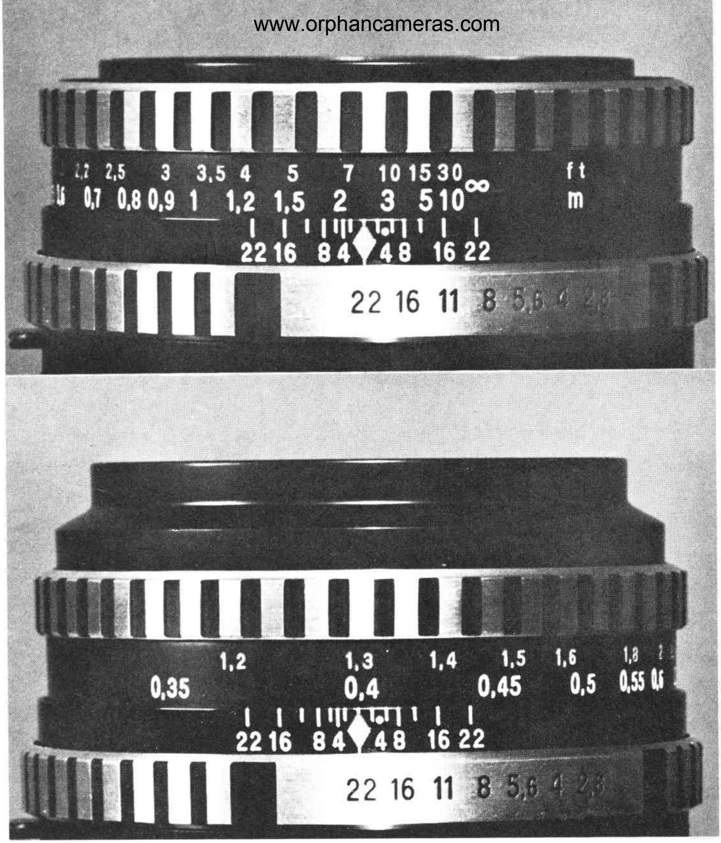
Each of the Hanimex interchangeable lenses is inscribed with a depth of field indicator scale, which is of great assistance in determining just how much of the depth of a scene will be registered in acceptably sharp detail.

To the beginner it has the appearance of a highly complicated calculator, but once you learn how it works it is extremely simple.

When you focus a Hanimex lens, you do so by rotating the helical mount or the lens barrel. After obtaining the clearest possible detail of your subject in the groundglass focusing screen, reference to the index point on the lens will indicate the exact distance on which the lens has been focused.

Adjacent to this focusing index point on the immovable section of the lens barrel, the depth of field scale extends both to the left and the right. It is, as you will notice, a replica of the lens aperture calibrations duplicated on either side of the focusing index point.

Having first set the lens diaphragm control ring to the desired aperture and having focused the lens, you then refer to the depth of field scale. On this scale, you look to the two positions marked with the same *f*/number which you have chosen for the exposure. Opposite this *f*/number on the



These two pictures show a Tessar f2.8/50 mm. standard lens focused at different distances. In the top illustration, we see the aperture scale set to f/22 and the infinity calibration of the focusing scale set against the f/22 point on the right side of the depth of field scale. Reference to the f/22 point on the opposite end of the depth of field scale reveals that this setting delivers a depth of field ranging from around 4 ft. to infinity. This is called the "hyperfocal distance setting" for f/22 aperture. For maximum depth of field, one merely aligns the infinity setting against the relevant aperture calibration on the right hand side of the depth of field scale.

In the lower picture we see that when the lens is focused at close range (1.3 ft. in this example) the depth of field, even at f/22 aperture, is very small (in this example, it is only a little under 2½ inches).

depth of field scale you will find the nearest distance (left of the focusing index point) and furthest distance (right side of the scale) at which the lens will register acceptably clear detail at the focused distance and using that particular aperture.

If this distance zone does not provide sufficient depth, the scale will quickly reveal at what *f*/number you will obtain the depth desired.

Now rotate the focusing mount of the lens to another distance setting and you will see that the depth of field is continuously variable at each *f*/number as the focused distance changes.

Knowing that depth of field increases as the focused distance increases, one might assume that the greatest depth of field exists when the lens is focused on infinity, but this is not quite so. You will see why by further reference to the depth of field scale on the lens.

Hyperfocal Distance Setting

For each aperture setting, every lens has a point on the focusing scale which provides the maximum possible depth of field. This position is called the *hyperfocal distance setting*.

Instead of setting the infinity mark of the focusing collar against the fixed index point, you set it to the right of that point, against the relevant *f*/number of the depth of field scale. Whilst your lens will then be focused on a distance closer than infinity, you will see that the depth of field extends from near distance right to infinity.

Assuming that you have not yet chosen your first Hanimex interchangeable lens, take the standard lens of your camera and try this little exercise.

Turn the focusing mount of the lens until the infinity calibration is opposite the number 16 at the extreme right of the depth of field scale. Now look to the number 16 on the *left* side of the scale and you will see that this lens will provide its greatest depth of field (from about 8 feet to infinity) when it is used at *f*/16 aperture and focused on the distance now opposite the focusing index point. This distance setting is the hyperfocal distance for your standard lens, when set at $f/16$.

By locating the infinity mark against each successive number on the right hand side of the depth of field indicator you will find that there is a different hyperfocal distance setting for each aperture of the lens.

This hyperfocal distance setting is ideal for scenic pictures in which it is not particularly important to secure critical focus on any particular feature of the scene. However, it is important to remember that nothing within the depth of field zone can ever be as precisely sharp as the point on which the lens has been focused by observation of the groundglass screen. Therefore, the setting of hyperfocal distance is merely a rapid system of prefocusing for quick snapshots and cannot take the place of critical focusing, especially for subjects at close range.

Cheap cameras with fixed focus lenses, for which it is claimed that everything will be sharp from six feet to infinity, are constructed on the basis of a small maximum aperture (generally not adjustable) and the lens permanently focused on the hyperfocal distance.

Depth of Field Previewing

Hanimex automatic diaphragm lenses are fitted with a manual over-rider which permits the photographer to close the aperture manually, whilst the preset diaphragm lenses are closed down manually in any case.

By doing this one can preview the depth of field by observation in the reflex viewfinder. As you close down the aperture whilst observing the viewfinder image you can note an increase in the depth of acceptable sharpness. Objects which were quite indistinct when you focused the groundglass screen at the full aperture of the lens will then become recognisable.

Some photographers find this facility useful, although it has its limitations in view of the fact that closing down the aperture also dims the viewfinder image to a point where it is difficult to observe the scene comfortably.

Depth or Sharpness?

Earlier in this book we learned that a sophisticated lens design employs multiple glass elements in order to correct the inherent aberrations of a simple meniscus or doublet lens.

Although the degree of correction achieved is of a high order, the lens nevertheless does not give its best at every aperture setting. With the aperture wide open, there may be noticeable loss of definition in the corners and at the edges of the film frame.

As the aperture is closed down, the definition improves until we reach the so-called *optimum aperture,* which is generally three stops smaller than the maximum opening.

Closing down beyond this point will increase depth of field, but it will not increase image sharpness. In fact, the reverse is the case. The physically smaller apertures introduce the problem of diffraction of light waves, which bend excessively around the edges of the smaller lens opening and thus fail to register the sharpest possible image points on film. We thus find that there is a price to pay in terms of image definition when we seek to extend depth of field.

Because diffraction is relative to physical diameter of the lens aperture rather than to its f/number value, the problem becomes more acute with the shorter focal length lenses in which the complete iris diaphragm mechanism is physically smaller at any given f/number.

This explains why wide-angle lenses do not stop down as far in f/number values as do the long telephoto lenses. In terms of *physical* diameter, the *maximum* opening of the f2.8/28 mm. wide-angle lens is only 10 mm., which is to say that this 10 mm. diameter has an f/number value of f/2.8, whilst the same *physical* diameter of the iris diaphragm on a 300 mm. lens would have an f/number value of almost f/32.

Hence the physical diameter of the wide-angle lens when fully opened is roughly equivalent to the long telephoto when stopped down to its minimum aperture! It is also interesting to note that the long telephoto lens of 300 mm. focal length delivers approximately the same depth of field at f/32 as the 28 mm. wide-angle lens does when fully opened to f/2.8 value.

Naturally, Hanimex interchangeable lenses are so designed that, for all practical purposes, the smallest aperture setting provided on the adjustable diaphragm will not result in an unacceptable loss of definition at the plane of focus.

For optimum results, it is suggested that despite the provision of smaller f/numbers for exposure control, the wide-angle lenses, in particular, should not be used at values less than f/11 if critical sharpness is required. Much depends on the nature of the subject, of course, as well as the degree of enlargement on paper or screen.

LENS HANDLING TECHNIQUES

Hanimex interchangeable lenses for 35 mm. single lens reflex cameras come in two basic types . . . those with fully automatic diaphragm and those with the manual preset system.

It is important to note that when handling the fully automatic type, care should be taken not to damage the delicate automatic tripping device which is in the form of a small pin protruding from the rear of the lens mount. Do not stand the lens on this end without first fitting the protective rear cap which is supplied as standard equipment.

Interchanging Lenses

Each Hanimex preset lens is fitted with an interchangeable mount to meet the specifications of your camera. If the camera accepts lenses having the universal Praktica screw-thread mount, you simply order a Praktica-fitting Hanimex lens.

However, if your camera is one which accepts lenses having a bayonet-type mount, it is possible to purchase suitable adaptors for your Hanimex lenses at very moderate cost. By this means it is possible to fit a Hanimex preset interchangeable lens to virtually any 35 mm. single lens reflex camera.

Automatic diaphragm lenses can also be fitted to bayonet mounting cameras, but it will sometimes be necessary to operate the diaphragm manually due to variations in the method of automatic tripping employed by different cameras. You should first consult your dealer to ascertain whether the selected Hanimex lens is available with fully automatic diaphragm mechanism for your particular camera.

Holding the Camera

It may seem rather elementary to advise you on how to hold your camera, but there are little tricks of the trade which can often help the less experienced photographer.

For instance, holding the camera in its natural horizontal position, we obtain a horizontal picture, but if the subject is principally vertical in nature, do not hesitate to turn the camera through 90° to obtain a vertical framing.

Most cameras are designed with the principal controls convenient to the right hand so that we can advance the film and cock the shutter, set the shutter speed and release the trigger with the minimum of effort.

It is therefore general practice to focus the lens by means of the rotating collar (helical focusing mount) using our left hand. In fact, when using short lenses, we can grip the camera with both hands and merely extend the middle finger of each hand to provide a two-sided manipulation of the focusing mount of the lens.

With longer lenses, which tend to upset the balance of the camera, the left hand is placed under the lens barrel, both in order to focus and also as a support which provides better balance for a stable camera position. If the left elbow can be pulled tightly on to the chest, or if we can lean it on a firm support such as a table or a fence, the ability to hold the camera steady will be greatly enhanced. This is especially important with the longer lenses as a counter to the magnification factor which not only magnifies image size, but also unsteadiness of the camera.

Releasing of the shutter should be a very smooth operation. Do not jab the release, but squeeze it smoothly. Some people have the mistaken idea that a rapid pressure will stop the subject action . . . *it will not!*

The only influencing factor in stopping subject action is the selection of suitable shutter speed. A quick jabbing release of the trigger will invariably introduce severe camera shake at the moment of exposure and result in a completely blurred picture.

Remember the instructions given to a rifleman . . . squeeze the trigger gently and you will remain on target . . . jerk it suddenly and you will miss every time.

Using a Tripod

The very first accessory with which a photographer should equip himself is a sturdy tripod because more good shots are lost by camera movement than by any other cause.

When you invest in a tripod, don't aim for one which will fit in your gadget bag. These miniature models are too flimsy to be of much practical value. A solid tripod with the *minimum* number of leg extensions is by far the best choice. It should also have an adjustable head to permit a variety of camera positions, including the vertical format. Although most modern tripods of suitable calibre are fitted with a pan and tilt head, this is really more satisfactory for movie cameras and it is recommended that you add a sturdy ball and socket head, which is far more manoeuverable for still camera work.

Your camera is fitted with a threaded bush on the underside for mounting it on to a tripod and this thread is universally used in all but a few European countries.

The camera with shorter focal length lenses will balance nicely on the tripod when this mounting is used. However, the length and weight of the longer telephoto lenses is likely to introduce some undesirable oscillation around the mounting position and you will find that the Hanimex long telephoto lenses are provided with a special tripod-mounting bracket to effect a better balance. In this case, you should screw the tripod into the special lens bush instead of into the base of the camera.

Focusing Aids

We have already seen that the image of your subject can be critically focused on the groundglass viewing screen by rotating the focusing mount of the lens smoothly and with care.

In addition to this visual observation and evaluation system, most modern 35 mm. single lens reflex cameras have a special focusing aid in the centre of the viewfinder. This may take the form of a split-image rangefinder device (called a "stygmometer") or it may be a microprism grid.

To use the stygmometer it is necessary to centre it over a prominent vertical element of the subject and it will then be noticed, if the lens is not precisely focused, that the vertical element is broken into two parts. Focusing the lens will bring this into a single continuous line without the break in the centre of the stygmometer.

The microprism grid consists of a centre spot of tiny prisms which will break up the clarity of the subject image until the lens is accurately brought to focus on the correct plane. When the image is precisely focused the grainy pattern of the microprism will virtually disappear.

Both of these focusing aids do not operate satisfactorily when the lens is stopped down to a smaller value than about $f/3.5$ and so they are of most value with high speed lenses which, when fully opened, do not have much depth of field.

The fact that these aids are ineffective when the lens is stopped down to smaller apertures is of little consequence because this is only done after correct focus has been determined.

Preset Scale Focusing

There may be occasions when time does not permit precise focusing, such as when the photographer is touring and wishes to make quick record pictures of scenic attractions . . . perhaps even shooting from a vehicle.

Under these circumstances, it is sound practice to preset the focusing scale of the lens according to the hyperfocal distance system which we have discussed previously. In this manner he can make rapid snapshots of adequate clarity, using his camera like a simple fixed focus model. One need only evaluate the average lighting condition and set the aperture and shutter speed accordingly. The hyperfocal distance can then be set for that aperture value.

Infra-Red Focusing Point

Each Hanimex lens is provided with a special focusing reference point for infra-red photography. This is recognised by a red spot or line slightly to the right of the normal focusing index point on the lens barrel.

Because infra-red rays do not come to the same focus point on film that normal light rays do, it is necessary when using infra-red film to adjust the focus of the lens.

First focus normally, then refer to the distance scale opposite the regular index point. The distance lying at that point must then be moved slightly to the right to correspond with the infra-red focus index.

However, very few amateurs will ever use this feature, as infra-red film is not readily available in camera stores . . . you may need to place a special order . . . and its applications are principally in the field of crime detection and research.

Nonetheless, it is made possible for the amateur to experiment in the unusual effects of infra-red photography if he so desires.

ALL ABOUT TELE-CONVERTER LENSES

The versatility of a limited kit of Hanimex lenses can be extended by the addition of an inexpensive optical device known as the tele-converter lens.

This is a grouping of two or three negative optical elements which has a relationship to the rear elements of a true telephoto construction. By adding it to the rear of any lens (i.e., by mounting between camera body and lens) we can achieve a doubling or tripling of the focal length of the lens.

This handy conversion of any Hanimex lens is achieved with a mere 33 mm. additional physical depth.

Hanimex Tele-Converter Lenses

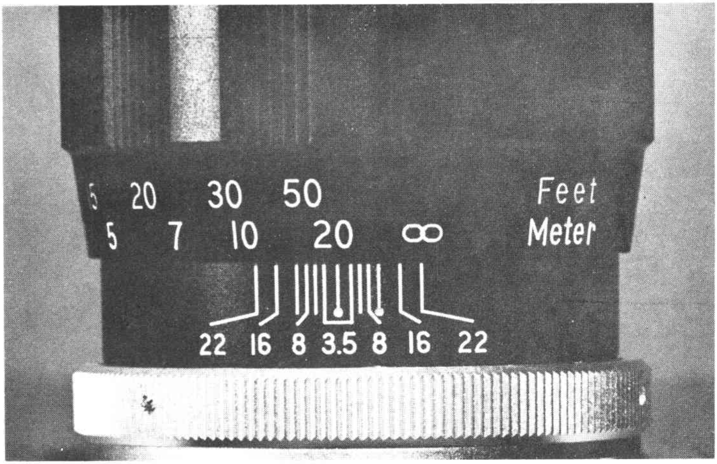
There are three models available, these being the 2x, the 3x and the 2 to 3x tele-converters. As their identification suggests, they are used to double the focal length of the prime lens, to triple it or, in the case of the latter model, do either.

Furthermore, tele-converters are additive, so that by combining two 3x converters you effect a 6x increase of the focal length of the lens. However, this degree of multiplication is not very practicable due to the fact that the greater the tele-converter magnification, the greater the loss of definition delivered by the prime lens.

It is recommended that only one converter be added to the lens.

The Pros and Cons

The principle of the tele-converter offers some positive



Here we see a Hanimex f3.5/135 mm. medium telephoto lens, set to the hyperfocal distance for f/22 aperture. Many photographers like to use such a lens at this setting for maximum depth of field in landscape pictures. We can see that the depth of field ranges from around 35 ft. to infinity in this example.

advantages which are extremely attractive and the following list outlines these:

(*a*) Any lens can be quickly converted to a longer focal length at minimum cost.

(*b*) This conversion is achieved with a considerable saving in length and weight over a prime lens of comparable focal length.

(*c*) This compactness provides improved manoeuverability over the comparable focal length prime lens.

(*d*) If the converter has an inbuilt tripping mechanism for the automatic diaphragm of the prime lens, one obtains this convenience in a longer focal length where it may not be available in an equivalent prime lens (e.g., a Hanimex *f*4.5/200 mm. auto diaphragm lens becomes a 600 mm. lens by adding a tele-converter with auto diaphragm control, but the Hanimex $f8/600$ mm. lens does not have an automatic diaphragm).

(*e*) The focusing range of a prime lens is unaltered by the addition of a tele-converter; therefore, one can have a lens/converter combination of much longer focal length which retains the near focusing feature of the prime lens.

(*f*) Just one tele-converter doubles the number of different focal lengths provided by a limited range of lenses. If you have a standard 50 mm. lens, a 135 mm. lens, and a 300 mm. lens in your kit, the addition of a 2x tele-converter will convert these into 100 mm., 270 mm. and 600 mm. focal lengths at will, giving you a choice of six lenses.

The Other Side

Tele-converters also have certain limitations which must also be considered in the final analysis and these are as follows:

(1) When the tele-converter increases the focal length of a lens it also multiplies the f/numbers by the same factor. Thus a 2x tele-converter reduces the speed of an $f/2.8$ lens to $f/5.6$ and likewise reduces the exposure value of each aperture throughout the range. From this you will see the great loss of light-gathering capacity which would result from combining *two* tele-converters and a prime lens. If this resulted in a 6x magnification of the focal length of a Hanimex $f4.5/200$ mm. lens, that lens would then have a *maximum* speed of $f/27$ and a minimum f/number setting of $f/132$!

(2) With the maximum aperture of the lens thus reduced in f/number value, focusing aids of the stygmometer and microprism grid type would be rendered ineffective.

(3) When a lens is designed, its potential performance is carefully calculated without provision for additional optical units and so the optimum performance cannot be maintained when a tele-converter is introduced. The loss of definition is greatest when tele-converters are added to the shorter focal length lenses and they are not recommended for wide-angle lenses. Even with the standard lens and medium telephoto lenses it is advisable

to stop down a little to minimise fall-off in definition at the edges of the film frame.

(4) Because the addition of a tele-converter provides a greatly increased image magnification with little consequent increase in the overall manoeuverability of the lens, one is tempted to handhold the camera when the use of a tripod might be absolutely essential. The resultant magnification of the image would reveal an unacceptable unsteadiness of the camera.

Converters and Depth of Field

Because a converter necessitates working at reduced aperture values, most pictures taken with tele-converters suggest an improved depth of field over what the prime lens delivers.

This is a fallacy. If an *f*2/50 mm. lens is used with a 2x tele-converter, it becomes an *f*4/100 mm. lens and delivers, at maximum aperture, the same depth of field which exists with an *f*4/100 mm. lens used wide open without converter.

Practical Advantages

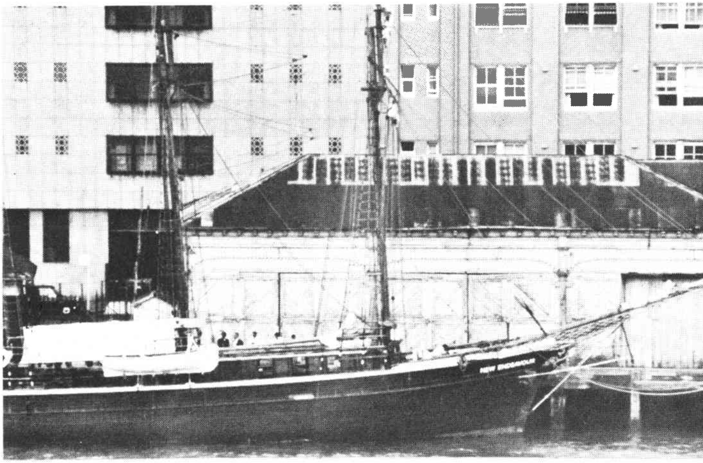
As the advantages of a tele-converter seem to be pretty well balanced out by the disadvantages, is it worthwhile investing in one at all?

It depends on what end result you are seeking. If your aim is a critically sharp high-magnification enlargement, the answer is probably "No," but if you are content with a 10″ x 8″ print, or a relatively small projected image on a screen (say, to 48″ width), the tele-converter can definitely justify its small price.

It can also give you a satisfactory evaluation of the suitability of a longer lens to the subject interests which you have. For example, if you have a 200 mm. Hanimex lens and you are contemplating the purchase of a 400 mm. lens, the addition of a 2x tele-converter to your kit, at moderate cost, will give a good indication of whether or not a future investment in a 400 mm. lens will be to your advantage.

USEFUL LENS ACCESSORIES

There are two basic lens accessories with which the photographer should be familiar . . . lens hoods (sometimes called "sunshades") and filters for special effects.



In the top picture you see a yacht which is barely visible in the broad view below. The lower picture was taken with a 50 mm. standard lens. The yacht was made to fill the viewfinder by using a Hanimex f5.5/300 mm. lens coupled with a Hanimex 2x Tele-converter lens. This provided a combined focal length of 600 mm., thereby magnifying the image of the yacht by 12 times, from the same camera position. In the top picture, one can read the name "New Endeavour" on the bow of the yacht . . . a remarkable performance.

Both of these accessories have really worthwhile practical applications and it is advisable to be thoroughly conversant with their functions in the quest for the ultimate in photographic technical quality.

The Lens Hood

In virtually every photographic situation, one will find uncontrollable sources of light which can shine on to the front surface of the lens. It may be a powerful source of light *behind* the subject or it may be light reflected from a highly reflective surface within the field of coverage of the lens (for example, from water surfaces, glass, metals and similar matter).

Should this strongly directional light enter the lens, it will bounce back and forth inside the barrel and, in some cases, even travel in a direct path to the film when the shutter opens.

The end effect is a degradation of contrast and definition of the image on film. The lens hood is a preventitive measure which is strongly recommended, as it has the effect of screening most unwanted light from the lens. In cases of emergency, one can also hold one hand in the manner of an awning over the front of the lens to keep the surface of the lens in shadow.

As there are very few situations in which a lens hood will *not* result in improved image quality, the purchase of this basic accessory should not be delayed.

Filters for Black and White

The black and white film transfers colours into relative shades of grey tone and modern panchromatic films are designed to see all colours without bias. However, this is not quite the case. Panchromatic films are relatively insensitive to green and hence they reproduce this colour in a darker tone of grey than they should do.

This discrepancy can be corrected by fitting the lens with a greenish coloured glass filter, the yellow-green type being the most popular choice.

This helps to restore the grey tone relationship of green subject matter to that of other colours in the scene. It is easy to see why the yellow-green filter is important in landscape photography with black and white films.

The effect of the various coloured filters used for black and white photography is that each one lightens the grey tone rendition of subjects of its own approximate colour and darkens that of its complementary (opposite) colour.

This effect can be put to creative use, as it permits the photographer to exaggerate grey tone relationships by either subduing or emphasising the grey tone rendition of selected elements in the photograph.

A classic example is the practice of emphasising clouds in a picture by the use of a yellow filter on the lens. Actually, the filter has no effect whatsoever on the clouds, but because yellow is the complementary colour of blue (and each filter darkens the grey tone rendition of its complementary colour) the filter actually darkens the rendition of the blue sky, thereby creating a much stronger contrast ratio between blue sky and white clouds.

If the sky is totally overcast without any sign of blue, there is no point in using the filter.

Filters also have the often desirable effect of cutting through atmospheric haze, although they cannot penetrate industrial smog. Hence they have a special application in long telephoto photography were extreme camera-to-subject distances are involved with a consequently higher level of atmospheric haze with which to contend.

The principal coloured filters for black and white photography are light yellow, medium yellow, yellow-green, green, orange and red. They are listed here in approximate order of density and most will darken a blue sky in the same order of density. Light yellow darkens the sky slightly whilst red darkens it to a dramatic tone of almost black density.

Medium yellow and yellow-green are excellent for sky tones, skin tones and landscape pictures. Green is more dramatic for landscapes. Orange is excellent for architectural subjects and for minimising the density of freckles on skin tones. Red is generally used for architectural subjects against a dramatically darkened sky.

Exposure Factors

As each filter reduces the light gathering capacity of the lens in proportion to its colour density, their use involves an exposure adjustment.

To simplify this adjustment, each filter has, engraved on its mount, an exposure correction factor. If this factor is shown, for example, as 2x, the film must be given twice the normal exposure.

This can be done by setting a shutter speed of twice the duration (e.g., 1/125th second instead of 1/250th second) or by setting the next aperture larger than that necessary without the filter.

The easiest way is to apply the filter factor to the A.S.A. rating of the film. If we are using a 100 A.S.A. film and a 4x filter factor is applicable, we simply calculate the exposure in terms of a 25 A.S.A. film. In other words, we divide the A.S.A. rating by the filter factor.

Filters for Colour

When using colour reversal film (i.e., for colour slides, not negatives) there is another range of filters used. The filters used for black and white film do not have any application in colour photography and their accidental use would merely degrade the pictures with an overall caste of the filter colour.

Filters for colour slides have another purpose. They are used to correct the colour temperature of the subject illumination.

Colour slide films for daylight use are designed to be used in clear sunlight between the hours of 10.00 a.m. and about 3.00 p.m. and if we use them at other times of the day or under other than clear sunlight conditions, the colour rendition will be adversely affected.

Early morning and late afternoon sunlight has a warmer quality than it does between the recommended hours and this results in an overall warming of the colours recorded. We can correct this by applying a "Morning and Evening" filter to the lens.

On overcast days, the light has an extra bluish quality which degrades the colour rendition and we can again apply a corrective filter which is aptly designated the "Cloudy" filter.

Another filter having a similar application, but to a more subtle degree, is the "Skylight" filter. This one is handy when shooting over large stretches of water, when reflection of the sky gives a slight bluish caste to the scene. It is also occasionally used to correct the tendency of some lenses towards a cold bluish rendition of colours under normal daylight conditions. It is, in effect, a warming filter.

Then we have a special filter known as the "Flood" filter, which is used to correct the reddish rendition (especially of skin colours) when daylight colour slide film is used under artificial lighting indoors.

It should also be noted that these colour temperature correction filters have an exposure factor which requires adjustment of the exposure.

The Universal Filters

The filter which *can* be used on both colour slide film and black and white films to equal advantage is the U.V. or Ultra Violet filter. This one is quite colourless, being nothing more than a perfect optical flat, but because it is ground to perfect flatness, it has the effect of filtering out ultra violet rays which exist at high altitudes, and on large stretches of water or snow.

In these locations, colour slide films will record an excessive blue caste, which is greatly reduced by the U.V. filter. At the same time, this filter has strong haze penetration characteristics and is equally useful for black and white film when it is undesirable to alter grey tone relationships.

Due to its being colourless, the U.V. filter is popularly used as a lens protector and many photographers keep one fitted to the lens to screen dirt, scratches and smears from the front surface of the lens proper. They figure that the U.V. filter is much cheaper to replace in the event of accidental damage.

Whether this is sound thinking is a matter for conjecture because one will occasionally wish to record atmospheric haze rather than to penetrate it, for reasons of pictorial effect. However, the regular use of the U.V. filter in this manner cannot do much harm, especially as its lack of colour means that it does not have any exposure correction factor.

In colour slide photography, the U.V. filter results in optimum colour saturation and this possibly accounts for its widespread popularity because strong posterish colours are the aim of so many amateur photographers. The more dedicated enthusiast, however, often prefers softer, more subtle colours.

Polarising Filters

The second "universal" filter is the polarising filter, which is used to minimise reflections on such surfaces as water and glass, in cases where the lighting cannot be adjusted to eliminate unwanted reflections on the subject.

To penetrate these reflections which are caused by polarisation of the reflected light, the filter glass is rotated in its mount until maximum visual penetration prevails and this may be conveniently observed in the groundglass viewing screen of your single lens reflex camera.

The degree of penetration will be greatest when the reflective surface is photographed from an angle between 32° and 37°. Polarising filters are especially useful when photographing window displays.

They also have an additional application in colour photography in that they darken blue sky rendition without any detrimental effect on colour balance in the overall scene. Because a small degree of reflected light will also be penetrated on foliage and numerous glossy surfaces, the colour saturation of the entire scene will possibly appear greater.

Neutral Density Filters

On occasions, it may be found that the film loaded into the camera is too fast for every application. For example, under bright sunlight conditions it may not be possible to select a large diameter of the lens diaphragm even when using the fastest speed of the shutter. In this situation, it is possible to reduce the film speed by applying a neutral density filter. Such a filter has a deep grey colour and may be obtained in several different densities. The A.S.A. speed of the film is reduced by the filter factor engraved on the mount.

The application of a neutral density filter does not have any effect on colour balance or on grey tone rendition.

It is handy to reduce film speed in this way when using a high powered light source (e.g., flash) at close distance when a sufficiently small lens aperture is not available.

Negative Colour Film

Colour films which do not produce positive transparencies (colour slides), but which record the scene in negative or complementary colours for transference to printing paper, are called *negative* colour films.

Their use is expanding rapidly and you may wonder if these, too, should be subjected to colour temperature correction by filters on the camera.

Due to the fact that the majority of prints from colour negative film are produced for the photographer by commercial laboratories, it is recommended that the filtration be left to these laboratories at the time of printing.

In these highly automated plants, electronic evaluators do a far more accurate job of correcting colour imbalance than we could hope to do with a limited range of filters used on the camera and although we can effect our own basic correction at the time of exposing the film, it is not necessary to do so.

Mounting the Filter

An examination of the front of the lens mount will reveal that the rim has an internal thread. This is designed to accept both filters and lens hoods.

The mount of the filter is also threaded at the rear so that it will screw firmly into place on the front of the lens barrel. In turn, the front of the filter mount is also internally threaded like the lens, so that a lens hood may be screwed in place in front of the filter.

As the diameter of these threads varies by fractions of a millimetre for lenses of different speeds (maximum physical diameter), it is essential that you take your lens to the camera store to have the correct filter size determined.

CLOSE-UP PHOTOGRAPHY

We have already seen that each Hanimex lens has a nearest focusing point of several feet distance from the subject, and that this distance becomes greater as the focal length of the lens is longer.

What methods are used to extend the near focusing range so that small objects can be approached from close quarters and rendered in magnifications of up to life size on the film.

There are two basic systems. We can fit close-up lenses (dioptre lenses) to the front of the lens to provide a limited magnification of the image, or we can fit extension tubes or bellows between the lens and camera body for more dramatic effect.

Although an extension bellows is more convenient to focus, due to its rack and pinion drive, it is not possible to equip this accessory with a tripping pin for the lens with automatic diaphragm. Therefore, the fixed tubes, which come in a set of three or four tubes of different length, are the more popular choice, as they permit the inclusion of an automatic diaphragm tripping pin.

Extension tubes may be used individually to obtain image magnifications proportionate to the length of the tube, or they may be screwed together to obtain even greater image magnification.

The shorter the focal length of the lens, the greater the image magnification at a given extension. It is therefore obvious that a wide-angle lens used in conjunction with extension tubes will provide a dramatic magnification of the film image of small objects.

However, the extremely short working distance between subject and lens, necessitated by this combination, has several drawbacks. Firstly, the camera and the operator's head will be so close to the subject that lighting will become a real problem. Secondly, depth of field, even with a wide-angle lens used at small apertures, will be almost intolerably shallow (only a fraction of an inch). Thirdly, such a close viewpoint may not be advisable if the subject is aggressive (e.g., a poisonous spider).

It is generally more convenient to operate from a greater distance by combining the extension tubes with a longer focal length lens.

It should be noted that whilst the near-focusing range of the lens is extended by the use of extension tubes or alternative devices, the lens cannot be focused in its normal range up to infinity.

However, when coupled with a long telephoto lens, such as a Hanimex 400 mm., extension tubes can be handy in extending the nearest focusing distance in terms of feet rather than inches. Such a combination is ideal for nature studies (e.g., photography of small birds), in which the normal near-focusing range of the long lens does not permit a sufficiently close approach.

Exposure Adjustment in Close-Ups

Because extension tubes and bellows extend the lens to film distance, they alter the effective light gathering capacity of the *f*/numbers inscribed on the aperture control of the lens.

The optical rule is that marked *f*/number values apply to subjects which are photographed at a distance at least 10 times the focal length of the lens.

At closer range, the effective value of each aperture is considerably reduced. If the camera is of the type which employs an inbuilt exposure meter which measures through the lens (a so-called "TTL" camera), the necessary adjustment will be calculated automatically.

With cameras not thus equipped, it is necessary to calculate the adjusted exposure, multiplying the *f*/number by N/(N—1), where N is the number of times the object distance is greater than the focal length.

To simplify this by example, if the object is at 12″ distance and a 100 mm. lens is being used (i.e., a 4″ lens), then N equals 3 and the new value of any *f*/number is found in multiplying that *f*/number by 3/(3—1) . . . i.e., *f*/number by 1.5, which means that a lens aperture of *f*/4 would have an effective value of *f*/6 when calculating exposure.

Because a close-up attachment lens, screwed on to the front of the lens in the manner of a filter, does not involve any alteration to the physical lens-to-film distance, some photographers prefer this system, as it eliminates exposure adjustment calculations. The only real drawback is that these attachment lenses do not conveniently permit image magnifications of the same magnitude as do extension tubes.

Dioptre lenses are similar in appearance to filters and have inscribed on their mounts an image magnification factor expressed as +1, +2, +3 and so on.

Hanimex interchangeable lenses at their normal nearest focusing range (i.e., without extension tubes) yield an image size on film which ranges between 1/10th and 1/20th of life size.

As dioptre lenses are not readily obtainable in magnification factors greater than +3, it would be necessary to couple several together (their factors being additive) in order to achieve a 1:1 reproduction ratio on film (a life-sized image).

As these attachment lenses are not highly corrected in terms of optical aberrations, such extensive coupling would result in intolerable degradation of lens definition (image detail) and so the extension tube system is more practicable.

PRACTICAL APPLICATIONS

Having considered the fundamental theories of interchangeable lenses in terms of what each will do and how one compares with the other, we might now investigate the practical applications and methods of using lenses of different focal lengths.

There are certain "tricks of the trade" which it will be useful to learn so that one may extract the optimum performance from each lens in the Hanimex range.

Using the Wide-Angle Lenses

In addition to the more obvious application in encompassing tall objects such as skyscrapers, the problems of which we have already discussed, the wide-angle lenses are often used by candid photographers who are faced with the problem of photographing comparatively large groups of people in confined situations.

In such cases there are two main traps for the uninitiated. The first is that wide-angle lenses tend to make people on the edge of the picture appear a little broader than they are. The skilled operator will arrange his group so that the thinner people are at each end of the group and, in mixed groups, the ladies are placed towards the centre.

Secondly, one must ascertain whether or not the angle of view of a wide-angle lens is within the coverage afforded by flash equipment. The likelihood of insufficient flash coverage (i.e., illumination at the edges of the frame) is an important factor in the use of a 28 mm. lens, although most electronic flash units will afford adequate coverage for a 35 mm. lens.

If it is planned to use a 28 mm. lens for flash photography, equip yourself with a flash unit which provides at least a 75° angle of illumination.

It is also worth repeating that the use of a wide-angle lens calls for a carefully levelled camera angle to avoid unacceptable distortions of the subject's vertical lines.

For reasons previously stated, the wide-angle lens is not ideally suited to landscape photography unless it is desired that a panoramic effect be obtained. Should this be the case, the resultant negative or slide will be seen to best advantage if subjected to a high degree of enlargement on paper or screen, otherwise the finer detail of distant objects will not be seen in sufficiently large dimension to permit comfortable appreciation.

When working under difficult conditions such as in a crowd, where one's view of the subject is not uninterrupted, the wide-angle lens is handy in that its extremely broad view provides some margin for unintended inaccuracy in aiming the camera (e.g., the camera may be held at arm's length and aimed at the subject without close observation in the viewfinder). Of course, this is compromising good technique, but it may mean obtaining a picture where normal methods would be impracticable.

The inclusion of foreground elements of the scene as a means of framing the subject and leading the eye towards the centre of interest in your picture is something which is readily achieved when using wide-angle lenses. However, due to the rapidly diminishing perspective inherent in wide-angle shots, it is important to exercise caution so that the relative sizes of framing elements and the principal subject do not detract from the subject's stature and importance in the overall scene.

Medium Tele Lenses for Portraits

Not only do the medium focal length telephoto lenses provide a most pleasing perspective rendition of facial features in portraiture, but many people are chronically camera conscious and cannot be photographed with a natural expression unless taken unaware of the camera.

The 135 mm. to 200 mm. range of Hanimex lenses is therefore the ideal choice for taking informal portraits (sometimes called "candids") from a discreet distance. With a 200 mm. lens, for instance, a head and shoulders portrait will fill the picture frame from a distance of 12 feet or so.

Using lenses of medium telephoto proportions, additional care must be taken with focusing the image on the viewfinder groundglass. The correct practice is to focus on the black periphery of the iris of the subject's eye nearest the camera. As depth of field is shallow, it is common for the rear of the subject's head to be a little soft in focus, but this will be found quite acceptable if the eyes are sharply defined.

If close portraits are made with short focal length lenses (i.e., the standard or the wide-angle lenses) it will be found that the tip of the subject's nose is often rendered out of focus in addition to being grossly distorted in relative size. If the face is viewed at a 45° angle to the optical axis of the camera, it will also be found that the image size of the nearest eye is noticeably greater than that of the other eye which is slightly further away from the lens.

The fact that medium telephoto lenses focused at close range deliver a greatly softened image of the background is to be considered a distinct advantage in portraiture, for the most compelling portraits are those in which the subject is sharply rendered against an out of focus background.

Indeed, expert photographers invariably work towards this end in order to isolate the subject and concentrate our attention on it. Often they will purposely select a large diameter of the lens aperture with the purpose of compressing depth of field . . . this technique is called selective focusing or differential focusing and it gives the picture a strong optical illusion of third dimension.

Sports Action

There are few of us who can resist the lure of sports action photography and the medium telephoto lenses are also ideal for this type of work under many circumstances.

Of course, much depends on just how closely we may approach the subject and whether or not a close viewpoint will endanger the photographer, the subject, or both.

The several forms of motor sport (in which we might include such *water* sports as motor boat races and even water skiing) can be efficiently recorded with a 180 mm. or 200 mm. Hanimex lens from moderate distances. As a rough guide to this it is interesting to note that a 200 mm. lens will not cover the full height of an average man at distances closer than 40 feet or so.

For the best rendition of speeding vehicles, experienced photographers use a special technique known as "panning." We know that a very fast shutter speed is necessary to freeze the action of a moving object and if we do arrest the action satisfactorily, the result is often no more exciting than a picture taken when the subject is stationary. Thus, frozen action is generally undesirable for it loses the essential element of motion.

On the other hand, if the camera is also in motion parallel to the direction of travel of the subject and moving at the same speed, we have a condition similar to that which prevails when both camera and subject are stationary. In this condition of duplicated motion, it *might* be said that the only thing moving is the background.

Therefore, the technique for subjects moving rapidly across the field of view is to swing one's body in an arc so that the camera moves parallel to the subject, and the image of the subject is held in the viewfinder at a constant position. The shutter is then released very smoothly (resisting the temptation to press it rapidly) and the camera is carried through to the end of your body swing just as one "follows through" in a good golfing shot.

The result should be a clearly defined subject against a blurred background, giving the impression of speed and action. This technique allows the photographer to capture dramatic sports action studies with a quite moderate shutter speed (1/250th second will suffice) and this permits the use of a smaller lens aperture to compensate for the inability to focus precisely.

One of the most difficult types of sport for the photographer is the one which involves "roving" action in which the lens-to-subject distance is changing rapidly, constantly and often unpredictably. Such games as football, polo, and hockey, would fall into this category. Whereas track racing of athletes, horses and cars provides a predictable plane of focus in that the contestants must follow a prescribed path, roving games have motion both across the field of view and to and from the camera. Because of the very broad area in which the motion is taking place, the shorter focal length telephoto lenses are probably the best choice. These give a reasonably magnified image of the subject from a moderate distance and yet their angle of view is still sufficiently wide to permit comfortable manoeuvring.

The really long telephoto lenses may seem the logical choice for photographing human figures from the spectator area, but their angle of view is so narrow that it is often difficult to keep the players in the viewfinder. A good compromise is the lens of variable focal length which is known as a *zoom* lens. Even with this lens, it is necessary to constantly adjust the focusing of the lens when photographing roving sports action.

At all times it is sound practice to keep an eye on the background, ensuring that it is sympathetic to the subject and that it does not introduce unpleasant distractions. For sports action shots, an overall pattern of spectators, thrown out of focus, lends desirable atmosphere to the scene.

Zoo Photography

Most photographers will, at one time or another, take their cameras to a zoo and photography under these circumstances can be quite frustrating if one has to contend with unsightly cages of chain wire and piping.

Again the medium telephoto lenses are probably the best choice, as they permit some degree of isolation of the subject as well as bridging the average camera-to-subject gap which exists in the typical zoo.

If one is obliged to photograph *through* the wire of an enclosure, one should not be deterred. When the lens is pressed close to the wire, or even poked through an opening in the mesh, the foreground will be so much out of focus that a discernible image will not register on film.

At the same time, by careful application of the depth of field scale on the lens, it will often be possible to throw the background so far out of focus that the pattern of chain wire will merge into an unobtrusive blur. This is achieved, naturally enough, by working at a large aperture of the lens (i.e., smaller *f*/numbers). With a little practice and care, it is possible to make zoo portraits of the animals so that they appear to have been captured in their wild state. Of course, much depends on just how much artificiality exists in the zoo setting.

Animals in the Wild State

The opportunity which we have to photograph animals and birds in their natural wild state depends very much on individual circumstance. However, even the city dweller will find the *minor* forms of wild life in his own garden . . . such things as butterflies, spiders, caterpillars and the less timid species of birds.

The smaller creatures which do not venture far from their established "quarters" will generally be subjected to close-up shots using extension rings on the camera, whilst the birds which enter domestic gardens can be satisfactorily recorded with a medium telephoto lens. In this latter case, it is worthwhile establishing an artificial *feeding station* in the form of a stout post on top of which is a platform carrying seed, breadcrumbs and water. Above the platform, a small branch can be added so that the birds alight on this before hopping down to the platform. Whilst on the branch, they are ideally situated for telephoto portraits with a natural atmosphere.

The camera with, say, a 200 mm. or 300 mm. Hanimex lens can be situated inside the house, at an open window, so that the photographer can work unseen by the timid subjects. With this fixed "set-up," the lens can be kept pre-focused on the branch so that no time is lost when picture opportunities arise.

One small tip . . . change the branch at regular intervals so that bird droppings do not appear in the picture to give away your little trick.

In the countryside, two methods of approach are commonly used. One is for photographers who have time and patience to set up a "hide" from which the creatures may be observed and photographed discreetly. The hide takes the form of a hessian screen supported by four lightweight posts and often camouflaged with foliage. After being introduced in moderate proximity to a nest or watering place, the hide is moved a little closer each day until it is within sufficiently close range and the intended subject has become used to its presence.

The photographer then commences his vigil inside the hide until the subject appears on the scene. He is then able to make his photographs by aiming the camera through small cut-outs in the hessian screen.

Depending on the subject's size and the camera-to-subject distance obtained by this approach, it may be possible to use a relatively short focal length lens with its attendant advantages in terms of depth of field.

With timid subjects, even the hide approach may necessitate the use of a long telephoto lens mounted on a rigid tripod inside the photographer's enclosure.

The alternative approach is that of stalking the quarry . . . a method to which many must resort for reasons of time restrictions. This "hit and miss" approach results in a high percentage of failures, but it *can* be successful. A long telephoto lens is essential because greater camera-to-subject distances will prevail. This means that a tripod will seldom be practicable and the use of some form of shoulder brace for mounting the camera is strongly recommended. A support fashioned on a rifle stock is ideal and this should be combined with the use of other bracing elements such as one may find in the location (e.g., fences, tree trunks, rocks).

CARING FOR YOUR LENSES

It would be fair to say that the lens is the heart of the camera, for unless the lens is maintained in first class condition, its full potential cannot be attained.

Lenses are subject to several common dangers, and the extra care which is recommended here will ensure a long, active life for your investment:

(1) Dust, grit and sand are enemies of all optical equipment. Special care should be taken to protect your lenses from sand at the beach, grit borne on the wind, and dust which settles on unprotected surfaces. Get into the habit of fitting the protective caps on your lenses as soon as you finish shooting.

(2) When cleaning lens surfaces, first remove foreign deposits with an air blower or a soft brush swept very lightly across the glass . . . only then, when grit has been carefully lifted, should you apply a cleaning cloth or tissue.

(3) Cleaning cloths impregnated with silicone are *not* recommended, as they may leave a greasy deposit on the glass. The safest method is to breathe on the glass and then wipe gently with a lens cleaning tissue or a soft handkerchief.

(4) Beware of condensation. Lenses should be stored in a cool, dry place, away from dampness. If condensation forms on the lens when it is brought into a warmer temperature, allow this to evaporate or wipe carefully with a clean, soft cloth.

(5) Avoid excessive heat in storage. The worst place in your car is the glovebox.

(6) Avoid shocks, such as dropping, which may dislodge the careful spacing of the glass elements and upset the focusing. Here again, the lens cap is a safeguard, as it also protects the thread which holds filters on the lens. If you drop a lens, it is strongly recommended that it be immediately inspected by an expert technician.

(7) Watch for fungus growths which may appear in the form of a fine pattern resembling a spider's web on the glass surfaces. This growth is quite common in areas where high humidity prevails and it is both difficult and expensive to have removed. The major preventative measure is to air the lens regularly in sunlight. It is also wise, at the same time, to operate the iris diaphragm of the lens at regular intervals so that the fine lubricants are kept from drying out.

(8) Finally, never attempt to effect a home repair job on your lenses. Leave the job to a skilled technician.

Despite the necessity for these precautions, a lens is not so delicate that it cannot withstand heavy duty.

When examining a lens, do not be discouraged by the occasional air bubble which might be seen in the glass. This will not affect the performance and is, in fact, a sign of good quality glass.

TABLE OF SPECIFICATIONS FOR HANIMEX LENSES

HANIMEX PRESET DIAPHRAGM LENSES

Lens	Number of Elements	Aperture Range	Min. Focus Distance	Angle of Coverage	Weight	Filter Thread Size
28 mm f2.8 Hanimex	7	f2.8-f16	18 ins	74°	10 ozs	58 mm
35 mm f2.8 Hanimex	6	f2.8-f16	2 ft	64°	8¼ ozs	49 mm
35 mm f3.5 Hanimex	6	f3.5-f22	7 ft	64°	7½ ozs	52 mm
135 mm f3.5 Hanimex	4	f3.5-f22	6 ft	18°	14 ozs	49 mm
135 mm f2.8 Hanimex	5	f2.8-f16	6 ft	18°	14 ozs	55 mm
200 mm f4.5 Hanimex	4	f4.5-f22	10 ft	12°	19 ozs	55 mm
300 mm f5.5 Hanimex	4	f5.5-f32	25 ft	8°	25 ozs	62 mm
400 mm f6.3 Hanimex	3	f6.3-f32	30 ft	6°	32 ozs	72 mm
600 mm f8 Hanimex	3	f8 -f32	32 ft	4°	5¾ lbs	90 mm
90-230 mm f4.5 Zoom	11	f4.5-f22	8 ft	27-10°	29 ozs	58 mm

Hanimex Preset diaphragm Lenses have interchangeable non-automatic adaptor mounts to fit all of the following camera mounts: Praktica/Pentax/Edixa/Yashica/Mamiya/Ricoh universal thread, Exakta, Minolta, Miranda, Nikon, Leica, Konica, Petriflex and Canon.

TABLE OF SPECIFICATIONS FOR HANIMEX LENSES

HANIMEX AUTOMATIC DIAPHRAGM LENSES

Lens	Number of Elements	Aperture Range	Min. Focus Distance	Angle of Coverage	Weight	Filter Thread Size
21 mm f3.8 Hanimex	9	f3.8-f16	1.1 ft	92°	10.75 ozs	72 mm
28 mm f2.8 Hanimex	7	f2.8-f16	18 ins	74°	9 ozs	58 mm
35 mm f2.8 Hanimex	6	f2.8-f16	2 ft	64°	8 ozs	49 mm
135 mm f3.5 Hanimex	4	f3.5-f22	6 ft	18°	15 ozs	49 mm
135 mm f2.8 Hanimex	5	f2.8-f16	6 ft	18°	16 ozs	55 mm
200 mm f3.5 Hanimex	5	f3.5-f22	10 ft	12°	22 ozs	62 mm
300 mm f5.5 Hanimex	5	f5.5-f22	18 ft	8°	30.5 ozs	62 mm
400 mm f6.3 Hanimex	4	f6.3-f22	25 ft	6°	35 ozs	72 mm
90-230 mm f4.5 Zoom	11	f4.5-f22	8 ft	27-10°	30 ozs	58 mm

Hanimex Automatic diaphragm Lenses have a fixed automatic adaptor mount to fit the following cameras: Praktica/Pentax/Edixa and Yashica, etc.

TABLE OF SPECIFICATIONS FOR HANIMAR LENSES

HANIMAR PRESET DIAPHRAGM LENSES

Lens	Number of Elements	Aperture Range	Min. Focus Distance	Angle of Coverage	Weight	Filter Thread Size
35 mm f3.5	6	f3.5-f22	3 ft	64°	7½ ozs	52 mm
135 mm f3.5	4	f3.5-f22	7 ft	18°	11 ozs	49 mm
135 mm f2.8	4	f2.8-f22	7 ft	18°	12 ozs	52 mm
200 mm f4.5	4	f4.5-f22	11 ft	12°	16½ ozs	52 mm

Hanimar Preset Lenses have 'T' mount adaptors available in the following fittings: Praktica/Pentax, Nikon, Minolta and Canon.

TABLE OF SPECIFICATIONS FOR HANIMAR LENSES

HANIMAR AUTOMATIC DIAPHRAGM LENSES

Lens	Number of Elements	Aperture Range	Min. Focus Distance	Angle of Coverage	Weight	Filter Thread Size
28 mm f2.8	7	f2.8-f22	1½ ft	75°	9½ ozs	58 mm
35 mm f2.8	6	f2.8-f22	1.8 ft	62°	8¾ ozs	
135 mm f2.8	5	f2.8-f22	6 ft	18°	17½ ozs	55 mm
200 mm f3.5	5	f3.5-f22	8 ft	12°	27½ ozs	62 mm

Hanimar Automatic Lenses are available in Praktica/Pentax fitting only.

EXPOSURE INDEX (FILM SPEED) COMPARISONS

A.S.A.	10	12	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	800
D.I.N.	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	30

The equivalent values shown here, whilst approximate in theory, are accurate in practical application. Systems such as Scheiner and H. & D. have fallen into disuse, whilst the Weston system has been brought into line with A.S.A. For earlier Weston ratings, read one number lower than A.S.A. scale above. (Thus 125 A.S.A. is approximately equivalent to 100 Weston discontinued system.)

DISTANCE CONVERSION TABLE—FEET TO METRES

Feet/inches	*to Metric units*	*Metric units*	*to Feet/inches*
$\frac{1}{8}$ in	0.32 cm	0.5 cm	$\frac{3}{16}$ in
$\frac{1}{4}$ in	0.64 cm	1 cm	$\frac{3}{8}$ in
$\frac{1}{2}$ in	1.27 cm	2 cm	$\frac{13}{16}$ in
1 in	2.54 cm	3 cm	$1\frac{3}{16}$ in
2 in	5.08 cm	4 cm	$1\frac{9}{16}$ in
3 in	7.62 cm	5 cm	$1\frac{15}{16}$ in
4 in	10.2 cm	6 cm	$2\frac{3}{8}$ in
5 in	12.7 cm	7 cm	$2\frac{3}{4}$ in
6 in	15.2 cm	8 cm	$3\frac{1}{8}$ in
7 in	17.8 cm	9 cm	$3\frac{1}{2}$ in
8 in	20.3 cm	10 cm	$3\frac{15}{16}$ in
9 in	22.9 cm	12 cm	$4\frac{3}{4}$ in
10 in	25.4 cm	15 cm	$5\frac{7}{8}$ in
11 in	27.9 cm	20 cm	$7\frac{7}{8}$ in
1 ft	30.5 cm	25 cm	$9\frac{13}{16}$ in
2 ft	61.0 cm	30 cm	$11\frac{3}{4}$ in
3 ft	91.4 cm	40 cm	$15\frac{3}{4}$ in
4 ft	1.22 m	50 cm	$19\frac{3}{4}$ in
5 ft	1.52 m	60 cm	$23\frac{5}{8}$ in
6 ft	1.83 m	80 cm	$31\frac{1}{2}$ in
7 ft	2.13 m	100 cm	$39\frac{1}{2}$ in
8 ft	2.44 m	1.5 m	4 ft 11 in
9 ft	2.74 m	2 m	6 ft 7 in
10 ft	3.05 m	2.5 m	8 ft 3 in
15 ft	4.57 m	3 m	9 ft 10 in
20 ft	6.10 m	4 m	13 ft 2 in
30 ft	9.14 m	5 m	16 ft 5 in
40 ft	12.20 m	10 m	33 ft 0 in
50 ft	15.24 m	15 m	49 ft 2 in
100 ft	30.48 m	20 m	66 ft 0. in