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Celestron

Multipurpose Telephotos

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INSIDE FRONT COVER: Macaw at 30 feet. Photographed by Thomas J. Johnson with the Celestron 1250mm, f/10 Multipurpose Telephoto Lens. **INSIDE BACK COVER:** Statue of Liberty at 3 miles. Photographed with the 1250mm, f/10 also, by Robert T. Little.

The Telephoto Lens

A telephoto lens is a camera lens that has a focal length longer than that of ordinary camera lenses. Most 35mm cameras come equipped with lenses of focal lengths from 50 to 58 millimeters. Such lenses produce the customarily small images on film that we are all familiar with: a bird at 50 feet shows up as no larger than a speck of dust – if at all.

Telephoto lenses, on the other hand, have focal lengths ranging up to 1,000mm or more. With such a lens a bird at 50 feet shows up on film so large that it practically fills an entire 35mm slide. This is the basic advantage of the telephoto lens: the telephotographer is capable of ultra-close-up and frequently dramatic portraits of nearly anything at a distance.

The telephoto lens is the lens of choice for the nature, industrial, sports or news photographer when the action is distant or inaccessible and the subject must be captured in detail. But the telephoto lens is becoming a lens of increasing interest to the casual photographer as well. For the telephoto lens can do things no other camera optic can do with a distant subject.

The telephoto lens is capable of long-distance candids or portraits with a minimum of facial distortion. The telephoto lens is also capable of extremely selective focus, because of its shallow depth of field, and it is capable of eliminating distracting elements from a picture, because of its narrow angular coverage. The telephoto lens is inherently capable of artistic effects, such as the extreme compression of line-of-sight distances.

The Celestron System

Another name for the telephoto lens is the "long lens." The name derives from the fact that telephotos have long focal lengths. Unfortunately, traditional optical design means that with a long focal length comes a long lens housing. Thus, all too often, telephotos live up to their nickname literally and burden the photographer with excessive tube weight, tube length and operational difficulties.

Not so with Celestron Telephoto lenses – a different breed of "cat." Compound-catadioptric, that is. The two models offered are very long on focal length indeed: a 750mm, f/6 and a 1250mm, f/10. But both are very short on weight and bulk: neither weighs quite four pounds or exceeds 11 inches in length. They offer the easy handling of lenses only a fraction their focal length. And more besides – like continuous focusing from infinity to just 15 feet, and some of the highest quality optics available anywhere in the world today.

The Celestron system features the Schmidt-Cassegrain optical system –

"The two models offered are very long on focal length indeed: a 750mm, f/6 and a 1250mm, f/10. But both are very short on weight and bulk: neither weighs quite four pounds or exceeds 11 inches in length."

the Cadillac of the modern optical systems that combine mirrors and lenses to fold a long optical path into a compact parcel and simultaneously produce the sharpest possible images over the widest flat field. (See the optical diagram of the Celestron system.) But there is more to the Celestron Telephoto system than compact portability and optical excellence. There is also an extensive line of photographic and visual accessories – the most extensive such line ever offered for a telephoto lens.

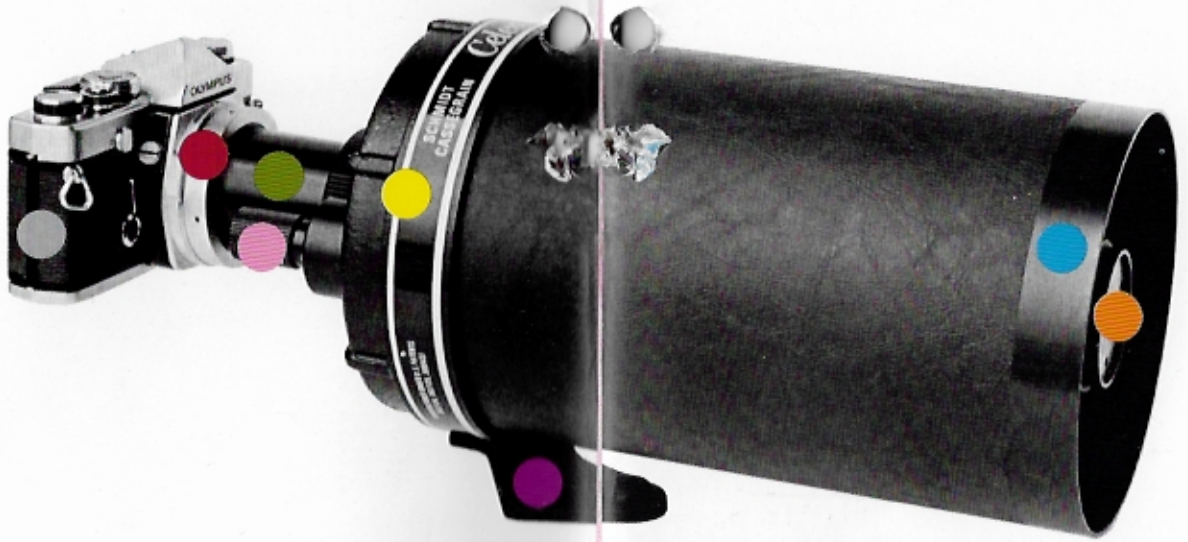
As a result, the Celestron Telephoto is a telephoto that's a telescope and a telescope that's a telephoto. It not only lets you photograph the antennae of a butterfly at 100 feet – at a multitude of magnifications – it also lets you *observe* the antennae of a butterfly at 100 feet – at a multitude of magnifications. It not only lets you photograph a moonrise over distant peaks, it also lets you observe the craters on the moon – and much more in the sky besides, including the rings of Saturn, the belts of Jupiter, and distant nebulae.

The 750mm and the 1250mm

Except for optics, the two models of the Celestron Telephoto are virtually identical. (See lens specifications.) However, the T-Mount Camera Adaptor for the 750mm is shorter, and we should point out that it is not interchangeable with that for the 1250mm. (For identification of this and other parts of the Celestron Tele-

The Celestron Multipurpose Telephoto

(1250mm, f/10 model shown here. Weight: 4 pounds. Length: 11 inches.)



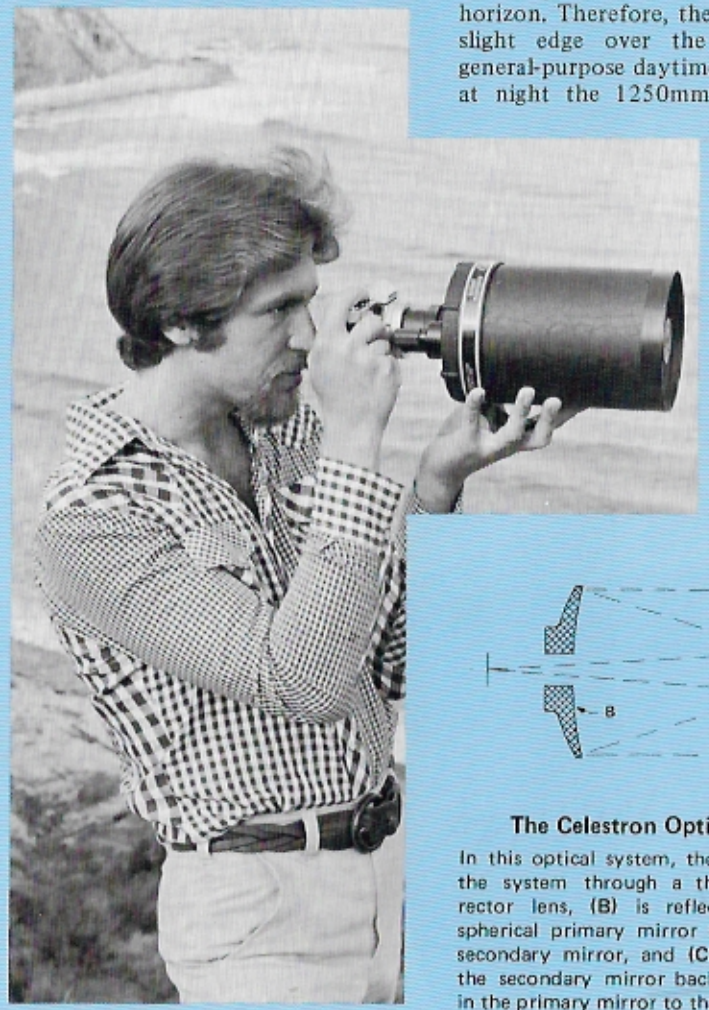
photo, see the table of contents.)

While the two Celestron Telephotos are the same type of lens and while, basically, each is good for the same kind of photography or visual use, the differences in optical specifications between the two lenses tend to make each lens especially suitable for particular tasks.

For example, the 750mm, f/6 is very "fast" for a mirror-lens tele, making it especially suitable for focusing and shooting in dim-light situations. And the focal length of the optics make hand-holding this lens eminently practical. Also, compared to the 1250mm, the 750mm has a closer near-focus distance and a wider photographic and visual field.

The low f/number and the wide field of the 750mm make it particularly well-suited for certain types of visual observing whenever a very bright image and wide field of view are required.

On the other hand, the 1250mm, f/10 is a moderately fast lens of very high visual and photographic power. It is excellent for extreme close-ups, especially in typical daylight – whether the subject is at 20 feet or on the horizon. Therefore, the 1250mm has a slight edge over the 750mm as a general-purpose daytime telescope, and at night the 1250mm is superior in revealing the details of the moon, planets, nebulae and clusters of stars.



The Celestron Optical System

In this optical system, the light (A) enters the system through a thin aspheric corrector lens, (B) is reflected by a large spherical primary mirror toward a convex secondary mirror, and (C) is reflected by the secondary mirror back through a hole in the primary mirror to the focal plane.

Mounting Your Camera

Virtually any 35mm-single-lens-reflex camera with a removable lens and a focal-plane shutter can be coupled to the Celestron Telephoto in seconds. Cameras with larger formats can also be coupled to this lens using special custom adaptors fabricated at your local machine shop. For 16mm motion-picture photography, our T-to-C Movie Camera Adaptor is required. (See the section on shooting movies.)

To couple your 35mm SLR to our lens, remove the lens of your camera and attach the camera body to the T-Mount Camera Adaptor using the T-Ring for your specific camera. (Camera rings for most cameras are available from us; see our price list.) The camera ring attaches to your camera just like your normal lenses and threads onto the T-Mount Adaptor.

Next, thread the T-Mount Adaptor over the rear-cell recess of the telephoto. You can position your camera body at the desired angle by loosening the knurled collar at the rear cell of the lens and rotating the entire camera body. Be sure to re-tighten the collar snugly.

Mounting the Lens

While it is possible, with practice, to produce crisp photographs by hand-holding your lens, it is best to provide a sturdy support while shooting. Telephoto lenses not only magnify the subject, they also magnify any wavering of the lens during the exposure.

Ideally, your lens should be mounted on a heavy-duty photographic tripod *via* the lens' ¼-20 Tripod Adaptor Block, but for greater mobility you can use a monopod or a shoulder stock.

CAUTION: If you have occasion to remove the Tripod Adaptor Block, it is best to re-cover the holes with tape. If you re-thread the screws more than 2½ turns, without the Tripod Block in place, they will protrude too far into the lens housing and could damage the optics.

Focusing

The focus control for your lens is located at the back casting. Turning the knob moves the primary mirror with respect to the secondary mirror and focuses the subject. You focus closer by turning the knob clockwise and focus farther away by turning the knob counter-clockwise.

Since a telephoto lens has less depth of field than a normal lens, it is important that such a lens offer precision focusing – especially if the lens is fast and you focus and shoot at the same aperture. The micrometer focusing screw of the Celestron Telephoto advances the primary mirror a very short distance with each

Mounting Your Camera

Virtually any 35mm SLR camera body (A) can be coupled to the Celestron Telephoto in seconds with the T-Mount Camera Adaptor (C) and a T-Camera Ring (B) for your camera.

turn of the focus knob, thus providing extremely sensitive control over focus.

In some instances, rapid shifts in focus may be required – as when you are shooting a fast break on the basketball court or photographing a particularly fidgety bird. The generous size of your focus knob will enable you to make most such shifts readily.

(In using your lens as a telescope, you might notice that the image shifts slightly when you are focusing at extremely high power. At about 200 power, for example, the shift might be as much as one-third the field. This is normal for the focusing mechanism of this lens.)

Finding the Exposure

The Celestron Telephoto Lens is a fixed-aperture system. With the 750mm you will be shooting at f/6 and with the 1250mm you will be shooting at f/10 – unless you use our Tele-Extender or a similar device, in which case your f/number will be higher. (See the section on increasing photographic magnification.)

Since the aperture of your lens is fixed, you control the exposure by varying the shutter speed of your camera. If you own an incident light meter or if your camera has a built-in, through-the-lens light meter, you can use the meter to determine your shutter speed.

If you use an incident light meter, the lighting of your subject should be the same or nearly the same as the lighting where you are. Assuming that the lighting is the same, you can set your meter for the aperture of your lens, take a reading of the unprotected sun rays at your shooting position and adjust your shutter speed to what the meter calls for. (A setting of f/11 for the 1250mm or f/5.6 for the 750mm will be close enough.)

If you use your camera's light meter, consult your manual for instructions on "stopped-down metering" or metering with a manual-diaphragm lens on your camera.

If a light meter isn't available, you can rely on the following rule-of-thumb: in typical daylight, using a film of a given ASA rating, your shutter speed at f/16 will be the inverse of your film's ASA rating. In other words, if your film is rated ASA 64, then in typical daylight, at f/16, your shutter speed will be 1/64th of a second – or 1/60th of a second, since that's the closest increment on your shutter ring.

This is a handy rule, because if you know what your shutter speed is at f/16, you can figure out what it is at f/11 or f/5.6 – simply by applying the fact that opening up one aperture stop is equivalent to slowing down your shutter speed one increment. Then we can keep the exposure constant if every time we open one stop we take one step up in shutter speed. This means that if 1/60th sec. is right for f/16, then 1/125th sec. is right for f/11 and 1/250th sec. is right for f/8, and so on.

Of course, this rule-of-thumb is just a guideline. But then, more often than not, what your light meter tells you is just a guideline too. If you want to be sure of getting your shot, the best thing to do is bracket your exposure with shutter speeds both faster and slower than that indicated by either your light meter or rule-of-thumb. Then, with practice, experience will tell you which shutter speeds (and films) are best for your subjects.

Hints for Shooting

In the back of this booklet, under "Recommended Reading," we have listed several excellent works on photography. Most of them contain hints on telephotography; a few deal exclusively with the subject.

However, there are a few hints on shooting with a long lens that are important enough for us to emphasize:

- Avoid sighting or shooting through mist, fog, haze or heat waves. No telescope or telephoto can cut through these obstructions.
- Aiming a powerful telephoto lens requires practice. Be patient. Try keeping both eyes open – looking through the viewfinder and past the camera at the same time – and you'll soon learn to bring both fields into congruity.
- Whenever possible, use a cable release and the mirror-lockup feature of your camera. This, with high shutter speeds and a sturdily mounted lens, will contribute to sharp images.

Filter Photography

For telephotography under typical daylight conditions, it is sometimes advisable to use photographic filters to increase the contrast between subject and background, to gain a more natural rendition of colors and so forth. The Celestron Series VI Drop-In Filter Set is designed to permit such flexibility in making exposures.

This filter set consists of six ring-mounted, optical glass filters. These fit into the rear-cell recess at the back of your lens, ahead of the T-Mount Adaptor, and are held in place by the adaptor when it is threaded onto the lens. The six filters in this set include a #1A, #8, #11, #25, #80A and #96.

The #1A is a "Skylight" filter, designed primarily for color work. It is salmon-pink in color and reduces the bluishness of shaded, overcast, distant or aerial scenes. No exposure compensation is required.

The #8 is a yellow filter for black-and-white work. It gives a good gray scale for natural clouds, sunsets, marine scenes, foliage and portraits against the sky. Increase your exposure time by a factor of 2.

The #11 is a yellowish-green filter, for black-and-white work also. It lightens flowers and foliage, enhancing their texture in sunlight. It also darkens the sky background for portraits against the sky while generally yielding the most natural skin-tone rendition with panchromatic B&W films. Increase exposure time by a factor of 4.

The #25, another filter for black-and-white work, is a red filter that produces spectacular cloud pictures, reduces haze in shots of distant landscapes and dramatically emphasizes the texture of wood, stone, sand and snow. Increase exposure time by a factor of 8.

The #80A is a blue filter for color conversion. You can use it to expose daylight-type films to incandescent or photoflood lighting (3200°K) indoors or out, avoiding the overall reddish cast that results without some such filtration. For daylight photography, it produces interesting effects by emphasizing atmospheric haze and fog. Increase exposure time by a factor of 4.

The #96 is a neutral-density filter for black-and-white or color work. Use it when you need to reduce exposures – for example, when you're shooting a brilliant subject with a high-speed film, or when you want to

Filter Photography

The Celestron Series VI Drop-In Filter Set offers the telephotographer greater flexibility in making exposures. The filters nestle snugly in the rear-cell recess of the Celestron Telephoto.

decrease shutter speed to pan with a moving subject and produce a blurred background. Increase exposure time by a factor of 2½.

At times you'll find that filter photography is not only advisable but essential to presenting the subject at all; for example, shooting an aircraft or a flock of birds crossing the solar disk. Such shots are spectacular, but without proper filtration they are hazardous to your vision and to your photographic equipment.

You should NEVER attempt to view or photograph the sun through ANY optical equipment without the proper solar filter – even when the sun is only moderately elevated above the horizon. The Celestron Solar Filter provides the protection required for photography with the solar disk as a background.

The Celestron Solar Filter, which may be used for viewing also, is designed to press-fit snugly over the front cell of your lens. Basically, the filter is an optically flat window coated with Inconel®, a neutral-density substrate that reduces the intensity of the sun's rays to 1/100th of 1% at all wavelengths.

The Celestron Solar Filter is available as a full-aperture, 5-inch model or as a stopped-down, 2-inch model. Either permits solar-disk photography or observation of such subjects as sunspots, but the stopped-down model compromises resolution somewhat and also reduces your effective f-value to f/15 or f/25.

Increasing Photographic Power

With our lenses attached to your camera, the photographic magnification of our 750mm is 15X, while that of the 1250mm is 25X (taking 50mm of focal length as equal to 1X.) While this is as much power as you're likely to need for most shooting situations, there may be times when even greater focal lengths are desirable. This may be accomplished in two ways, but please bear in mind that an increase in subject size also results in an increase to the effects of shutter vibration, atmospheric turbulence, haze, and wind on the sharpness of your pictures. Too, as the focal length increases, the lens' numerical f/ratio increases in the same proportion, so slower shutter speeds or faster, grainier films are necessary. Therefore, extended focal lengths are recommended only when no other alternative, such as closer approach to your subject, is possible.

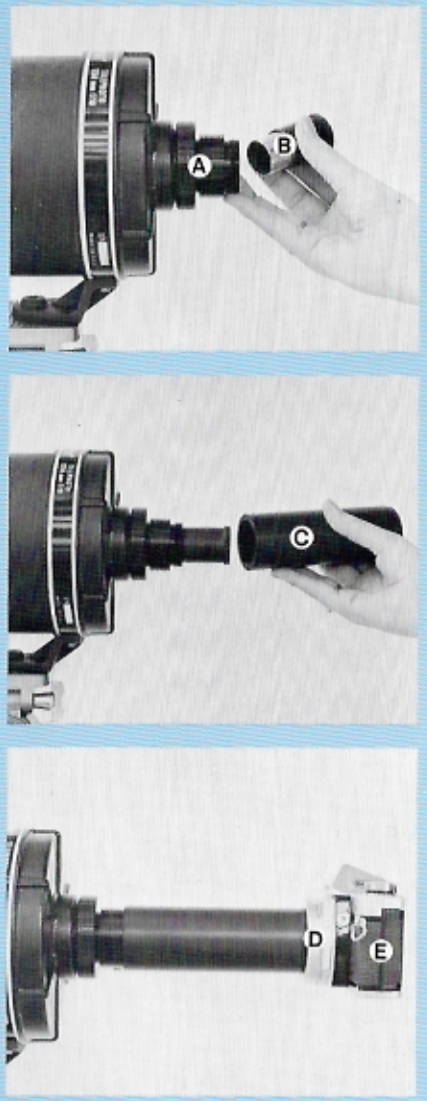
The Photographic Tele-Converter

Not to be confused with the Celestron Tele-Extender (discussed in the following section) the tele-converter is a device available at virtually any complete photo retail store. Its function is what its name suggests: conversion of a normal camera lens into a telephoto (or of a telephoto into a yet more powerful optic). The device is typically two inches or so in length and fits between camera lens and body. The most common powers available are 2X and 3X, though several suppliers offer intermediate ratios, and even a few "zoom" models.

A tele-converter is an easy and inexpensive method of achieving modest increases in focal length with our lenses. With a 2X unit, for example, our 1250mm lens becomes effectively a 2500mm optic. We can't vouch for the performance of specific brands among the proliferation of tele-converter suppliers, but commonly accepted brands include Komura, Vivitar, Soligor, and Spiratone. For optical reasons, these devices generally work best with lenses of relatively high f-value, so it's fairly safe to predict, should you already own one, that it will perform satisfactorily with our telephotos, if it works well with your much faster ordinary camera lenses.

The Celestron Tele-Extender

In rare cases, it may be desirable to increase the magnification of our lenses by extreme factors. For example, the photographic monitoring of destructive or non-destructive testing and the monitoring of hazardous manufacturing processes sometimes require ultra-close inspection, as do specialized forms of nature photography. In such instances, magnifications of up to several hundred times may be required.



Mounting the Tele-Extender

The Celestron Tele-Extender System permits ultra-high-power stills at magnifications of up to 1,015X. (See reference tables.) The system consists of a Visual Back (A), a given ocular (B), a Tele-Extender tube (C), and a T-Camera Ring (D) to attach your 35mm camera body (E).

To meet these needs, we offer the Tele-Extender, a tube that lets you space back your camera body so you can project a highly magnified image to the film plane using one of our oculars (eyepieces). The Tele-Extender permits photographic magnifications of up to 600X with the 750mm lens and up to 1,000X with the 1250mm lens.

The Tele-Extender tube attaches to your lens *via* our Visual Back. (See "Your Lens as a Scope.") The Visual Back threads onto the lens in the same way as the T-Mount Camera Adaptor, an ocular is placed into the Visual Back and the Tele-Extender tube threads over the ocular onto the Visual Back. Your camera body is attached to the other end of the Tele-Extender with your camera T-Ring.

The range of tele-extension powers available with our Tele-Extender and oculars is given under "Reference Tables." Corresponding f/values and picture angles are given as well.

Shooting Movies

Motion-picture photography with a telephoto lens is one of the most exciting forms of photography there is. The results frequently have the aesthetic impact of true art – as revealed, for example, in the work of Enzo Martinelli, who relies on the Celestron 1250mm for his long-lens shots in the TV series "The Six Million Dollar Man."

However, making movies through a long lens is a more exacting avocation than taking stills through a long lens.

For example, almost any 16mm reflex camera with removable lens can be coupled to the Celestron Telephoto using our T-to-C Movie Camera Adapt-

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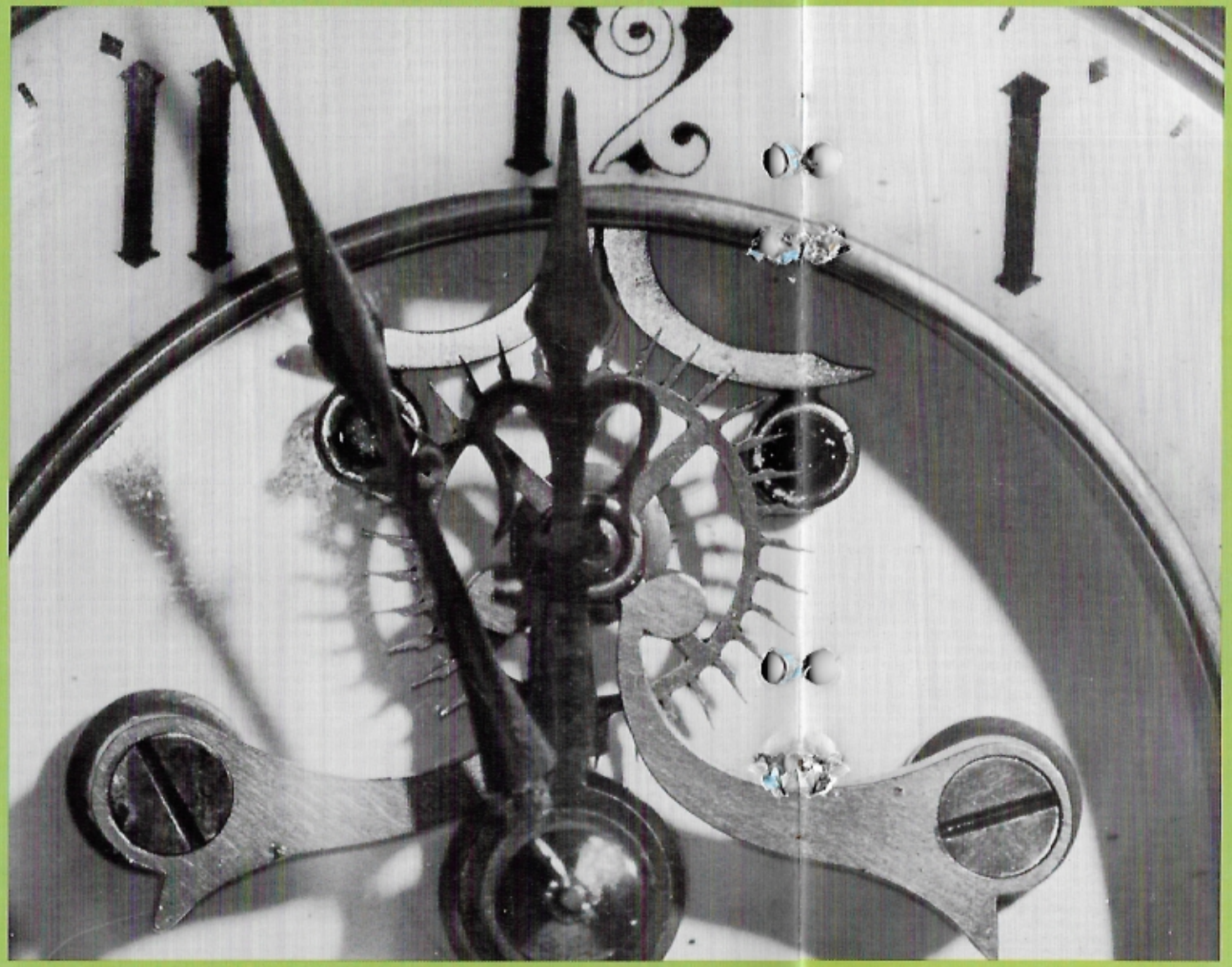


Close-Up Time

When it's close-up time, few lenses can out-perform the Celestron Multipurpose Telephoto.

Here, the 1250mm, f/10 reveals the intricate detail of a clock on a mantel 20 feet away.

For this shot, the camera body was attached to the lens using the Celestron Tele-Extender tube (without ocular). Magnification: 40X.

The smaller photo at the side is a comparison shot made from the same distance with an ordinary 58mm lens.

Both photos are printed to the same scale, and the high-power view is a full-frame print of a 35mm negative.

Photos by Arnie Rosner

Squirrel at 75 feet.
Photographed by
Edwin Hirsch with the
Celestron 1250mm, f/10
Telephoto.

Rose at 15 feet.
Photographed by
Leo C. Henzl, Jr. with
the Celestron 750mm, f/6
Telephoto.

Un-Ordinary Visions

Through the Celestron Multipurpose Telephoto, even the most ordinary subjects are transformed, suddenly and magically, into the most un-ordinary subjects.

Here, an ordinary black cat, deep in shadow 25 feet away, peers back at the Celestron 1250mm lens, and suddenly becomes the personification of all cats everywhere down through the ages.

Photo by Arnie Rosner

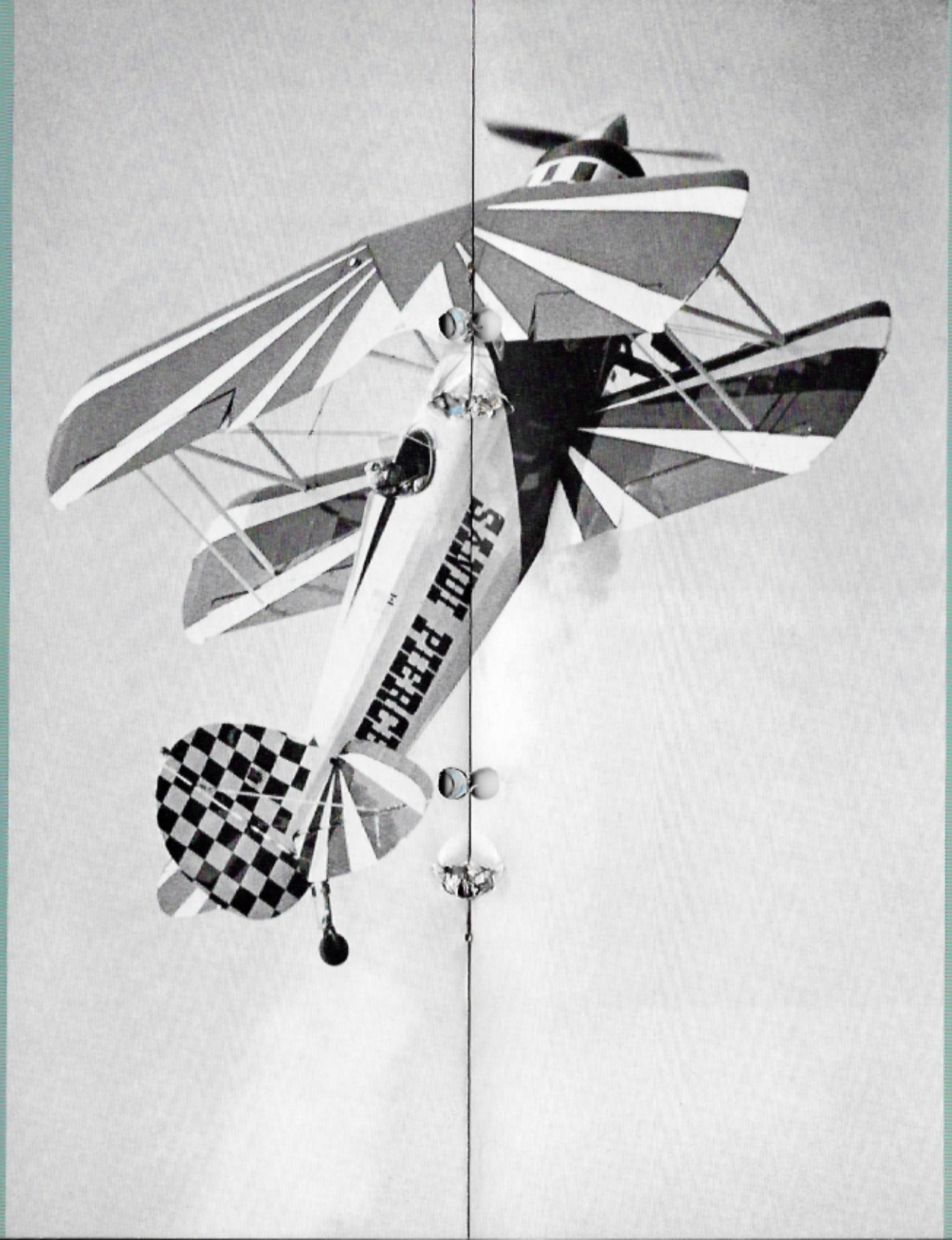
Through a Lens, Brightly

In dim-light situations, the f/6 photographic speed of the Celestron 750mm Telephoto is a sports photographer's dream.

Here, a Soviet hockey player at one end of the rink is snapped by a photographer at the other end of the rink — from a distance of almost 200 feet.

Note the resolution in this full-frame print of a 35mm negative. The film was Tri-X, pushed to ASA 1600.

Photo by Mel DiGiacomo



Of Space and Time

With its high power, the Celestron 1250mm, f/10 removes great chunks of space between the photographer and his subject.

Yet, given sufficient light, the moderately fast photographic speed of this lens can also slice time into surprisingly thin pieces.

Here, the 1250mm telephoto records a "barnstormer" in flight more than 200 feet away. Notice the propeller of the plane.

Exposure: 1/1000th of a second on Tri-X pushed to ASA 1600.

Photo by W.J. Beecher

Ostrich at 30 feet.
Photographed by
George Zehring with the
Celestron 1250mm, f/10
Telephoto.

Sugar Bird at 15 feet.
Photographed by
Mel DiGiacomo with the
Celestron 750mm, f/6
Telephoto.

Eagle at 30 feet.
Photographed by
W.J. Beecher with the
Celestron 1250mm, f/10
Telephoto.

Owl at 20 feet. Photographed by Sid Bahrt with the Celestron 750mm, f/6 Telephoto.

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or. But the weight of the camera will probably require support, and the platform should be sturdily designed because the slightest play between lens and camera will appear on film as blurred images.

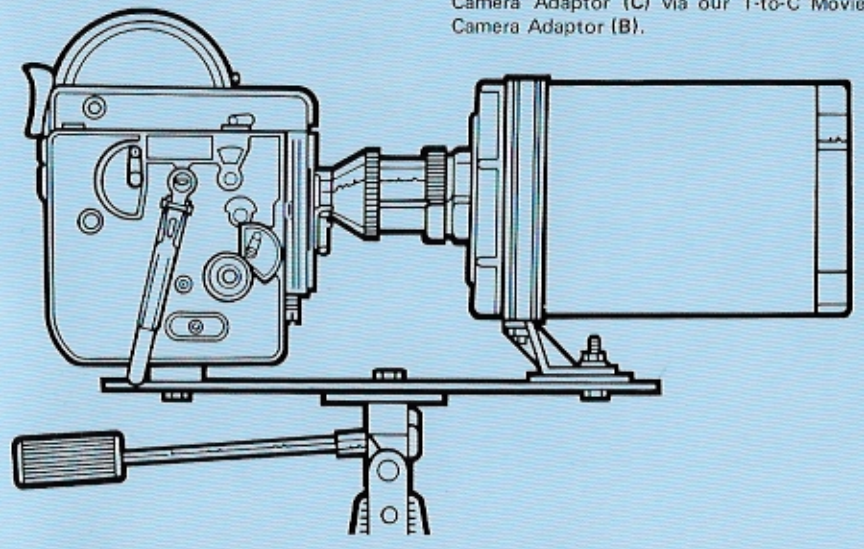
Also, your motion-picture camera has, in effect, a few fixed "shutter speeds" – when the camera is set for normal, slow-motion or time-lapse photography, and this means that neutral-density filters are required to change exposures with varying light conditions.

For instance, with the 1250mm, f/10 lens and your camera running at the usual 16 to 18 frames per second, Kodachrome color film (ASA 25) will probably give good results in typical daylight with a meter reading of f/11 or so. But if the scene is brightly lit and the meter reads f/16, say, you'll need a neutral-density filter to reduce your exposure by about one stop.

And, of course, a black-and-white film like Plus-X (ASA 125) makes filtration a must even in typical daylight. Using this film and the 1250mm in typical daylight, a reduction in exposure of about two stops will be required, and if your subject is set against bright sand, snow or sky, an even greater reduction in exposure will be necessary.

Mounting Your Movie Camera

With your 16mm movie camera coupled to the Celestron Telephoto, you'll add a new dimension to your home movies. From your balcony, you can photograph feeding time in a robin's nest. At the races, you can capture, up close, the head-on approach of a field of thundering thoroughbreds. And at the zoo, you can close in on the facial expressions of the great apes or the whiskery antics of the seals. Your camera body (A) couples to the T-Mount Camera Adaptor (C) via our T-to-C Movie Camera Adaptor (B).



All of which goes double, or triple, for the 750mm, f/6 telephoto. The 750mm, f/6 is one of the fastest mirror-telephotos on the market. If you use Kodachrome movie film with this lens in typical daylight, a reduction in exposure of about two stops will be called for, and if you use Plus-X, a reduction in exposure of about five stops will be in order.

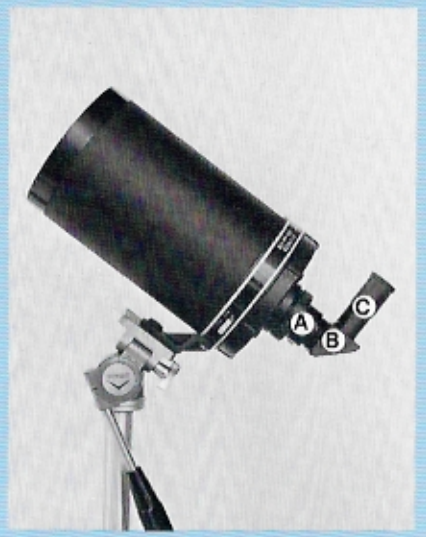
As noted above, motion-picture photography with the Celestron Telephoto requires our T-to-C Movie Camera Adaptor. This adaptor replaces the T-Camera Ring used for still photography. (See "Mounting Your Camera.") Remove the lens of your camera, thread in the T-to-C Adaptor, attach our T-Mount Camera Adaptor and couple the T-Mount to the telephoto.

As in still photography, Series VI filters may be placed in the rear-cell recess of the lens, ahead of the T-Mount Camera Adaptor. See "Filter Photography," especially the reference to the #96 neutral-density filter included with our Drop-In Filter Set. This filter reduces your exposure by about 1½ stops. Consult your photo dealer for filters in other densities.

Your Lens as a Scope

The Celestron Telephoto is unique among mirror-lens teles, inasmuch as it is designed to be used visually as well as photographically. In fact, the two models of this lens are photographic versions of the Celestron Schmidt-Cassegrain Telescope, the world's best-selling modern telescope. So you'll find your lens to be a rather remarkable telescope.

With maximum magnification and steady air, you'll find it possible to read newsprint at a distance of nearly a mile, to read neon signs 10 miles away or to identify an airliner 20 miles away. And, the same near-focus capability that produces such remarkable pictorial effects also works for you visually; at or near the close-focus limit of either lens, exploring your own backyard becomes an astonishing adventure in long-distance microscopy.



Your Lens as a Scope

With optional accessories, the Celestron Multipurpose Telephoto becomes a high-quality, high-power telescope in seconds. Add Visual Back (A), Star Diagonal (B) and ocular (C), as shown at left, or Visual Back (A), Porro Prism (B) and ocular (C), as shown at right. The Star Diagonal offers convenient right-angle viewing but gives reversed images — as in a mirror. The Porro Prism is a straight-through viewing system that gives unreversed images.

To use your lens as a telescope, all that is required is our Visual Back, an ocular (eyepiece); and either a Star Diagonal or a Porro Prism. The Visual Back threads onto the rear cell of the lens, the Star Diagonal or Porro Prism is inserted into the Back, and the ocular is inserted into the Star Diagonal or Porro Prism.

The Star Diagonal is a right-angle prism that reflects the optical path up to a convenient viewing position. For stargazing, with subjects overhead, this is the optimum configuration. However, with this accessory, images are reversed left-to-right — as in a mirror.

For both erect and true left-to-right images, our Porro Prism is required. This is a straight-through viewing system and it gives naturally oriented images for terrestrial viewing. However, with its additional optical surfaces, the Porro Prism reduces image brightness slightly and is not recommended for stargazing, though the loss isn't noticeable in daylight.

The visual power of the Celestron Telephoto depends on the focal length of the ocular selected for use with the lens. Generally, an ocular is named for its focal length. A "25mm ocular," for example, has a focal length of 25mm. To find the visual power of your lens, divide the focal length of the ocular into the focal length of the lens.

The visual powers of the 750mm lens and the 1250mm lens when used with our oculars will be found under "Reference Tables." Also given are angular fields of view and linear fields of view for selected distances.

The Most Useful Powers

Using our oculars, the range of powers for the 750mm is from 30X to about 200X. For the 1250mm, the range of powers is from 50X to about 300X. In selecting oculars for use with your lens, bear in mind that high powers decrease image brightness, diminish the field of view and magnify air turbulence.

For most purposes, the 750mm performs best as a daytime telescope between 40X and 60X, and the 1250mm performs best between 50X and 100X. With the lower powers, a sparrow at near focus more than fills the field of view. With the higher powers, you can inspect the structure of the sparrow's eye, or study the facial features of a friend at half a mile.

Note that the lower limit of useful *daytime* power for the 750mm is given as 40X, even though the instrument's overall lower limit of power is specified as 30X. This limit also applies at night *if* you are viewing bright objects, and can be even higher if you are viewing particularly brilliant objects such as the full moon or a streetlight.

The reason for the limit has to do with the interaction of mirror-lens optics and the light-constricted pupil of the human eye. If the pupil of your eye is smaller than the exit pupil (or emergent beam) of a mirror lens system, the housing of the secondary mirror may appear as a black shadow or dot in the center of the field.

Since the exit pupil increases in size with decreasing magnification, this is what happens when you use the 750mm at less than 40X and your eye has adapted to bright sunlight or to the image of the full moon. And it is especially noticeable to those who wear eyeglasses. If you wear glasses and detect a black shadow in the center of the field, try viewing without your glasses. If the dot persists, switch to higher power and leave your lowest power for stargazing.

Note that this shadowing is strictly a visual phenomenon. It doesn't show up photographically.

Stargazing

Under dark skies, with the ocean of air above you clear and steady, you will be amazed at what your Celestron Telephoto will reveal when

trained on moon and planets. Even under city lights and smog, your lens will readily reveal such wonders as the mountains and craters of the moon; the rings of Saturn; the cloud belts and shuttling moons of Jupiter; and the moon-like phases of Venus.

(See the section on stargazing under "Recommended Reading" for a few works that will describe these objects and help you locate them easily. The magazines listed are especially helpful for keeping tabs on the planets.)

"Even under city lights and smog, your lens will readily reveal such wonders as the mountains and craters of the moon; the rings of Saturn; the cloud belts and shuttling moons of Jupiter."

For observing diffuse celestial objects – such as star clusters, nebulae or galaxies – low-to-intermediate powers are usually best.

With the moon and planets, however, higher powers will be useful. The features of interest here are tiny and bright, and bear magnification well. Examine the object first with low power – check the rings of Saturn, for example, at 40X or 50X – and then if the air is steady enough for a crisp image, use higher power. Bear in mind, though, that the hourly progression of celestial objects from east to west will be magnified in the same proportion as your target, so at very high powers your subject will appear literally to whisk across the field. Therefore, the upper limit of usable power is imposed by your ability to "track" an object, rather than the ultimate quality of your lens.

To extend the range of powers available with a given set of oculars, we offer a 2X Barlow Lens. This accessory doubles the power of any of our oculars and also increases their eye-relief viewing distance. However, there is some small sacrifice of image quality with this lens system. The Celestron Barlow inserts into the Visual Back and accepts either Star Diagonal or ocular.

Viewing the Sun

NEVER ATTEMPT TO VIEW THE SUN THROUGH ANY OPTICAL INSTRUMENT WITHOUT THE PROPER SOLAR FILTER. INSTANT AND IRREVERSIBLE EYE DAMAGE WILL RESULT.

Our sun, the nearest star, is one of the most exciting celestial objects a telescope can be focused on. Its boiling, granulated surface often displays the magnetic storms we call sunspots, and against the background of its disk, Mercury, Venus and the moon sometimes pass in transit.

But the sun is incredibly bright, and hot. A pinhead of material from its core could emit enough heat to cause fatal burns 100 miles away. So, clearly, when we look at the sun through a telescope, special precautions are imperative to protect both eyesight and optics.

For these purposes, we offer the Celestron Solar Filter. With this accessory, either the 750mm or the 1250mm lens can be used to view the sun for extended periods in complete safety and comfort. The Celestron Solar Filter is described in more detail under "Filter Photography."

The Celestron Solar Filter

With the Celestron Solar Filter on your lens, you can safely use the solar disk as a background for your photographic subjects, and you can safely view sunspots or the occasional transit of a planet between earth and sun. The filter is designed to press-fit over the front cell of the lens.

Lens Care and Cleaning

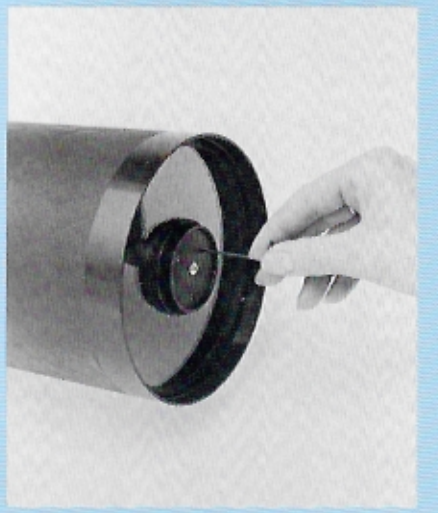
When your lens is not in use, place the lens cap on the front cell, cap the rear-cell opening and store the lens in its carrying case. Do this faithfully and your lens should never need internal cleaning.

To clean the exposed side of the corrector lens, first remove dust or dirt particles with a can of pressurized air or a camel's hair brush. Then use a photographic lens cleaner and non-silicone lens tissues (or white "Kleenex") to clean the lens.

Corrector lenses with Special Coating (magnesium fluoride) require special care. For such optics, a good cleaning solution is 1/3 isopropyl alcohol, 2/3 distilled water and two drops of biodegradable dish detergent per pint of solution.

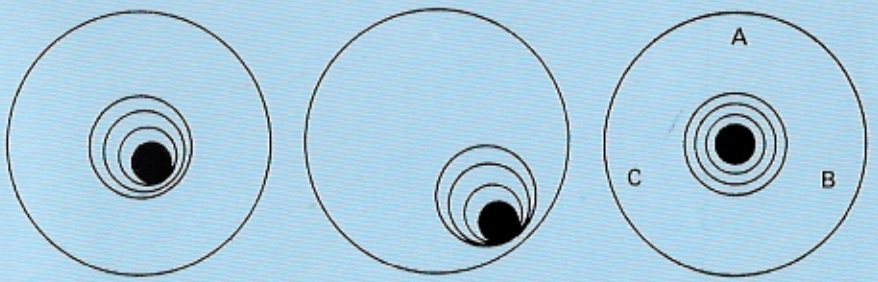
Collimation

Although your Celestron lens is extremely rugged, you may have to re-collimate it (re-align its optics with the optical axis) after a severe jar or sustained jostling. This is a simple procedure, requiring only a gentle touch. If you wish, we will re-colli-



Collimation Adjustments

Collimation (see text) is accomplished by adjusting the three screws around the periphery of the secondary housing, as at left. The image during collimation is shown by the drawings below. **LEFT:** Blur circle centered in the field of your lens. Secondary shadow within the circle is off-center. Your lens is out of collimation. **MIDDLE:** To re-collimate, re-point the lens to move blur circle to edge of field in direction shadow is off-center. **RIGHT:** Then move circle back to center of field by tightening and loosening appropriate collimation screws. Here you tighten screw B and loosen A and C. (The screws are oriented as seen from the back of your lens.)



mate your lens for you. There will be a small service charge.

To check collimation, you'll need a proper light source. A star or a light atop a tower a few miles away will do. Or, if the sun is low and at your back, you can use a distant "hot spot" such as a small, bright reflection from a telephone-pole insulator or a reflection from a piece of automobile chrome.

With your light source centered in the viewfinder of your camera (or better still, centered in the field of a low-power ocular), de-focus the lens and examine the blur circle. If the shadow of the secondary-mirror housing is not perfectly centered inside the blur circle, your lens is out of collimation.

To adjust collimation, re-point the lens so the blur circle is moved toward the edge of the field in the direction that the shadow is off-center. Then, using the three Allen screws around the periphery of the secondary housing, bring the blur circle back to the center of the field. Tighten the screw that lies in the direction that the shadow is off-center and loosen the other screws.

With the blur circle again centered in the field, you might find that the shadow of the secondary is still off center a bit. Repeat the process above until the shadow is perfectly centered inside the circle. If you are using your oculars, you can refine the accuracy of this process by using successively higher powers.

Use care when collimating your lens. The collimation adjustments are extremely sensitive. Generally, less than a tenth of a turn on these screws is enough for routine adjustment. Also, collimation will best be maintained when each screw is under moderate tension.

Warranty and Service

Your Celestron Telephoto is warranted to perform exactly as advertised and to meet the specifications listed herein. Further, your lens is warranted to be free from defects in materials and workmanship for a period of one year, subject to repair or replacement at our factory. Abuse or modification of the Celestron Telephoto voids this warranty.

Rarely is it necessary to return a Celestron for service, as a problem can usually be solved by telephone or mail. So call or write us first before returning your lens for service. If it is decided that your lens requires factory service, be sure to send a covering letter fully detailing the problem.

Write to:

Celestron International
2835 Columbia St., Box 3578
Torrance, Calif. 90503, USA

The Case for Our Lens

The Celestron Multipurpose Telephoto, with protective lens caps, in its foam-lined carrying case. The case measures 7" x 9" x 12", and tips the scales at a featherweight 2½ pounds, which is more than half of what the lens itself weighs.

Recommended Reading

Techniques

Advanced Camera Techniques for 126 and 35mm Cameras (AC-56), Eastman Kodak Co., Rochester, N.Y., 1972.

Filters for Black-and-White and Color Pictures (AB-1), Kodak, 1971.

Latham, Sid, *Filter Guide*, Amphoto, Garden City, N.Y., 1962.

Time-Life Books, *Light and Film*, Life Library of Photography, Time, Inc., New York, N.Y., 1970.

Wildi, Ernst, *16mm Movie Making*, Petersen Publishing Co., Los Angeles, Calif.

Nature Photography

Bahrt, Sidney, *A Wilderness of Birds*, Doubleday & Co., Garden City, N.Y., 1974.

Blaker, Alfred A., *Field Photography: Beginning and Advanced Techniques*, W.H. Freeman Co., San Francisco, Calif., 1976.

Time-Life Books, *Photographing Nature*, Life Library of Photography, Time, Inc., New York, N.Y., 1971.

Magazines

Modern Photography, monthly, ABC Leisure Magazines Inc., New York, N.Y.

PhotoGraphic, monthly, Petersen Publishing Co., Los Angeles, Calif. (Especially September 1973.)

Popular Photography, monthly, Ziff-Davis Publishing Co., New York, N.Y.

Stargazing

Moore, Patrick, *Concise Atlas of the Universe*, Rand McNally, New York, N.Y., 1974. (Available from Celestron.)

Also the following magazines:

Astronomy, monthly, AstroMedia Corporation, 757 North Broadway, Suite 204, Milwaukee, Wisc. 53202.

Popular Astronomy, monthly, Popular Astronomy Magazine Inc., 270 Madison Avenue, New York, N.Y. 10016.

Sky and Telescope, monthly, Sky Publishing Corporation, 49-50-51 Bay State Road, Cambridge, Mass. 02138.

Celestron 750mm, f/6 Telephoto Reference Table

Note: Field coverage is calculated for 35mm format only.

T-ADAPTOR FILM COVERAGE (15X)

Angular Coverage
1.81°x2.72°

Linear Coverage for Selected Distances	
Distance	*Coverage*
15'	4.76"x7.14"
30'	10.43"x15.65"
50'	18.09"x27.14"
100'	3.09'x4.63'
500'	15.72'x23.58'
1,000 yds.	95.02'x142.53'

TELE-EXTENDER POWERS, FOCAL LENGTHS, f/VALUES AND ANGULAR COVERAGE

Ocular	Power	Focal Length	f/ Value	Coverage
25mm	75X	3,750mm	30	.37°x.55°
18mm	105X	5,250mm	45	.26°x.39°
12mm	195X	9,750mm	75	.14°x.21°
9mm	255X	12,750mm	100	.107°x.160°
6mm	390X	19,875mm	160	.070°x.105°
5mm	480X	24,000mm	190	.057°x.085°
4mm	600X	30,000mm	240	.046°x.069°

TELE-EXTENDER LINEAR FILM COVERAGE FOR SELECTED DISTANCES

Ocular	15'	30'	50'	100'	500'	1,000 yds.
25mm	.93"x1.4"	2.09"x3.14"	3.63"x5.45"	7.40"x11.10"	37.70"x56.55"	18.85'x28.27'
18mm	.67"x1.00"	1.51"x2.26"	2.58"x3.87"	5.31"x7.96"	27.23"x40.84"	13.61'x20.42'
12mm	.35"x.53"	.79"x1.19"	1.39"x2.09"	2.79"x4.19"	14.66"x21.99"	7.33'x11.00'
9mm	.27"x.41"	.63"x.94"	1.05"x1.57"	2.09"x3.14"	11.17"x16.75"	5.59'x8.38'
6mm	.19"x.28"	.42"x.63"	.70"x1.05"	1.39"x2.09"	6.98"x10.47"	3.49'x5.24'
5mm	.15"x.22"	.33"x.50"	.56"x.84"	1.11"x1.67"	5.59"x8.38"	2.79'x4.19'
4mm	.13"x.19"	.25"x.38"	.42"x.63"	.98"x1.47"	4.89"x7.33"	2.44'x3.66'

VISUAL POWERS AND FIELDS OF VIEW

Powers and Angular Fields

Ocular	*Power*	*Field*
25mm	30X	1.42°
18mm	40X	1.14°
12mm	60X	.64°
9mm	80X	.60°
6mm	125X	.33°
5mm	150X	.25°
4mm	190X	.21°

Linear Fields for Selected Distances

Ocular	*20'*	*50'*	*100'*	*500'*	*1,000 yds.*
25mm	5.95"	14.87"	29.75"	12.39'	74.37'
18mm	4.78"	11.94"	23.88"	9.95'	59.70'
12mm	2.68"	6.70"	13.40"	5.58'	33.51'
9mm	2.51"	6.28"	12.57"	5.24'	31.42'
6mm	1.38"	3.46"	6.91"	2.88'	17.28'
5mm	1.05"	2.62"	5.24"	2.18'	13.09'
4mm	.88"	2.20"	4.40"	1.83'	11.00'

Celestron 1250mm, f/10 Telephoto Reference Table

Note: Field coverage is calculated for 35mm format only.

T-ADAPTOR FILM COVERAGE (25X)

Angular Coverage
1.07°x1.61°

Linear Coverage for Selected Distances	
Distance	*Coverage*
20'	3.56"x5.34"
30'	5.78"x8.67"
50'	10.26"x15.39"
100'	1.78'x2.67'
500'	9.25'x13.87'
1,000 yds.	55.51'x83.84'

TELE-EXTENDER POWERS, FOCAL LENGTHS, f/VALUES AND ANGULAR COVERAGE

Ocular	Power	Focal Length	f/ Value	Coverage
25mm	130X	6,250mm	50	.21°x.32°
18mm	180X	8,750mm	75	.15°x.23°
12mm	330X	16,250mm	130	.08°x.12°
9mm	430X	21,250mm	170	.06°x.09°
6mm	660X	32,500mm	270	.04°x.06°
5mm	810X	40,000mm	320	.03°x.05°
4mm	1,015X	50,000mm	400	.027°x.040°

TELE-EXTENDER LINEAR FILM COVERAGE FOR SELECTED DISTANCES

Ocular	20'	30'	50'	100'	500'	1,000 yds.
25mm	.71"x1.07"	1.19"x1.78"	1.99"x2.98"	4.19"x6.28"	21.99"x32.99"	11.10'x16.49'
18mm	.50"x.75"	.82"x1.23"	1.47"x2.20"	3.14"x4.71"	15.71"x23.56"	7.85'x11.78'
12mm	.25"x.38"	.44"x.66"	.73"x1.10"	1.47"x2.20"	8.38"x12.57"	4.19'x6.28'
9mm	.21"x.31"	.38"x.56"	.63"x.94"	1.26"x1.88"	6.28"x9.42"	3.14'x4.71'
6mm	.13"x.19"	.25"x.38"	.42"x.63"	.84"x1.26"	4.19"x6.28"	2.30'x3.46'
5mm	.12"x.18"	.19"x.28"	.35"x.52"	.71"x1.07"	3.66"x5.50"	1.88'x2.83'
4mm	.08"x.13"	.13"x.19"	.27"x.41"	.56"x.89"	2.93"x4.40"	1.57'x2.36'

VISUAL POWERS AND FIELDS OF VIEW

Powers and Angular Fields

Ocular	*Power*	*Field*
25mm	50X	.84°
18mm	70X	.68°
12mm	105X	.38°
9mm	140X	.36°
6mm	200X	.19°
5mm	250X	.15°
4mm	310X	.13°

Linear Fields for Selected Distances

Ocular	*25'*	*50'*	*100'*	*500'*	*1,000 yds.*
25mm	4.40"	8.80"	17.59"	7.33'	43.98'
18mm	3.56"	7.12"	14.24"	5.93'	35.61'
12mm	1.99"	3.98"	7.96"	3.32'	19.90'
9mm	1.88"	3.77"	7.54"	3.14'	18.85'
6mm	.99"	1.99"	3.98"	1.66'	9.95'
5mm	.78"	1.57"	3.14"	1.31'	7.85'
4mm	.68"	1.36"	2.72"	1.13'	6.81'

Celestron Telephoto Specifications

Standard with each lens: 35mm T-mount adaptor, ¼-20 tripod adaptor block, lens caps and foam-lined carrying case.

Celestron	750mm, f/6	1250mm, f/10
Focal Length	29.5"	50"
f/value	f/6	f/10
Photographic Power	15X	25X
Photographic Near Focus	15'	20'
Resolution	333 lines/mm	200 lines/mm
35mm Film Coverage	1.81°x2.72°	1.07°x1.61°
Linear Coverage at		
30'	10.43"x15.65"	5.78"x8.67"
100'	3.09'x4.63'	1.78'x2.67'
1,000 yards	95.02'x142.53'	55.51'x83.84'
Unvignetted Field* (without adaptors)	2.5" circle	1.8" circle
Visual Power Range**	30X-190X	50X-310X
Visual Near Focus	20'	25'
Low-Power Field at 1,000 yds.	1.14° or 59.70'	.84° or 43.98'
Construction	Aluminum	Aluminum
Tube Dimensions	5.5"x10"	5.5"x11"
Tube Weight	4 lbs.	4 lbs.
Case Dimensions	7"x9"x12"	7"x9"x12"
Case Weight	2.5 lbs.	2.5 lbs.

*With the 1250mm lens and 35mm T-mount, some vignetting may be detectable against white or light-blue backgrounds.
**Optional accessories are required to use your lens as a scope.