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Astro-Optics Division

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QUESTAR BOOKLET

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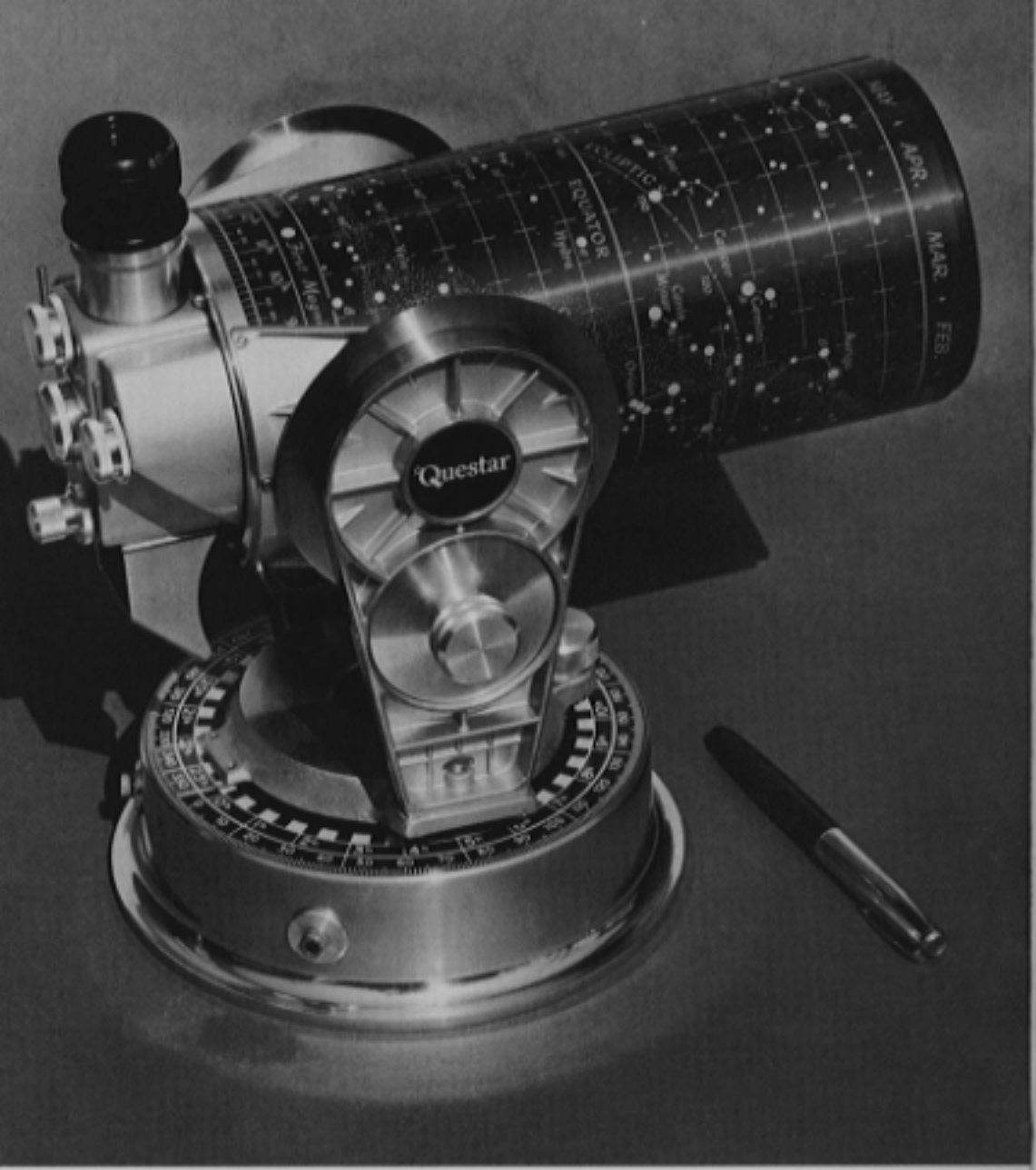
QUESTAR



This is the Questar Telescope. Some have called it the most beautiful instrument they have ever seen. In this position of its convertible mounting, it is a table-top telescope for general terrestrial observing.

Questar's color scheme is a deep warm blue and silver, with dark red name plates. No photograph can show the gem-like depth of color of its metal star-chart sheath. All other parts are stainless steel and aluminum in a rich variety of hand-finished textures.

There is no trim or added ornament. Questar's handsome appearance flows naturally from the functional utility of every part. It has the quiet elegance of handmade things that are at home in any drawing room.

A Questar like this was the personal gift of President Eisenhower to His Majesty King Mohammed V of Morocco on the occasion of his visit to the White House in November 1957.

QUESTAR

Questar is the finest and most versatile small telescope in the world. Its superb new optical system embodies the first basic discovery in telescope optics in 200 years. These optics belong to the new family of catadioptric, or mixed lens-mirror, systems, and permit a full-sized 3.5-inch telescope of 7-foot focal length to be compressed by optical folding into a closed tube only 8 inches long. Questar thus becomes the world's shortest high-power telescope.

All Questar's advantages stem from this ultra-compactness of its unique design. Superfluous now is the great tripod, the heavy machinery and counterweights of the long-tubed single-purpose telescope. In their place is a beautiful little 7-pound example of hand craftsmanship which is not just one, but several instruments. It does many things superbly well. It does them so easily and conveniently that you might well ask why such an instrument was not made before. The answer is that an extremely short form of the new optics had to be developed, new methods devised for its manufacture, and radically new ways to mount a telescope invented and perfected.

Questar introduced the new optics to the world in this daringly short design in May, 1954, after 8 years of research and development. Since then its performance has astonished everyone, including us who make it. It has firmly established the superfine small telescope on a new level of serious respect. And it has made this company not only the world's largest manufacturer of short catadioptric telescopes but the only maker of f/2 Cassegrain high-power optical systems.

There are Several Kinds of Telescopes

Binoculars and Spotting 'Scopes—The most familiar form of telescope is probably the binocular. So little magnification is asked of these image-erecting twin telescopes that they may be made extremely short without apparent loss of sharpness.

As we ask more power of a telescope, the focal length of its objective lens must be increased. Thus, in going from the low powers of field glasses to the moderate 25x or so of spotting 'scopes, the instrument is lengthened to reduce the aberrations of the lens. The optics of such instruments are easily mass produced in multiple groups to commercial tolerances.

Since the lens need not be perfect to do its job quite well in these two cases, the best practical compromise is quite sensibly employed. This may explain why no figure for sharpness or resolving power is ever given in binocular or spotting 'scope specifications. Adequate sharpness for their magnification is taken for granted, so all emphasis is placed on degree of enlargement, lens diameter, width of field, relative brightness, size and weight, which are actually physical descriptions of types of field glasses.

The Astronomical Telescope—In high-power telescopes all considerations recede before the central question—how sharp is it? How well can it define? What is its resolving power in seconds of arc? Does it resolve to the theoretical limit for its aperture?

This requirement of absolute perfection serves to distinguish the astronomical telescope from all commercial optical instruments. Each lens or mirror should now be made singly, with great care.

In place of the large "circle of confusion" produced by the best camera lenses, the astronomical telescope delivers the tiny round disk and rings of a classical text-book diffraction image from each point source of light. The size of this hard disk diminishes directly as aperture increases. The larger the aperture, the better the resolution permitted by these smaller disks. Stopping down makes the disk larger.

We ask the ultimate of this class of "perfect" instruments. Their images must stay sharp and clear at powers so high that the limit of useful magnification is set only by external causes, such as turbulence of air or dimness of the object viewed.

Shortcomings of Astronomical Telescopes—It is no accident that the very name of this highest class of telescopes describes their former limited usefulness. For generations people have come to think of them as suitable only for astronomy. Nor have they been wrong, for who wants to view the landscape upside-down? While erecting prisms can cure this trouble for refractors, not all reflectors have room to use them. The terrestrial use of either type, even with erect images, is complicated by the polar equatorial mounting, or if the mount is altazimuth, it is impossible to follow the stars. Conventional instruments are thus mounted for one use or the other, but never for both.

Refractors suffer from spurious color, particularly noticeable as a halo around bright objects, and this inability to bring all colors to the same focal point restricts their photographic usefulness by making necessary filters to absorb the unfocused colors.

The mechanical bounce of light from a reflector, on the other hand, brings all colors to a focus, but its shorter focal length reduces the size of image and of usable field. The reflector's open tube gives rise to internal tube currents that derogate the image, and its aluminized surfaces, unprotected from the excreta of insects, are exposed to dust and dew also. At the open end, too, are the metal

vanes that support the secondary mirror, whose alignment must be critically maintained. As light rays pass these crossed metal strips, the phenomenon of diffraction, visible as spikes around bright stars on some celestial photographs, acts to impair resolving power.

Neither refractors nor reflectors can focus on near things; some, indeed, no closer than a hundred yards.

But the great drawbacks to conventional telescopes are their long tubes and heavy, awkward mountings. The better the mounting, in fact, and the more controls it affords, the heavier and more complex and costly it becomes. Only one who has unlimbered the parts of a telescope from its coffin-like box and staggered forth into the night to assemble his fragile but heavy burden can fully appreciate the work involved. Once set up outdoors, the observer's chair then appears to be by turns too high, too low, too far or near the eyepiece—it never seems just right. The long tube trembles in the slightest breeze, the finder is remote, and the eyepiece swings through arcs of several feet. At every touch of focus knob, the whole contraption oscillates like the great balanced pendulum it is. There is nothing to be done but sit and wait until the magnified vibrations quiet down.

Finally, when the observer has had enough of unaccustomed acrobatic postures, he must take the whole thing down again and carry it piecemeal into the house, where, to the dismay of his wife, he must find a place to store it all. And lucky is the man who does not forget one last trip for his box of eyepieces.

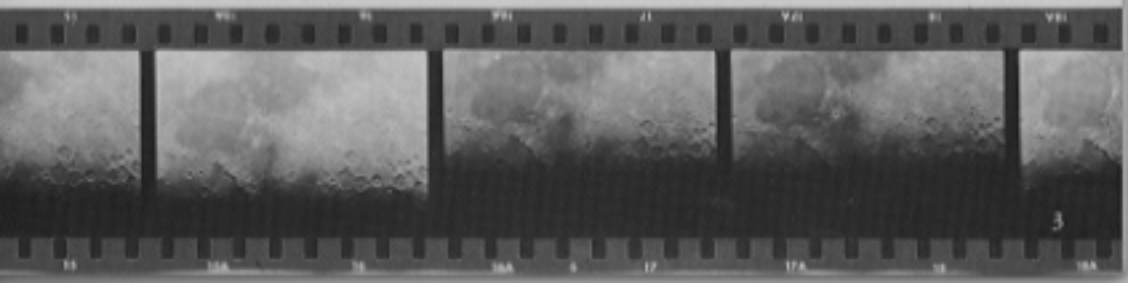
In view of all this fuss and inconvenience, it is small wonder that the conventional telescope is little known and little used. Only the truly dedicated will put up with it for long. All too often after one is acquired the novelty wears off and it is used less and less frequently, until at last it comes to rest in someone's attic. There was just too much work involved for the pleasure it provided.

The Many Miracles of Questar

In the following pages we shall try to tell you of the many merits of our beautiful hand-made product. Many of the photographs here let Questar speak for itself. They tell the story of performance in the best possible way, by recording it for everyone to see.

We hope that some of this material may prove interesting or useful both to the novice and to the expert. In preparing it we fully realize that everything we say will be appraised by the professional eye. We ask your indulgence for those places where we are either too technical, or not technical enough.

Today's 35 mm. single-lens reflex camera bodies with focal-plane shutters, but without lenses, are nearly ideal for receiving the images of telescopes like Questar. Picture sharpness can be a direct measure of telescope's optical quality.



This is how a cardinal 50 feet away appears with Questar's middle power of 80x. The bird seems hardly 8 inches from your eye. Note the needle-sharp detail of every single barb of each small crimson feather.

The Most Powerful Telescope for General Observing

To those accustomed to binoculars or spotting 'scopes, Questar's great powers of magnification almost always seem astounding. Indeed, it is hard to get used to seeing such huge sharp closeups of objects that have totally escaped the naked eye. Time after time the incredulous eye is raised from the telescope to locate in the general scene what appears to be so near.

With Questar on your porch or garden table, the world is yours. You are at the center of a two-mile circle where the farthest object, at 160x, seems to be but 33 feet distant. If there are hawks or waterfowl or deer 1000 feet away, they cannot feel your presence as you seem to join the group. At that distance, also, fly and wasp and bee are plainly seen, and even swarms of gnats.

At 100 yards this page is sharp and clear; the flower, the bird, the leaf and children's faces seem within our reach. Wherever we turn in the country landscape, nature reveals another of her hidden faces.

The city dweller likewise has no lack of splendid views; indeed, he may have several vantage points from which to look. Perhaps there is a river or harbor to explore. Everywhere the tasks of men go on, and then, after dark when lights come on, the textures of drab things acquire distinction as man-made light and shadow create another town.

Questar's final size and shape is by no means accidental. Its 3.5-inch aperture was selected as a golden mean, small enough to be a keen air-piercing rapier, yet large enough to do the job efficiently.

Its shape is right for you to wrap yourself around, so to speak—draw close to it and turn the tilting eyepiece into just the proper place. Your own observing comfort is the thing that matters here, and this eyepiece tilt may save your neck that little bit of twist that brings fatigue. The finder view is wider than that of most binoculars, and you need not move your head for power changes. These built-in features, plus the smooth slow motion controls, put all of Questar's power at your fingertips.

The 6.7-pound Questar slips out of its case fully assembled, all in one piece, ready for use. The mounting is of correct altazimuth type, similar to a surveyor's transit, for terrestrial use from any handy surface. Every unique feature of this mounting, excepting only the electric drive, has been specifically designed for terrestrial work. The rotary barrel, for example, will also turn the eyepiece horizontally to permit Questar's use from a high wall or shelf as you look sideways into the instrument, and the star chart pulls forward to become sunshade, rainshield or dewcap.

There was never so flexible a mounting. We have tried to think of everything that would make both prolonged and impromptu observation easy. Take it on your motor trips—it attaches in a jiffy to your car. Take it to your high hotel room, to the mountains, to the shore. Don't worry about mirror coatings or salt air corrosion—Questars withstand sea air and the high humidity of jungles with just ordinary care. So take it with you wherever you go, for the fullest enjoyment of your family and friends.

Anyone can take a picture like this without special care. We went out of our way to take this one as the veriest tyro might, buying Eastman Panatomic film at a small town drugstore, carrying the exposed roll for several hot summer weeks in a car, then having it developed and printed by a local photo shop. Exposure was 1/50 sec. at prime focus with extension tubes and Hexacon camera body. Films are much faster now.

On this trip in 1956 we were testing the Linhof Professional De Luxe Tripod. With camera removed, telescope on tripod was carried ready-to-use lying on back seat of car. Note that barrel is rotated 90° for vertical framing. Before shooting bus, over ¼-mile distant, it was studied visually in 40x eyepiece view which is more brilliant than image seen on ground glass.

Questar owners have sent us many excellent 35 mm. color slides of birds. The most beautiful bird photography is done with electronic flash illuminating a feeder, which may be camouflaged by means of bark and leaves like this one. Colored cardboard backgrounds can be used, and often blossoms or exotic flowers employed with personal artistry and taste to great decorative effect. The photographer no longer needs to hide in a blind or tent up close, but now can use Questar at 35 or 40 feet with such a set-up. A few experiments will determine the best position of the two lights used, and then each shot under these ideal, controlled conditions will be a perfect exposure. The birds seem completely unaware of the brilliant flashes of light. From time to time their wing motion will be caught, as in this shot from 37 feet. Mecablitz flash with extra light; Adox KB14 B & W film.

It takes but a minute to attach your Questar to the great mass of your car. Just pull out the two front leg hole plugs, screw them into the base casting, and hook their wide heads over the lowered glass. Many modern cars are so flat on front and rear decks that Questar may be used from them without attachment.

The World's First Long Distance Microscope

The long distance microscope is a wholly new and previously unknown optical instrument. A new experience awaits both amateur and expert, for Questar can be continuously focused all the way from infinity down to less than 10 feet. Its exquisite definition at high powers may be turned with startling effect on all objects in this astounding range.

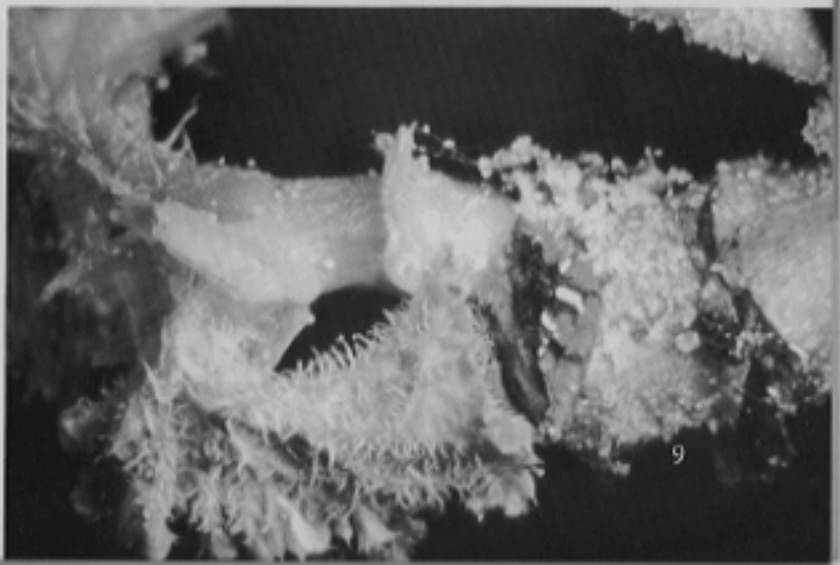
Conventional high-power telescopes are physically limited by their long tube structures from focusing closer than a few hundred feet. To work at less than ten feet a refractor of like aperture would need about a 9-foot tube, double its normal length.

Questar's exclusive internal focusing permits the exploration of the near with such tremendous powers that here, for the first time, is a microscope that works at a distance.

The result is invariably thrilling, even to the most experienced persons. No one has seen views like these before. Lowly weed-tops become great symmetrical bouquets; the bee at the wildflower, a monster of terrific size. Many Questar owners never tire of exploring the tiny details of plant structure from their garden tables.

Since it is the only telescope that can be demonstrated indoors, regardless of the weather, your Questar may become a conversation piece when entertaining guests. At our offices we demonstrate at 25 feet a well-lit group of common objects—a dollar bill, some stamps, a butterfly's wing, safety matches, torn paper's edge, and some specimens of color printing. We can recall no visitor to date who has not been astonished at the detail of these commonplace things when revealed by Questar at this distance.

At the laboratories of the Corning Glass Works, a research project has employed a Questar to take various kinds of 16 mm. motion pictures in a study of what occurs at the juncture of molten glass, tiny crucible and air at temperatures around 3000°.



Above, taken at 30 feet, this half-inch flower has a tiny visitor. Where is his little shell? Below, the tongue, head and eye of a moth. At right is a small plant stalk.

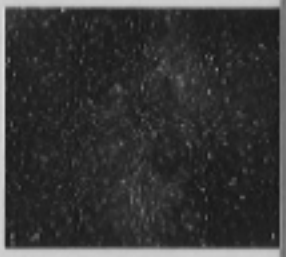
Mr. and Mrs. Ralph Davis of Sarasota, Florida, are Questar owners who find high resolution photography with their instrument a fascinating avocation. Becoming impatient with the graininess of fast emulsions, they took this picture of the lunar crater Copernicus by 80x eyepiece projection, with equivalent focal length of 31 feet, on slow fine-grain Microfile film at 14 seconds exposure. In this time the moon moves backward by 7 seconds of arc against the background of stars with which Questar's electric drive is synchronized. To compensate for this they set the polar axis slightly askew by experiment until the moon's image appeared stationary on the ground glass. On this scale, moon would be 2 feet in diameter.

A Portable Observatory in One-half Cubic Foot

For astronomical use, Questar's dual-purpose mounting becomes the polar equatorial mounting used by all observatory telescopes. Essentially the polar equatorial is only an altazimuth mounting tilted so that its vertical axis points near the pole star to align it with the earth's axis. Its chief advantage is that celestial objects, which appear to wheel overhead and set in the west as the earth rotates eastward, may be followed with one continuous motion instead of a series of zig-zag steps.

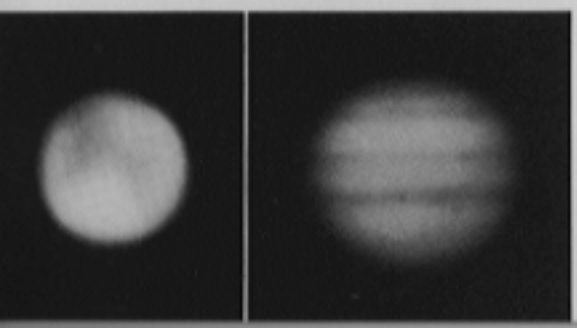
Questar is tilted into polar equatorial position by pushing three precision-ground legs into honed sockets in the base casting. The center leg is adjustable. Less than a minute suffices to locate the pole star in the finder, shift the telescope's position, adjust and clamp the leg in alignment. The adjustable leg also compensates for the table top's deviation from true level. The instrument is in balance, without the use of counterweights, in all latitudes from 55° in Canada to 32° in Mexico. It is firm and stable, rock steady, and its eyepiece and controls are raised about one foot above the table.

Many advantages result from this basic new conception of observing from a table. The observer is at rest, seated facing south in the easy attitude of study. He looks down to scan the heavens, as into an inclined microscope. His whole body is relaxed, unstrained. He may vary his position, rest his elbows on the table, or cover one eye by cupping his palm over it to avoid squinting. The large arteries that nourish his eye and brain are not constricted by a bent or twisted neck. His visual acuity is at its peak, so that the longer he looks the more he sees.



In taking the Copernicus picture the Questar optics in their 8-inch barrel were performing like a fine conventional telescope with a tube 30 feet long. What is the secret of such amazing performance? It is just a matter of superfine quality. Each lens and mirror set must be a masterpiece of the optician's art. An f/8 mirror starts to work when its surface is accurate to ¼ wavelength of light. If its focal length is cut in half, to f/4, the surface must be four times finer, ⅛ wave, to perform as well. Questar's mirror, working at f/2, thus must be sixteen times more perfect of figure than a conventional f/8 mirror, or accurate to 1/64 wavelength. No test but a performance test can indicate its quality. So each lens and mirror is brought to final figure by a series of performance tests during the aspheric hand-retouching of the matched set. By these slow, painstaking, skilful means the small residual aberrations of this most modern of all optical systems are still further reduced.

All the pictures in this booklet, save those of the various instruments, were taken by Questars with 35 mm. cameras. From an image smaller than a pinhead, the remarkable picture of Mars, below, was made with an exposure time of 24 seconds! The world's greatest telescopes have taken worse pictures of this elusive planet whose "canals" have never been plainly photographed. At right is Jupiter. High-power telescopes like Questar have proportionately small fields of view, but show the best-known nebulae very well. Starfields are best photographed by the fast Schmidt wide-field cameras. Our own little cameras are miniature Schmidts in speed and field, so Questar owners have mounted them piggy-back on the electrically driven 'scope and secured several thousand star images in only 4 minutes, above.



The comfort of this observing position will spoil you for all other telescopes. The gain in seeing is often quite impressive. Of course, Questar may be used from a fixed post, if desired, or from a portable tripod in the field, with many of the same advantages.

When facing south, the observer has the most interesting part of the sky before him. Here is the moon, the celestial equator, and the plane of the ecliptic from which the planets never stray by more than nine degrees. Here are the constellations of the zodiac.

Questar's patented perpetual star chart now comes into play to locate celestial objects or relate them to the setting circles without need of calculation. This chart, due to its feature of rotation, takes the place of twelve monthly maps. No need to hold books overhead, or puzzle out which quarter of a map to use or in which direction to face while using it. No need to hold a flashlight in your teeth. You just turn the chart to the month of the year, look down at it and check against the sky. What you see on the map is in the sky: what you cannot see is hidden by the earth that month. That's all there is to it. The color contrast of its light yellow stars against the deep warm blue of the sapphire-plated metal makes them easily discernible in very dim light. Because the planets move (from the Greek *planete*, meaning *wanderer*) no map can show them. The chart gives accurate positions for 340 stars, and, once set, the right ascension circle, when motor driven, becomes a 6-inch celestial clock in step with the heavens.

This flexible but sturdy star chart also slips forward to become a dewcap, protecting the front lens against fogging over on those moist nights that cause telescopes to condense moisture like an iced drink.

Under the star chart is a large moon map whose engraved lines are filled with white enamel against the dark blue metal sheathing of the barrel. This unobstructed barrel is made possible by Questar's patented fork-within-a-fork design, which supports the tube by its rear closure plate without encircling straps near its center.

The left side arm of the fork carries the circle and declination clamp; in the right arm is the declination slow-motion drive. A similar slow-motion knob in the fork's base operates the right ascension drive manually, whether or not the motor is running. These slow motions are of the 360° continuous type, such as only the most modern observatory instruments afford. They are velvet-smooth, with no backlash at all. Built-in slipping clutches allow manual fast motion without risk of damage.

An important innovation is the patented Questar method of mounting the primary mirror on a thimble passing through its perforated center, with plastic spacers to keep the glass away from heat-conducting metal. Aside from this support, the mirror is free-standing in air, with consequent mechanical and thermal stability. The long thimble is free to slide along another stainless steel tube, permitting Questar to achieve its great focal range without moving the eyepiece rearwards by several feet. A focus knob, below and to the right of center of the control box, actuates the mirror and serves to indicate its position.

We have long known that nature seems especially to favor the superfine small telescope. The story of our life with Questar is the record of one astonishing performance after another. In the spring of 1960, now half a year ago, we received photographs indicating that our own minuscule, 7-pound instrument 3 years previously had photographed a piece of fine lunar detail that was also at the photographic limit of the great Mt. Wilson 100-inch telescope. We know this sounds ridiculous and quite mad, but here is the story: The picture at left was run full-page height in previous Questar booklets. In this central region of the moon the two arrows point to the cleft of Hygenus, about 1 second of arc and a bit over 1-mile wide. We were elated, 3 years ago, to publish this proof of unusual performance. The crater Hygenus, between arrows, is 4 miles wide, while above it to the right is the 14-mile-wide crater Triesnecker.

Upon improving their enlarger last spring, the Davises found that from the same 35 mm. negative taken 3 years ago, they could print not only little craterlike enlargements in the Hygenus cleft, but intricate traceries of the more delicate cleft system at left of Triesnecker.

Below are two such prints. Perhaps little has survived the platemaking and printing. But we hope you can at least see the "craterlike enlargements" of the Hygenus cleft.

Visitors who compare the Triesnecker clefts with plates C4a and C4b of Kuiper's "Photographic Lunar Atlas" (Univ. of Chicago Press), called the finest ever taken, receive the same shock we did at what appears to be about the same .4-second resolution.

Built into the control box is a sliding erecting prism which deflects the main ray bundle up into the radial eyepiece. A finger-flick lever pushes the prism aside at will, allowing the main rays to continue axially rearward to any attached eyepiece or accessory. In so doing, it allows the rays of a low-power wide-field finder telescope, whose collecting mirror and lens are underneath the box, to enter the eyepiece above it. Thus one eyepiece serves both finder and main telescope at the flick of a finger without moving your head.

Built into the control box is also a modern short-focus negative achromatic Barlow lens. Another finger-flick places this above the prism to double the power of the eyepiece used. No need to squint through a miniature ocular for high power—you use the same normal-sized one with comfortable high eye-point. Thus each eyepiece has 3 powers—4, 40, 80x and 8, 80 and 160x. You needn't move your head. For powers above 300, if desired, you can use our camera coupling with eyepiece holder ring to elevate the 5-element, wide-field Erfle 80x eyepiece farther above the amplifying lens.

The supreme touch of practical luxury is furnished by the built-in synchronous electric drive which, by neutralizing the rotation of the earth, holds celestial objects motionless in the field of view. No telescope of which we know has a driven gear so large per inch of tube length; none has so much torque per ounce of driven parts. There are no universal joints or tiny bevel gears to introduce large periodic errors. The Cramer motor's sealed gear train runs in oil, requiring no attention. Drawing only 2.7 watts, it operates from 110v 60 cycle current. An inverter may be used for battery power, and special motors are available for foreign voltages and frequencies.

Questar's automatic following is smooth and effortless, free of falter, jump or backlash. No need for exact polar alignment for it to work extremely well—you may be off true north by several degrees. The surprisingly rapid drift of objects from the field of view when viewed at high powers with a manually driven telescope, need no longer interfere with demonstrations.

The basic Questar concepts of building-in and merging accessories with telescope are genuine advances that have won for Questar more patent awards than any telescope of record. Few instruments at any price are mounted so adequately and elegantly as Questar. All these refinements, innovations and conveniences leave the Questar owner free to concentrate wholly on observing near the limit of his vision. He will, of course, improve his visual abilities with practice, as all experienced observers do when they set out to train their eyes to the particular degree of magnification, brightness and contrast of one or two well-chosen powers. As in any other field, it takes a little practice to enjoy a telescope's full powers of resolution.

And as to resolution, no picture taken with a Questar can equal what the eye can see with it. The physical losses at each step of the photographic process add up to a serious overall lack of sharpness; often only a fraction of what the eye sees clearly gets recorded. So all these Questar pictures show but part of what was actually seen when they were taken.

This is the Questar optical system. Its correcting lens and mirror are but 6 inches apart. Due to the perspective in this photograph, the 3.8-inch mirror looks smaller than the lens, but is actually larger. Quartz mirrors are available on special order for those who wish the ultimate in resistance to temperature shock.

Not shown is the amplifying lens which cuts in or out of the ray bundle just above the prism to increase the power of the comfortably large eyepiece. Also not shown, below the prism, is the finder lens which faces downward toward its tilted collecting mirror. Finder image enters eyepiece when prism is moved aside; at the same time axial rays from main system are projected rearwards to the film plane shown.

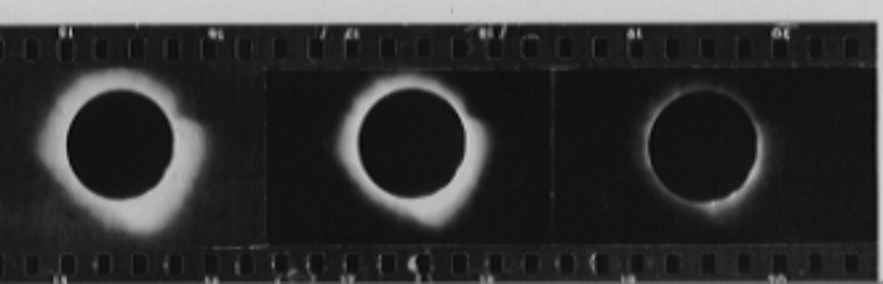
The book is a 1647 edition of Johannes Hevelius' great "Selenographia," the first systematic study of the moon, only 38 years after Galileo invented the telescope. Note how little the conventional telescope has changed in over 300 years.

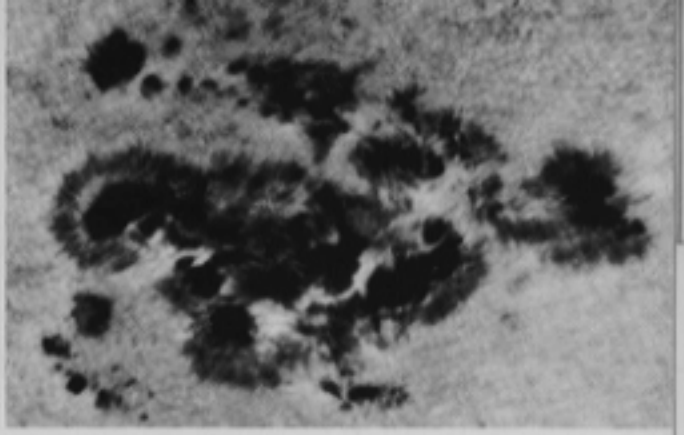
This picture illustrates several Questar features. The star chart and dewcap are off to show the large moon map engraved on the sapphire-plated, deep-blue barrel. This is turned a little on its axis for someone's observing comfort. On this side is the stainless-steel declination circle indicating altitude; large knob is clamp which locks it in position when desired.

The standard Questar filter, of 1.5 inches off-axis aperture, is shown on inside back cover. Above are two views of the larger version of this patented device, whose working is described on the second page following. One full-aperture filter on the telescope is posed to let us look through its ventilating slots, while another in its handmade walnut box is at lower left. The standard filter is best for low powers; the large one is five times brighter for high-power work with unimpeded resolution. These filter disks must be truly parallel to a disheartening degree. Each uncoated disk must test to absolute invisibility. To keep them thin as window glass, they are made by optical contacting to a heavy flat. To eliminate the pinholes inevitable in all evaporated metal films, the full-aperture disks are three times coated and twice hand-rubbed.

This is probably the most technically difficult photograph ever made with a Questar. The effective focal length used was over 50 feet! The largest of these elusive solar granulations measures only 2 seconds of arc. They are best seen from mountaintops to avoid looking through the thickest and worst part of the earth's heat-agitated air. The Director of the High Altitude Solar Observatory, 11,300 feet in the Rockies, has congratulated the Davises for securing these pictures regularly from sea level at Sarasota, Florida, and us, for making Questar, whose short barrel and high resolution make it particularly well-suited to the task.

At some observatories Questars are used to record conveniently each day's sunspots on the solar disk. *Below* is the sun's corona in the total eclipse of Oct. 2, 1959. Due to clouds nearly all observers except *Mr.* Dumont Rush in the Canary Islands missed seeing it. Note identical size of sun and moon images. Prime focal length is 56 inches.





Another Davis sunspot group. The intricate tracery of "bridges" across many spots defies one's best efforts to print them. Using Questar's 40-80x ocular with eyelens toward film (which makes a fine magnifier), you may see them in profusion on negative. Most of them get absorbed by the black central part of spots during development. This is one reason why professional astronomers study negatives instead of prints.

The First Safe and Distortionless Solar Telescope

Since Galileo invented the telescope in 1609, men have tried to study the surface of the sun and to penetrate the mystery of the sunspots. During his lifetime, the solar disk was viewed by projecting its image upon a white card from the single lens that served as eyepiece. This primitive method, which still persists to this day, is lacking in sharpness. The intense beam of concentrated rays that traverse the eyepiece lenses, although fine for lighting cigarettes, will burn up the cement between the elements of any first-class modern eyepiece to quickly ruin it.

The sun is best seen by direct observation. This method requires some arrangement to keep the blinding light and heat from entering the observer's eye. Previous dispersion or absorption devices have always been applied near the very hot "burning glass" image of the sun at focal point. Incredibly enough, no one ever thought to diminish the solar radiation save *after* it had passed through most of the instrument, warping lens or mirrors, heating the air trapped in the tube, and sometimes damaging not only eyepiece but the observer's eye, as well, when a dark glass filter has suddenly cracked from heat.

It has remained for Questar to introduce a filter which keeps the unwanted harmful heat outside where it belongs. Only one part of the light in 50,000 enters the telescope at all, the rest being reflected by a measured thickness of chromium metal on a sheet of glass placed over the front lens. The choice of chromium is a happy one; it is so hard that it resists abrasion and requires no special care, and it transmits all colors truly without selective absorption.

With Questar, the sun's face may now be studied in safety and comfort with a steadiness of detail previously unknown. Since Questar is prevented from warming to the task, no internal convection currents or warped optical surfaces are created to spoil otherwise good seeing. The highest powers may be employed at unimpeded peak efficiency.

The patented Questar solar filter is now available in two apertures: an inexpensive off-axis 1.5-inch size, and one of full 3.5-inch size in ventilated cell. The considerable difference in price reflects the cost of manufacture of the thin glass plate of the larger one, whose tenth-wave surfaces must be plane parallel to one second of arc.

Telescopic Photography

It is easy to take photographs with Questar by attaching a 35 mm. single-lens reflex camera body, without lens, just behind the control box. Questar becomes the lens, focusing its expanding bundle of light rays on the reflex groundglass. Having checked the focus, the exposure is made. That is the procedure.

Suitable cameras are the Alpa, Asahi Heiland Pentax, Astra, Consol, Contarex, Contax D and S, Edixa, Exa, Exakta, Hexacon, Leica (with reflex housing), Miranda, Pentacon, Pentamatic, Praktica, Praktina, Praktiflex, Rival Reflex and Tower.

Please note that all these cameras furnish three essentials for their use with telephoto lenses of long focus. Each provides a groundglass for exact focusing. Each has a roller-blind focal-plane shutter close to the film, and each has a removable lens assembly whose receiving flange will accept a coupling. Reflex cameras with between-the-lens shutters of the Compur type are unsuitable because their shutter openings would be too small to admit the wide ray bundle, even if the lens elements could be removed and couplings attached.

Couplings are available for the above cameras. These sets include a 50 mm. 3-section set of extension tubes, and an eyepiece holder ring, previously mentioned.

The bundle of light rays emerging from the small central tube on which the mirror slides, expands as it goes rearwards. Actual image size and focal length increase with the distance rearwards that is chosen as the focal point by Questar's internal focusing. There is no fixed focal point. It is flexible—you bring the rays to focus where desired.

With camera close-coupled, the circular image does not fully cover the full 24 x 36 mm. double-frame film size. The focal length is about 49 inches, the focal ratio f:14. Moving film plane rearwards 50 mm. by means of the extension tubes lets the enlarged image cover all but the extreme corners, with approximate focal length of 56 inches at f:16.

An important feature of this variable focusing is that it permits Questar to retain its very perfect correction at all distances. Below 20 feet extra rings around the diffraction images of highlights appear, becoming noticeable as loss of contrast at the brutally short range of less than 10 feet. Placing eyepiece or film plane a few more inches farther to the rear compensates for the short distance, putting the system again into complete balance. The extra rings vanish as the classical disk and ring image of the perfectly corrected telescope is restored.

At left, the Davises found Adox KB14 film almost as grainless as Microfile, considerably faster and with vastly better range of tone. This greatly reduced the amount of enlarger dodging necessary for a good print. Some dodging is almost always required since the bright portion of the moon gets about 1000 times more light than the deep shadows. Emulsion cannot respond to such a range by more than about 50 to 1, so in making a print like this the hand is held below enlarger lens and slowly moved to the right, allowing much more light to reach and penetrate the over-dense left-hand portion of the film.

Mouse-size flying squirrel at 30 feet, twice size. Left, a larger closeup of a baby owlet, no bigger than a chick, also from 30 feet. Note feather detail. Below, from 350 feet, a field shot at 1/1000 sec. on Agfa Isopan. Note the long-focus Questar's great depth of field. Everything is sharp.

A first-class star image.

The late Dr. C. E. K. Mees, Director, Eastman Kodak Research Laboratories, once remarked that he bought his Questar "because it had the finest diffraction image he had ever seen outside of textbooks."

Diffraction images are easy to see. Polaris, the second magnitude North Star, is a fine test object practically stationary in the sky. In sunlight we may turn Questar on a variety of small shiny curved surfaces which reflect a tiny bright image of the sun to form an artificial star, a bright point source of light smaller than the resolution of the telescope. The chromium trim of cars, glass insulators, points that sparkle on the crushed stone of shingles, droplets of dew on plants, a crumpled piece of foil or cellophane—such highlights are not hard to find. These artificial stars are studied at high powers.

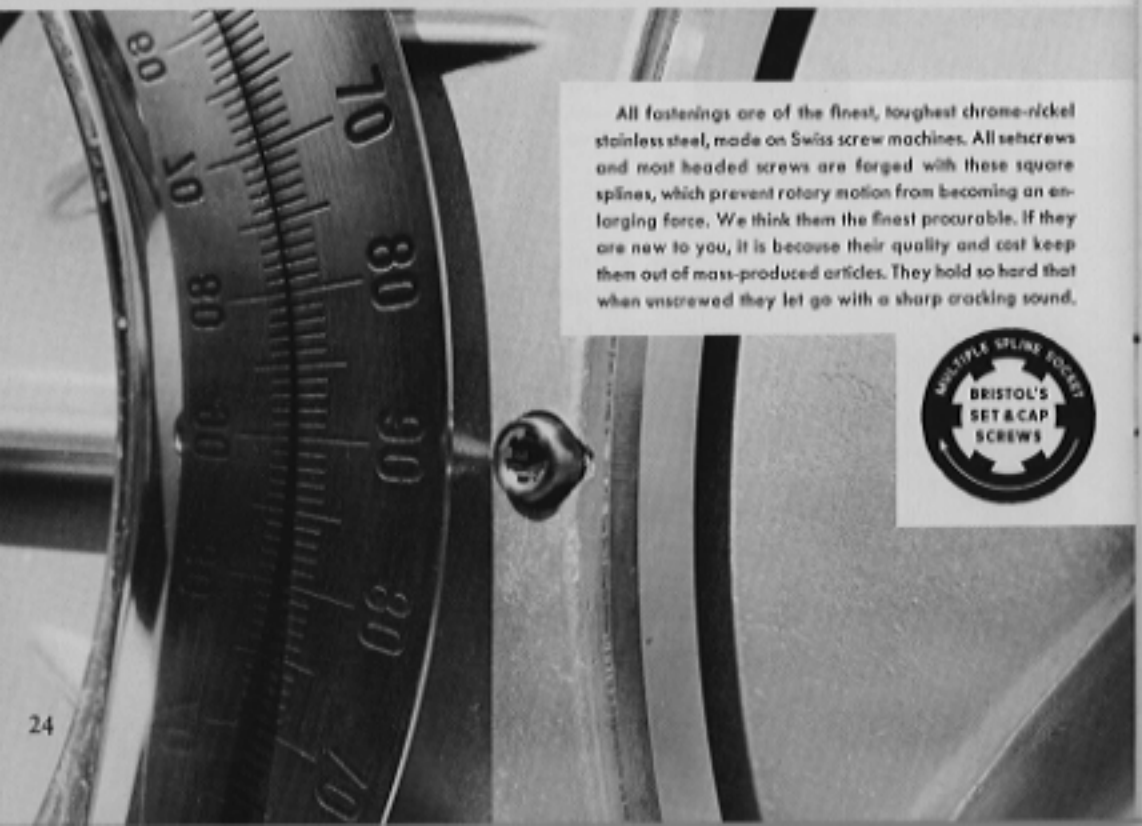
This is the ultimate test. Only the most perfect lens or telescope will show at focal point a tiny hard round disk, containing 85% of the light, surrounded by a narrow bright ring with sometimes a faint second ring visible. The first ring should be narrow and quite hard. The size of disk determines resolution. Images of extended surfaces are built up by countless overlapping disks or dots. At prime focus, the disks are of the order of .0001 inch in diameter.

In 1958 Questar was the first high-power telescope to reach the stratosphere, where the air is so thin that stars no longer twinkle. *At left,* preparing the great balloon. *After the flight,* Commander Ross, pilot, and Naval Observatory Astronomer Mikesell. Questar worked fine at 86° below zero, 40,000 feet high.

Two years later Questar had become a regular little workhorse in a list of research laboratories that reads like a directory of scientific institutions. The largest universities, corporations, and some public school systems continue to purchase Questars, as do many government agencies, including the Army, Navy, Air Force, atomic energy plants, space agencies, and research groups.

So many projects are exotic and secret that we know nothing about them. We do know that some Questars are in navigational devices, some have photographed nose-cone re-entries, and some are used in television. Four will go, with color television, into the world's most advanced surgical pavilion. We have been told that some Questars have reached outer space. Are they the first true telescopes to do so?

Questars are on every continent and in every kind of climate. They are in use at great observatories and small ones; at universities, colleges and schools. Many distinguished persons are Questar owners. The list of corporation heads alone is an impressive one. But more impressive still is the fact that there is no single type of Questar owner. Men and women of all ages, from every walk of life, enjoy the versatility of Questar.



All fastenings are of the finest, toughest chrome-nickel stainless steel, made on Swiss screw machines. All setscrews and most headed screws are forged with these square splines, which prevent rotary motion from becoming an enlarging force. We think them the finest procurable. If they are new to you, it is because their quality and cost keep them out of mass-produced articles. They hold so hard that when unscrewed they let go with a sharp cracking sound.

MULTIPLE SPLINE SOCKET
BRISTOL'S
SET & CAP
SCREWS

Going in and out of focus shows up every fault that optics suffer—astigmatism, false color, spherical aberration and coma. A tail or flare is serious. The expert tests a system in this manner at a glance.

The larger the aperture, the smaller the dot and the greater the power of definition. Photographic lenses do not produce these tiny disks, but much larger, fuzzy "circles of confusion." The faster the lens, the larger these are apt to be.

The foregoing may explain why stopping down would only serve to coarsen Questar's image. This usually surprises the photographer who is used to stopping down his lenses to increase their sharpness. He has never had the use of perfect lenses. Fast lenses are necessary for slow films, but now film speeds are sharply going up, and in the normal course of progress they will keep on doing so. Thus, as emulsion ratings double and redouble, the abilities of Questar should continue to increase.

The Questar optics are so perfect that man cannot hope to better them in any instrument of equal aperture. Had we cut down its focal length to make it faster, it would no longer be the world's sharpest telephoto lens. The result of both lessened sharpness and smaller power to enlarge would be a serious overall loss indeed.

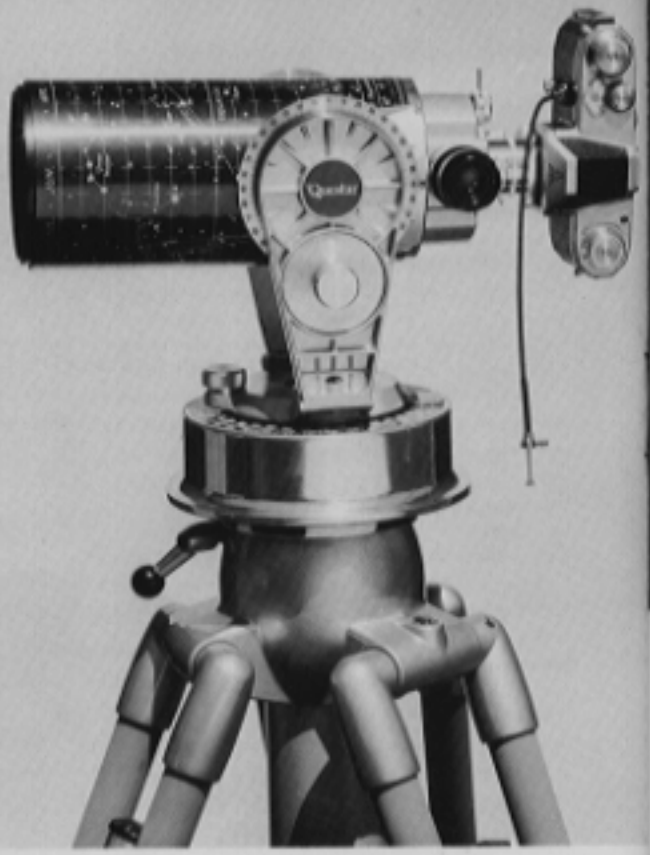
To take pictures at great magnification of distant objects is not difficult. To fully utilize Questar's powers of definition is a challenge to your skill. The requirements are simple: exact focus, an air path of tranquil atmosphere, and no movement at all of the focused ray cones on the film during exposure. It takes very little vibration to shift an image disk, only .0001-inch across, by its own diameter. How far the photographer is willing to go to meet these conditions will make the difference between securing a merely acceptable picture or a brilliantly sharp one.

The most spectacular evidence of Questar's superfine optical system is the fact that for special purposes its effective focal length can be extended greatly by eyepiece projection without breaking down the image. With each set of couplings is supplied a threaded ring which holds the 80-160x eyepiece inside the forward end of the extension tubes, projecting the image 64 mm. from eye lens to film for a focal length of 17 feet. At 100 mm. projection distance, the focal length becomes 30 feet.

This is over 9000 mm. of focal length from Questar's little 8-inch barrel! All of it is usable, as the 1-second detail of some of these photographs attests. When you consider that this is 60 times the 6-inch separation between Questar's lens and mirror, we think you will agree that such magnificent performance from so small an instrument borders on the miraculous.

Since the 1958 text above was written, many new uses for Questar have been found. These are reflected in several new pictures and captions in this new printing of November, 1960. We have learned more about telescopic photography, too. May we send you our latest leaflet on the subject?

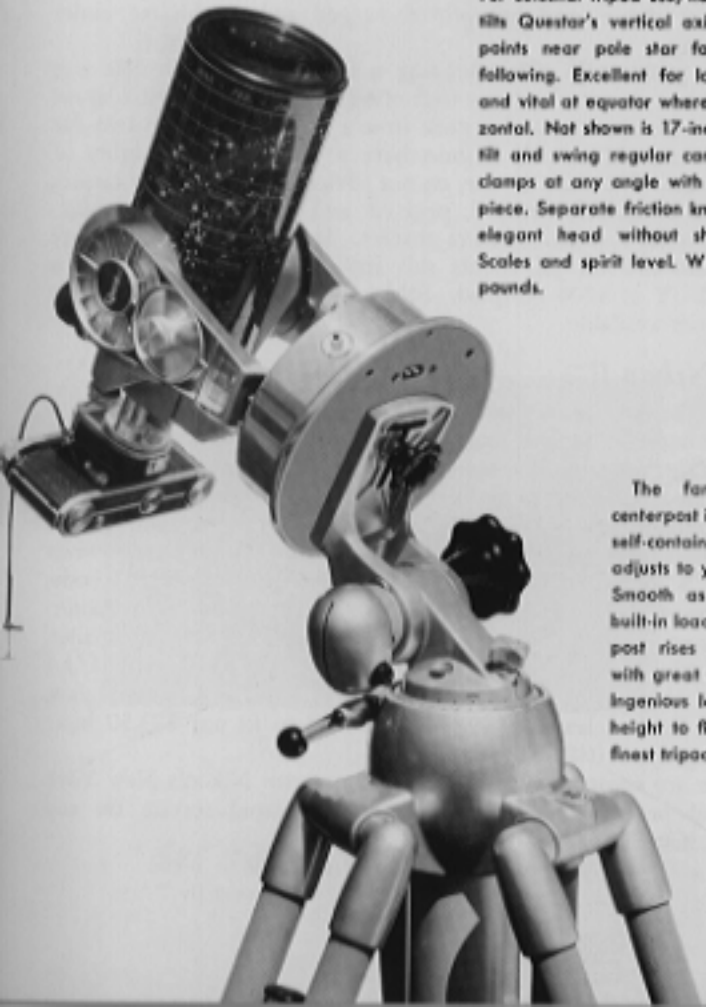
IMPORTANT! Only single-lens reflex cameras are suitable for direct-image photography. The lens must come off just like this. So check your reflex camera for these features: a wide hole to admit an expanding bundle of rays, and a shutter of the roller-blind type at rear of box, near film and focal plane. ALL CAMERAS REQUIRE THIS BASIC COUPLING SET. Those with bayonet lens mounts need an adapter ring to join basic set. As shown above, the coupling set's black extension tubes place camera's focal plane 2 inches rearward for reduced vignetting at f/16. These 2 inches increase photographic focal length from 49 to 56 inches.



Without coupling's black extension tubes camera is close coupled, as shown above for terrestrial work at f/14 on Linhof Tripod. Note that the whole barrel turns to vertically frame picture. Questar may still be used visually. Knob on this sidearm operates altitude clamp.

Basic coupling set has two other important uses. With each set is included an eyepiece holder ring which can be clamped between any two tube sections to hold an ocular. *At left and below*, note how ring is held between uppermost tube sections to lift 80-160x eyepiece up to 2 more inches above the built-in amplifying lens for powers to about 300x. No need to buy expensive extra high-power eyepieces with tiny lenses, small fields and uncomfortably low eyepoints. This is the modern way to achieve high powers with a superb wide-field ocular of comfortable normal size. By changing sections to vary height you may choose your favorite degree of magnification. Questar's built-in negative achromat or short-focus Barlow amplifying lens is the one discovered by the late great lover of fine optics, Frank Goodwin. He sold thousands to all who use telescopes and probably has changed observing habits permanently. Eccentrically advertised and wretchedly mounted, each lens was nevertheless the finest procurable, and for his insistence that every last one be perfect, we honor the memory of an old friend. Third function of basic coupling set is to hold 80-160x ocular in eyepiece ring clamped, as shown below, between first joint of extension tubes. Here 5-lens Erfle eyepiece projects image 64 mm. to film for full coverage of double frame at effective focal length of 17 feet.

It is impossible to overemphasize the importance of a stiff, tremorless support for both visual and photographic work with a high-power telescope. High-power photography is much like sharpshooting with a high-power rifle. The marksman has to hold his heavy target rifle, with its leather sling taut, hard and true on target. So must we support our great long-focus lens; it must be truly motionless during the period of exposure. The tripod at left, by Linhof of Munich, is not only the finest we have ever seen but the first we have ever recommended without reservation. Solid as a concrete pier as shown, and the only tripod we know that is stiff enough to support Questar adequately at standing eye level. Lighter than it looks; only 17 pounds. Easy cam-locking legs, here shown extended 2 inches, makes height adjustment simple. Folds to 36 inches—carry it in car trunk with a folding stool. Exclusive big rubber pads screw down to render harmless the sharp steel spikes that could damage car, floor or person. Detachable stiffening struts, spirit level. Beautiful finish matches Questar's. This is best of class—no lighter one will do.



For celestial tripod use, new pan head tilts Questar's vertical axis, so that it points near pole star for continuous following. Excellent for low latitudes, and vital at equator where axis is horizontal. Not shown is 17-inch handle, to tilt and swing regular cameras, which clamps at any angle with egg-shaped piece. Separate friction knobs lock this elegant head without shifting view. Scales and spirit level. Weight only 3 pounds.

The famous Linhof geared centerpost is now improved and self-contained. Most luxuriously adjusts to your exact eye level. Smooth as silk, with amazing built-in load equalizer. Two-inch post rises 20 inches. Attaches with great 3.5-inch dia. clamps. Ingenious lever locks it at any height to fittingly complete the finest tripod we have ever seen.

Special Questar-Modified Praktina Camera Outfit

Here is a luxuriously complete all-round camera of proven high quality and great performance with Questar. Most of the pictures in this booklet were taken with Praktinas. Guaranteed for two full years. Each camera body is specially modified for us so mirror can be controlled by cable release to flip up well BEFORE shutter works, eliminating mirror-slam vibrations. Focal-plane shutter with quiet easy action. Self-timer also releases mirror first. Wide speeds of B, 1, 2, 5, 10, 25, 50, 75, 100, 200, 500, 1000 sec. Built-in sports finder plus TWO groundglass finders; one waist-level finder, so you can look down for astro work, and one precision optical glass penta-prism finder for general work. Small leather case fits either finder when detached.

We have chosen the famous 58 mm. Carl Zeiss Jena f/2 Biotar lens with full automatic internal diaphragm so you will have one of the world's great lenses for all-round use. Brilliant view until shutter is tripped.

Included is our complete basic coupling set plus a quick-detachable Praktina adapter ring, cable release, and a fine metal-piped top-quality leather case. Mr. and Mrs. Davis tell us that in their many years of Questar work, the Praktina camera has come to be their first choice, and has proved rugged and troublefree under hard usage.

Our problem in recommending a camera to our clientele is a difficult one. It must be a fine instrument, exceptionally well-adapted for use with Questar, and it must have a fine, big, modern lens for general use. Above all, it must have a long time probability of good value. We want no one, on our advice, to invest in any camera likely to be quickly dumped, price-cut and rendered rapidly valueless in today's chaotic camera market. It is therefore a pleasure to recommend on all counts this modified Praktina outfit as a BEST BUY at $200 postpaid. Sold only complete. Other Praktina accessories available.

The Nikon F

We became franchised Nikon dealers to offer the Nikon F camera with the famous lenses that jumped into world prominence when *Life* magazine discovered their superiority to existing types. Considered by many to be best procurable for general work. Has ball-bearing titanium foil focal plane shutter, with so little recoil that it permits maximum sharpness of negatives with Questar when mirror is locked in UP position. Our first choice is Nikon body, with waist level finder and Type C interchangeable clear-center-with-cross groundglass for most brilliant images at f/14 and smaller. Body only $220. With f/2 Auto-Nikkor lens, $310, with f/1.4 Auto-Nikkor, $375. Waist level finder $21. Type C groundglass, $16.50. Cable release, $2.40. Adapter ring to fit our $23.50 basic coupling set, $10.00. All postpaid.

We are constantly in touch by phone with Nikon's New York national headquarters. We can give you rapid service on any Nikon item.

Our phone number is 215-862-2866.

This is the way we ship your Questar.

Questars are shipped prepaid by insured parcel post, special handling, to any point in the 50 United States, or to any designated forwarder for export. Shipping weight 22 pounds. The encased instrument, in a protective luggage cover, floats in 4 inches of resilient blocks of curled hair and latex, preformed in a reusable "Leverpak" metal and fibre drum measuring 16 x 22 inches. This scientifically engineered package has delivered more than 1000 Questars faultlessly, and to every continent, by land, sea, and air. No unpacking fuss, muss, litter or dust! The drum should be stored away for your convenience in case you ever wish to reship.

The Questar Service and Sales Policy

Fast and efficient servicing of your Questar will always be available at the factory. Our policy is to protect your investment. Adjustments will be made at our expense if the fault was ours. Adjustment and replacements after reasonable wear, or modernizing of instruments, will be done at cost of time and materials.

We have tried to build each Questar as well as we could, of the finest parts procurable. Trained specialists are responsible for every detail. Every Questar is star-tested by our production manager on Polaris at night. None can be sold until he is satisfied that it beats Lord Rayleigh's theoretical limit and equals or betters the Dawes' criteria for perfect resolution.

Questars are sold direct at one net factory wholesale price. There is NO LIST PRICE of $2000 from which to allow a normal 15% distributor's discount and 35% retailer's discount. You save this $1000 sales cost by ordering from this booklet as over 1000 persons have before you. There are no school or church discounts, none for celebrities, presidents, nobility, or governments.

Please do not ask the name of the nearest Questar owner. It is our policy to protect the personal privacy of every Questar owner. Should you become one, you have our promise that in the following years we will never refer prospects to you for demonstrations, send strangers to your door, or ask you to act as our agent or salesman.

SPECIFICATIONS

OPTICS

FOCAL LENGTH variable, basic visual about 45.5" at f/13; field of view 55 min. at 40x, 42.5 min. at 80x, 21 min. at 160x. Field flat. Infrared focus identical. No coma, astigmatism or spherical aberration, visual or photographic. Each lens and mirror set matched by aspheric hand figuring.

FRONT LENS. Clear aperture 3.505" (89 mm.). Precision annealed BSC-2 glass. Axial thickness .350". Central obstruction only 1.07" diameter. Cassegrain secondary spot only .800" diameter.

MIRROR. Low-expansion glass, or quartz on special order. Perforated, center mounted, 3.800" diameter, thinner at periphery than at center. Radius tolerance only .006". Aluminum coating quartz protected. No coating has yet failed in 5 years.

FINDER LENS. 4" f.l. Powers 4 and 8x. Field of view 12° and 8°.

FINDER MIRROR. .900" diameter exposed to air; aluminum coated, none has failed in 5 years.

AMPLIFYING or BARLOW LENS. .700" diameter modern negative achromat, f.l. -1.73", coated.

EYEPIECES. 40x, 26 mm. 3-lens Koenig type. 50° apparent field, focusing mount. 80x, 13 mm. 5-lens Erfle type, enormous 75° apparent field, so wide the head must move to see both sides of it.

FOCUSING MOUNT. Both threaded to adapter tube.

SUN FILTER. Standard — has off-axis 1.5" aperture, coated twice with chromium to avoid pinholes. Glass .200" thick. See inside back cover.

SUN FILTER. SPECIAL FULL APERTURE—is mounted in aluminum cell with peripheral milled slots for ventilation. Furnished in walnut case to protect thin glass only .080" thick. See page 17.

BARREL

BARREL. Forged aluminum, machined full length. LENS CELL, aluminum 24S-T4, and REAR CLOSURE PLATE with stainless steel CENTRAL TUBE are turned as unit on toolroom engine lathe for finish machining of lens seat. Lens cell then black anodized and replaced.

MOON MAP. Cemented to barrel. Aluminum, .016" thick, hand-buffed, anodized, dyed deep royal blue, with etched lines white enamel filled.

STAR CHART (DEWCAP). Internally black flocked Synthane seamless tube 1/32" thick, to which is bonded a pre-rolled aluminum sheet similar to moon map. Against deep blue, lilac-colored enamel-filled etched lines and 340 stars in pale yellow enamel. A work of art, with glowing sapphire-plated surface.

INTERIOR FINISH of barrel and control box. Sprayed, after masking, with new dead-black alkyd, large-carbon-molecule paint.

LIGHT BAFFLE TUBE. Has 20 knife-edge internal stops.

FOCUSING MECHANISM. Mirror thimble on a honed, stainless steel sliding tube with 3-inch bearing length. Slides on stainless, fixed, light-baffle tube, with front-end insert tube of .010" wall thickness. Unlubricated. Conical s.s. spring loaded. Focus rod s.s. 303, ground shaft, 56 T.P.S. precision-ground threads. Nylon thrust bearing.

KNOBS. Aluminum 24S-T4, corrosion-resistant, hand-turned on turret lathe, individually handled to avoid nicks. Stainless steel shafts and levers.

FASTENINGS

CHROME NICKEL stainless steel 302, Bristol forged spline-head screws, engine turned, polished heads. Finest procurable. Splined wrench exerts wholly rotary force. Adjustable screws s.s., slotted. Setscrews Bristol splined, alloy steel, cup point. See page 24.

ERECTING PRISM. For highest resolution Questars are equipped with star diagonal prisms, the most efficient type. Images are erect but reversed left to right as in finder view. The less efficient, more complex Amici full-erecting prism costs $50 more, loses both light and definition, but permits distant signs to read correctly. Neither prism affects photography.

MOUNTING

BASE. Aluminum sand casting, virgin alloy 356-T6 heat-treated. Toolroom hand-turned and polished. Highly corrosion-resistant. Jig-bored and precision-honed for legs. Bottom flange 7" o.d. Fits tripods with ¼-20 threads.

TURNTABLE or LOWER FORK BASE. Sand casting, same alloy, toolroom turned, jig-bored and precision-reamed.

LEGS. Aluminum 61 S-T3, centerless-ground to .0001", anodized. Fine push fit. Center leg adjustable, extension assembly will not come apart to get lost in the dark. Butyl rubber tips.

BASE HOLE PLUGS act as car attachment screws, 24ST-4 aluminum staked to shank of 10-32 s.s. socket-head screws. Neoprene o-ring permits easy push fit into leg holes. See page 7.

SYNCHRONOUS DRIVE MOTOR. Cramer, 1/2 R.P.H. 110 V. 60 cycles; other cycles, voltages and direction of rotation available. Sealed, lubricated gear train. 2.7 watts.

RIGHT ASCENSION GEAR. Bronze, 4" diameter, hand dressed. 4" diameter Teflon-faced bearing surfaces.

SIDE ARMS, INNER FORK BRACKETS, CONTROL BOX. Die castings of corrosion-resistant aluminum alloy 13. Toolroom turned, milled, jig-bored, tapped and reamed. Special aluminum paint, baked, clear-lacquered and again baked; finish is impervious to acetone paint remover. Side arm edges again hand polished after painting.

FINDER MIRROR CAGE. Steel, dull finish, copper nickel chrome plated.

INNER FORK RING. Aluminum 24S-T4, machined.

ALTITUDE or DECLINATION CIRCLE. 3 15/16" diameter, 302 s.s. hand finished, riveted to bracket ring assembly, 1° divisions.

CLAMP. Bakelite padded s.s. stud clamps dec. circle to side arm. Azimuth or R.A. Circle. 6" diameter. Deep-blue anodized aluminum, engraved and white enamel filled, graduated to 1° and 4 min. of time. May be set as celestial clock. Manual slow-motion independent of drive.

SLOW MOTIONS. Continuous 360° rotation, safety clutch held. Permits control to a few seconds of arc. Absolutely free of backlash, lag or play. Has been called the smoothest control on any instrument. Ratio 31 to 1.

DIMENSIONS. Height, upright, 14". With barrel horizontal, 11" high and long. Weight, 6.7 pounds.

CASE

FINEST BRITISH COWHIDE, each one made by hand for us in Staffordshire, England. Deep luggage tan color, fully velvet lined in old wine color, leather pouches for accessories. Conservative white stitching, two locks. Rim of Questar's base held in case by adjustable eccentric Synthane disks.

LUGGAGE COVER. Textured heavy vinyl covered cloth. Weight, in case and cover, 11 pounds.

The only parts of Questar we import are the leather case from England, oculars, 2 small lenses, 1 prism from Japan.

QUESTAR CORPORATION

New Hope, Pennsylvania • Phone: 215-862-2866

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PRICE LIST, *November 1, 1960, subject to change without notice*

Postpaid in the United States

Questar, with pyrex mirror, star diagonal prism (see previous page) and sun filter, in leather case with 40-80x and 80-160x eyepieces, legs, cord, and luggage cover ..... $ 995.00

Questar, same as above, but with quartz mirror, for maximum image stability during temperature changes. Most useful in cold climates $1100.00

Either model above, with less efficient full-erecting prism (see previous page) ..... add $50.00

Solar Filter, Full Aperture (see page 17) ..... $ 150.00

Same, when ordered in place of standard sun filter ..... $ 125.00

Praktina FX Camera Outfit — Special Questar-Modified, complete with Questar couplings (see page 28) ..... $ 200.00

Nikon Cameras — We are franchised Nikon dealers. See description and prices on page 28.

Linhof Heavy Duty Professional Tripod, with Geared Center Post, DeLuxe Pan Head (see page 27) ..... $ 328.50

Linhof Tripod–$179.50. Geared Center Post–$79.50. Pan Head–$69.50. *Tripods, Center Posts, Pan Heads shipped by Railway Express Carriage Charges Collect.*

Counterweight, collar of heavy X-ray shield flexible vinyl for star chart, which can be slid forward and locked to exactly balance camera load. Clever, non-scratching device ..... $ 20.00

Basic Camera Coupling Set, needed for all cameras (see page 26) ..... $ 23.50

This basic set of couplings has PRAKTICA threads, which fit the largest number of single lens reflex cameras, namely: Asahi Heiland Pentax, Astra, Contax D, Contax S, Consol, Edixa, Hexacon, Pentacon, Praktica, Praktiflex, Rival, Tower.

Certain camera bodies need another adapter ring with a female Praktica thread to attach to our basic coupling. Adapter ring for Exakta $5.00. For Alpa $11.50. For Praktina $8.00. For Miranda $9.00. For Yashica Pentamatic $7.00. For Leica Visoflex reflex housing whose forward end attaches with threads $5.00. For Leica Visoflex reflex housing whose forward end attaches with bayonet rings $12.00. Be sure to specify which kind.

For new cameras or those not listed here, you need our basic coupling set, plus a ring with female Praktica threads that will attach to your camera body.

This is the Questar telescope in polar equatorial position for observing from a tabletop in such comfort that it will spoil you for all other telescopes. All the built-in features of this elegant mounting, so indispensable in general observing, now control the instrument for celestial use with ease and maximum convenience. The instrument is steady. It does not tremble at each touch like long-tubed conventional telescopes. There is nothing like it for teaching and group demonstrations. The electric drive ticks over quietly, keeping the object squarely in the field without the great annoyance of constant readjustment. The equatorial position is used also for solar work with the standard sun filter, shown resting on a car-attachment screw at lower right.