Photography Using The Questar Telescope

Goal

Taking high quality photographs through the Questar telescope, or any very long focus lens, requires special considerations in technique and choice of equipment. It is possible to record images using standard photographic procedures and marginal equipment, but in order to realize the optimum performance possible with fine optics on a consistent basis, it helps to have a basic knowledge of the factors and components that will determine the quality of your results.

Although this article primarily addresses 35mm still photography with the Questar telescope, many of the same principles also apply to applications that use any long focal length lens or microscope, used for imaging on film or video formats.

This paper was written for those new to photography using a telescope, that want the best results possible from their equipment. These procedures are not intended to complicate a straight forward photographic pursuit; they simply offer considerations and principles that will help you achieve satisfying results.

Camera Choice

For telescope photography applications the 35mm format, single lens reflex (SLR) model is the camera of choice. The argument "the larger the negative format the better the image quality" does not ordinarily refer to this application.

Small, lightweight, and easily portable telescopes are generally not able to cover a film size much bigger than the 35mm still format. Questar offers adapters for some larger format cameras such as the Hasselblad, or you can make one yourself for a special application, but if you are trying to take advantage of the increased film size for improved image quality, you will be wasting your time. Very high magnification is required to fill these larger formats, and light losses and other problems caused by these extreme effective focal lengths (EFL) make the pursuit impractical for most applications. There might be an advantage in adapting to a larger camera format if the film type or emulsion that you need is only available in that format, but with the possible exception of a requirement for an "instant film", this situation rarely arises.

If you are considering the purchase of a camera to use with your Questar, make sure that the camera offers interchangeable focusing screens, and some type of viewfinder magnifying. The reasons for choosing these options are explained later. If you have one of the new highly automated cameras that has everything, but lacks interchangeable parts, you might consider buying a used camera body just for use on your telescope. Some older models of the Nikon, Canon, Contax, and Olympus cameras will have all the features you need, at reasonable prices.

Correct Focus

As we all know, a sharp photograph is dependent upon sharp lens focus at the time of exposure. You now use one or more of the many types of camera focusing screen patterns to focus your camera, the split image and microprism being two of the most popular designs.

Unfortunately, because of the optical speed of the Questar, or any lens slower that about f/5.6, these patterns darken and no longer work. Most "off the shelf" or non-interchangeable focusing screens (microprism or split image) will not work well with a telescope of extremely long focal length lens.

Consistent and accurate focus at focal lengths above 1000mm requires a different type of focusing screen. These screens are usually listed by the manufacturer for use with "Telescope" and/or "Microscope" applications. These screens employ a fine matte pattern overall, with a clear spot in the center that includes a small cross hair. Correct use of this screen normally requires a finder magnifier. This magnifier is a small lens that attaches to the camera's finder viewing window. It may be a right angle device, or possibly a piece that replaces the camera's porro prism (stove pipe type). Because of this focusing screen consideration, a camera with interchangeable focusing screens is *very* important if you plan to do much photo work with a telescope.

This special screen is used when employing a technique called "parallax focusing." This procedure takes a little initial practice. Rough focus is obtained on the ground glass, then, clear area. Fine focus is obtained by moving one's head in a motion that suggests a "yes" or "no" type of gesture. As the eye moves across the viewing aperture the subject will move or "twitch" in relation to the cross hair. When this movement ceases, and the cross and subject remain constant with each other, correct focus has been obtained. This is not subject to eyesight diopter difference. If it's sharp for me, it will be sharp for you if you know the technique. This is not quite as time consuming as it may sound, and the effort spent mastering this technique will be more than justified in your photographic results.

Exposure

After achieving correct focus, the photographer must determine the proper exposure. Many cameras, when indexed for through the lens "stop down" or manual metering, will perform well with the Questar. Remember, the focusing screen that you employ for parallax focusing may require exposure compensation for correct light readings with some built in camera meters, so check the information supplied with your camera screen. If exposure compensation is needed, you can adjust your film speed dial to compensate for the difference.

Effective "T" or transmission stop" numbers take into account the reflecting lens design's central secondary mirror abscuration, and they are listed in the Questar instruction manual for most combinations of extension tube, and optical positive or negative lens combinations. The "T" stop figures are treated in the same way as the more customary "F" stop.

The basic 3.5 Questar and full extension tube set allows for full 35mm negative coverage, and its effective photographic speed is rated at about T/18. Use 18 as the effective "F" number for exposure calculations (this is a setting between f/16 and F/22 on an exposure meter). Usually, all exposure compensation will be controlled by adjusting your camera's shutter speed. Neutral density filters may also be used, but normally, fast lens speed is at a premium and only the shutter speed adjustment is needed to regulate exposure.

A hand held or spot metering system is a good choice for telescope use. With the spot meter you will be metering close to the actual field of the photograph instead of the small portion to which you may be accustomed when using shorter lenses. Use the "T" numbers on the charts for your "F" number meter setting and adjust your shutter speed accordingly.

Of course, the advanced photographer may use incident readings, or even "rule of thumb" to determine fairly accurate exposure settings. It is strongly advised, especially at the beginning of your telescope use, that exposures be "bracketed." Any scene or event that warrants the photographer's interest and investment of time should be exposed above and below the indicated exposure in addition to what is metered and determined to be "right on." This not only acts as insurance for getting the photograph, but also serves as good reference for fine tuning your film, camera, and lens combination.

Notes about your procedures and camera setting recorded *at the time of shooting* are invaluable for future evaluation of your photographic technique. You may notice that notes taken a day later or while reviewing your processed film are usually about as effective as no notes at all.

Camera Support & Stability

Even though the 3.5" Questar barrel assembly weighs only about three pounds and almost any tripod will keep it off the ground with some security, a robust tripod is a must when shooting at extreme focal lengths. The user will also immediately begin to appreciate a fine quality tripod pan head; one with smooth motions and positive, no creep locks. The rough and jerky head movement of a tripod of marginal quality barely noticed with lenses of short focal length becomes three photo field jumps with telephoto lenses, especially if the focal length exceeds 1000mm.

Unfortunately, you will soon notice that even with a sturdy tripod support that your small, lightweight 35mm camera can react rather violently during exposures when the mirror and shutter are in operation. Some are smoother than others but all currently available SLR cameras shake, and shake enough to seriously degrade the sharpness possible with the Questar.

The camera doesn't just get its shake from one source; the problem comes from two, and these motions are generally two separate directions causing the camera to oscillate in an almost circular manner. When the shutter is released the reflex mirror snaps up, kicking the camera in a vertical direction, and before this tremor has calmed the shutter slashes its way across the back of the camera releasing energy in the horizontal plane (yes some shutters do move in the vertical direction, but they still shake). Using an air release and hanging a hundred pounds of shot bags on the tripod will not stop these camera acrobatics, and in most cases dampen them only slightly.

If you have doubts that this is a serious problem, focus your telescope on a distant object at high power with the camera attached. With the camera cocked, look through the telescope's eyepiece and release the shutter cable, air release, or the camera's timer, and watch what happens. It almost looks as though someone has kicked the tripod doesn't it? Oh, you say your camera is equipped with a mirror lock up provision, great, lock it up and try again. Yes, it's not as bad, but the shake is still there. It is a fact, you cannot get sharp photographs when the image is moving during exposure and "smearing" the image across the film.

One way these shakes may be lessened, but not totally eliminated is by using a fixture to create a common mounting foundation for the camera and lens as a unit. Questar currently offers two types of camera cradles that will do this conveniently. A rise/fall platform at the camera end of the aluminum beam makes matching your camera's height to the lens a simple process. Tying the two components together makes for a sturdy, integrated unit that is easy to use.

With an accurate camera focus, a robust tripod, a calm air path, and the camera mirror locked up prior to exposure, some shutter speeds will allow photographs that may be of sufficient quality for some photographers, or meet the needs of specific applications. Again, we are talking about trying to achieve results that take advantage of the images possible when using Questar optics. The only way to insure vibrationless exposures is to bypass the camera shutter altogether.

The card exposure procedure eliminates camera shake. This is a version of the old press photographer's "hat trick" for long exposures. A diagram for a slotted card is included on page 9 for suggestions on measurements, materials, and use. This may seem like a drastic extreme to resort to, but this technique allow you to get shake free photographs at reasonable shutter speeds (about 1/125th of a second and slower) without additional (expensive and specially made components. This procedure really does work, and works very well with a little practice.

If you own a camera with the attributes just discussed and an automatic exposure system, try this variation of the card trick. Compose your photograph and focus. Just before releasing the shutter, cover the front of the lens with a black card. With the card in place, release the shutter with an air or cable release, and allow a very short time for vibrations to settle out, and then rapidly remove the card. With the card in place the camera is receiving insufficient light for exposure and the shutter remains open. When the card is removed light strikes the film and the system meters the exposure and closes the shutter. The only vibration that occurs is during the brief instant the shutter curtain moves to close. This procedure *will not work* with auto exposure systems that set the lens aperture to adjust exposure. Remember, in any of these card applications the card should never contact the telescope. Make the card as black as possible and try to let your shadow fall upon it to help avoid fogging the film, especially when using films with fast emulsions.

If you have a subject that allows you to control the illumination, such as in a studio or close-up situation (insects, flowers, birds, etc.), try leaving your camera shutter open on the "B" or "T" setting while working in a dark place, and expose using only a light source. The action stopping ability of a strobe, flash, or even the timed use of an incandescent lamp will eliminate any vibration problems caused by the camera.

We always suggest the use of a cable or air release for exposures. We prefer an air release with a tube no longer than three feet unless more is required. If a cable is used it should be soft and flexible enough to isolate your movements from the camera. In addition, a motor drive or auto winder is an asset. This is not for speed, although it is an advantage in this respect, but it allows you to compose your photo accurately and work for extended periods for bracketing and card work without disturbing the camera as you recock the shutter. The additional weight also helps dampen vibrations.

Motion picture cameras also vibrate the system, especially at start-up, and these should be used with a camera cradle or unifying beam type tripod mounting. Film cameras that generate lots of movement have been used successfully employing two separate mounting platforms, and a light tight, non-contacting tube between the camera and lens.

The vibration problems discussed above do not apply to the use of video cameras (excepting some types of "still video" cameras that do employ mechanical shutters). Using long lenses with video is great because video imaging is done without the movement of mechanical parts, and you are able to view your results as you shoot. The importance of a quality tripod still applies though, and in this situation you may seriously want to consider a slow ratio geared head for positioning control if you will be tracking an object, or changing fields of view while recording.

Air Path

Now that you are aware of the photographic considerations that effect your choices of equipment and technique using the Questar as a long focus lens, we will shift to variables over which you have very little control even though they have definite effects on photographic results.

The air that separates us from our subjects could be equated to a type of "liquid" medium. This liquid is normally not like that found in a still pool, but more similar to that observed in a slow running stream. The transparency of the air can be equated to clear or clouded water, and atmospheric turbulence of the flow of the stream.

You will quickly notice that photos taken through the long air paths will show an apparent lack of contrast. This brings up a point regarding telephoto effects. It can be said long lenses "compress perspective" and accentuate haze effects, etc. Though these comments may be used with some accuracy within the photographic community, they may be thought of in a different way.

A photograph of a distant scene (say one mile from the camera position) that includes trees, a human figure, and an automobile, shot on a fairly clear day through the telescope and viewed as a photographic print, will have a distinct look. Perspective seems to be compressed. Trees that may have an actual separation in depth of one hundred feet or more appear to be pushed together, almost on the same plane. The figure in the photograph that is considerably closer to the lens than the automobile will appear smaller and out of scale with the car. A loss of normal contrast may also be noted, and sharpness may not be quite what is expected because of turbulence in the air path.

If this scene had been shot at the same time, from the same position with a normal, or short telephoto camera lens, and a full negative print of like size where made, the print would exhibit great apparent sharpness, contrast, and a more three dimensional view of closer foreground objects in the frame. But lets compare apples to apples and see what happens.

If an area on the normal angle photograph's negative, an area that matches the subject included in the telephoto shot (a very small area of the normal angle film), is enlarged to make a print that matches the area content of the telescope print, you will note some interesting effects. Disregarding the fact of increased film grain size, and the film's limited lack of sharpness because of the great enlargement, the pictures look the same! The contrast matches, perspective matches, (trees are still pushed together and sizes remain the same), and the atmospheric effects on sharpness is the same. It looks as though we really didn't change perspective at all, did we?

A couple strolling down the beach at sunset will obscure your sight of the sun if observed from a distance of twenty feet, even though the sun is approximately 865,000 miles in diameter. If this couple is now observed in the same line of sight from a distance of two thousand feet with the Questar, they suddenly begin to resemble the romantic pair you saw silhouetted against that huge red solar disk on the cover of a travel brochure. Again, if technically possible, a photograph shot with a shorter lens, and then enlarged to create a print with the same image size as the telescope image, will exhibit the same appearance as the telescope print.

The point we are trying to make here is that compromises in apparent quality of very long focal length photographs taken with theoretically perfect lenses, are caused by natural conditions and are *not* failures in lens performance.

We have briefly touched on the two major natural limiting factors of long focal length photography. Just as our model stream flows, so does the air. A smooth continuous flow, such as a light breeze that remains uniform between you and the subject is great! Light reflected from your subject arrives at your lens relatively undisturbed and undistorted. When differences in air flow occur we have a problem. Just as in the stream, curves, obstacles, temperature differences, and depth created eddies affect your ability to clearly see the stream bed.

What we may commonly refer to as "heat waves" is the basic problem. These turbulent eddies and currents bend and scramble light. The light no longer travels in a straight unhindered line to your lens. This effect causes unsharp photographs not only by distorting the image, but also by causing the image to "scintillate," or move on the film during exposure. Contrary to what many believe, this turbulence can be as annoying on a cold day as on a hot one. The key phrase here is temperature *difference* in the path, not just high or low temperature. If the ambient temperature is a chilly forty degrees during a sunny day, shooting over a roof top or a dark paved area will normally yield poor results because the warm air rising from these heated surfaces roll, or boil as they mix with the cooler air of a different density. Even shooting out through the open window of a heated room can cause extreme distortion from the airflow across the front aperture of the lens even though long range "seeing conditions" may be excellent.

Turbulence can also be a problem in close-up work. Heat from incandescent lamps, fan currents from other instrumentation, or the temperature extremes of the subject itself, can all cause scintillation that can seriously degrade high magnification photographic quality.

Atmospheric haze is a little more apparent to the unaided eye. Most of the stuff that obscures our skies and gives us those beautiful red sunsets is particulate matter. There is no way to filter this type of material out of your photographs. About all you can do is shoot through as little air as possible (get closer). Light scatter from moisture and ultra violet effects can be treated to some degree with filters. We will talk about these shortly.

Because these facts of nature are basically uncontrollable, procedures that take advantage of your surrounding are about the only way to lessen these problems. Try to get back in to that smooth flow or quiet pool in the middle of the stream. If possible keep your line of sight as far above the ground as possible, shoot from a hill or the top of a man made structure. Avoid a line of sight that has features that include objects with gross temperature differences from the surrounding air. Sometimes shooting across a body of water may yield excellent seeing conditions, but sometimes the opposite may be true.

If at all possible plan your photo sessions for times early or late in the day. It is during these periods you are most likely to experience the time I like to refer to as "the null." This is the period of time that night and daytime temperature extremes are beginning to overlap, and all things come as close to the same temperature as possible while still offering enough light for photography. Take some time during a leisurely day to find this "prime time." Set your telescope out about an hour and a half before sunset and acquire an object at a considerable distance. Check the conditions through the eyepiece about every ten or fifteen minutes. Soon a time will come when seeing conditions will change from minute to minute. The calmest time may occur before sunset and continue on into the darkness, or you may see conditions deteriorate again before sunset. The lesson here is that good conditions may be very short in duration and subject to change at any time. Shoot while you have the chance; it could possibly get better, but the conditions can just as easily deteriorate.

The eye and the brain act as a very sophisticated image processor. As you look through the eyepiece, your brain can interpret a fluctuating image and make perfect sense of it all, and in great detail. Unfortunately, your film is not that adaptable and it just sits there very passively recording the information just as it's received. If the light reflected from your subject dances around in an area larger than it should actually displace on the film, an unsharp photograph will result. The next time you find conditions that you feel are very good, look through the telescope's eyepiece at high power. Try to find a lined object (like a twig or pole) or a point source of light in the field at a long distance, and slowly bring the image slightly out of focus. Does the image twitch? If it does, your have demonstrated that your eye can overlook small amounts of scintillation that the film cannot. If you see no movement, shoot now because this condition is not likely to last for long!

Filters

The Quick-Change filter holder and Drop-In filters available from Questar allow filter use and changes without removing the camera from the telescope. Photographs of most subjects can be taken without any filtration, but under some circumstances the use of a filter may be advisable.

The UV (ultra violet blocking) filter helps remove short wave length light that is scattered in the atmosphere. This light serves no real useful purpose in our photographs and tends to lessen subject contrast. This filter generally needs no exposure compensation, but when adding any additional optical surfaces into the system be sure to recheck your focus carefully.

If you are using a video camera for long distance observation, try various grades of UV filters, and check the results on your monitor. The right filter may sometimes have a dramatic positive effect on image quality.

Although the polarizer is a favorite in general photography, it does sometimes present a problem when using lenses of long focal ratios (high numerical F stops). The polarizer will rob you of up to three F stops of light. Remember we are already working at about T18 with the 3.5" Questar. This type of loss puts us at about T45 or more, which is generally a little slow for most applications. Also, you are adding two additional pieces of glass with a total of four optical surfaces between the telescope and the camera, and we want to keep these surfaces to a minimum.

Colored filters have uses also, especially in black & white applications, but thorough discussions of their use is too long to include here. This information is readily available from local sources and inexpensive texts. Again, the light loss is the major consideration.

Films

Films are a personal choice to be made by the photographer as his subject requires. There is no magical film stock that is the best for all applications.

I generally lean towards slower, finer grain emulsions when the conditions permit. Working with a 25 or 63 DIN film with static subjects also allows for more accurate card exposures. These emulsions may not have any more latitude than a faster type, but a fairly accurate card exposure at 1/60th or 1/30th of a second is easier to achieve than a more rapid 1/250th.

Again, the subject of film choice is a little nebulous to include in detail here, and information on this subject is easy to find.

Summary

This information has intended to list considerations for those who would like to get the most from their Questar and camera. If it isn't fun, it's not worth the trouble, but having the basic principles and techniques laid out, you are free to pick and choose the information that you employ in your photographic endeavors.

You will find that having basic knowledge of this information will improve your technique in all aspects of photo work, and that what may sound very overwhelming and complex now will become common place and second nature in a very short period of time.

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