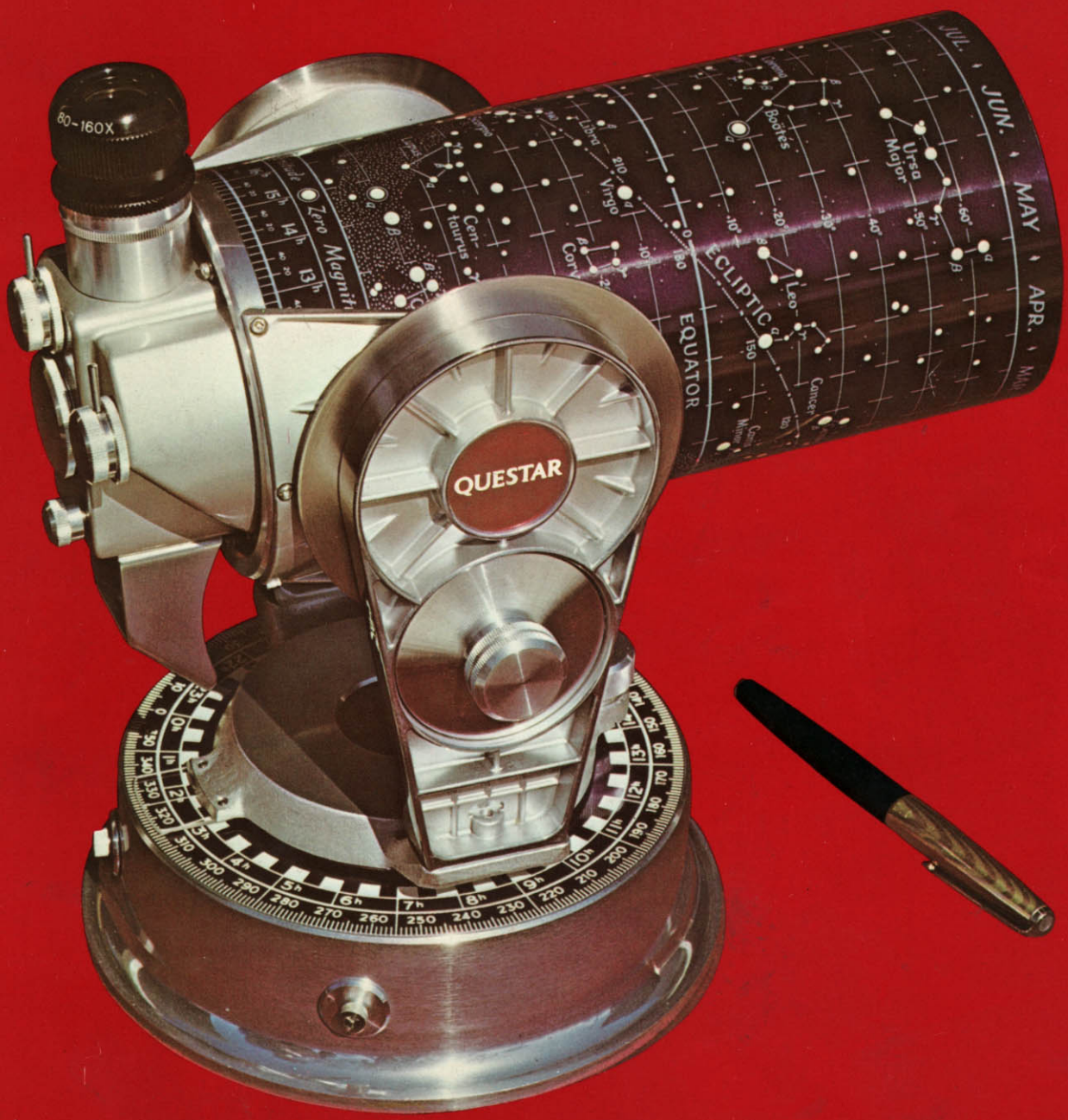
QUESTAR


80~160X
Zero Magnitude
Libra
Virgo
Centaurus
Bootes
Ursa Major
Leo
Cancer
ECLIPTIC
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QUESTAR


QUESTAR
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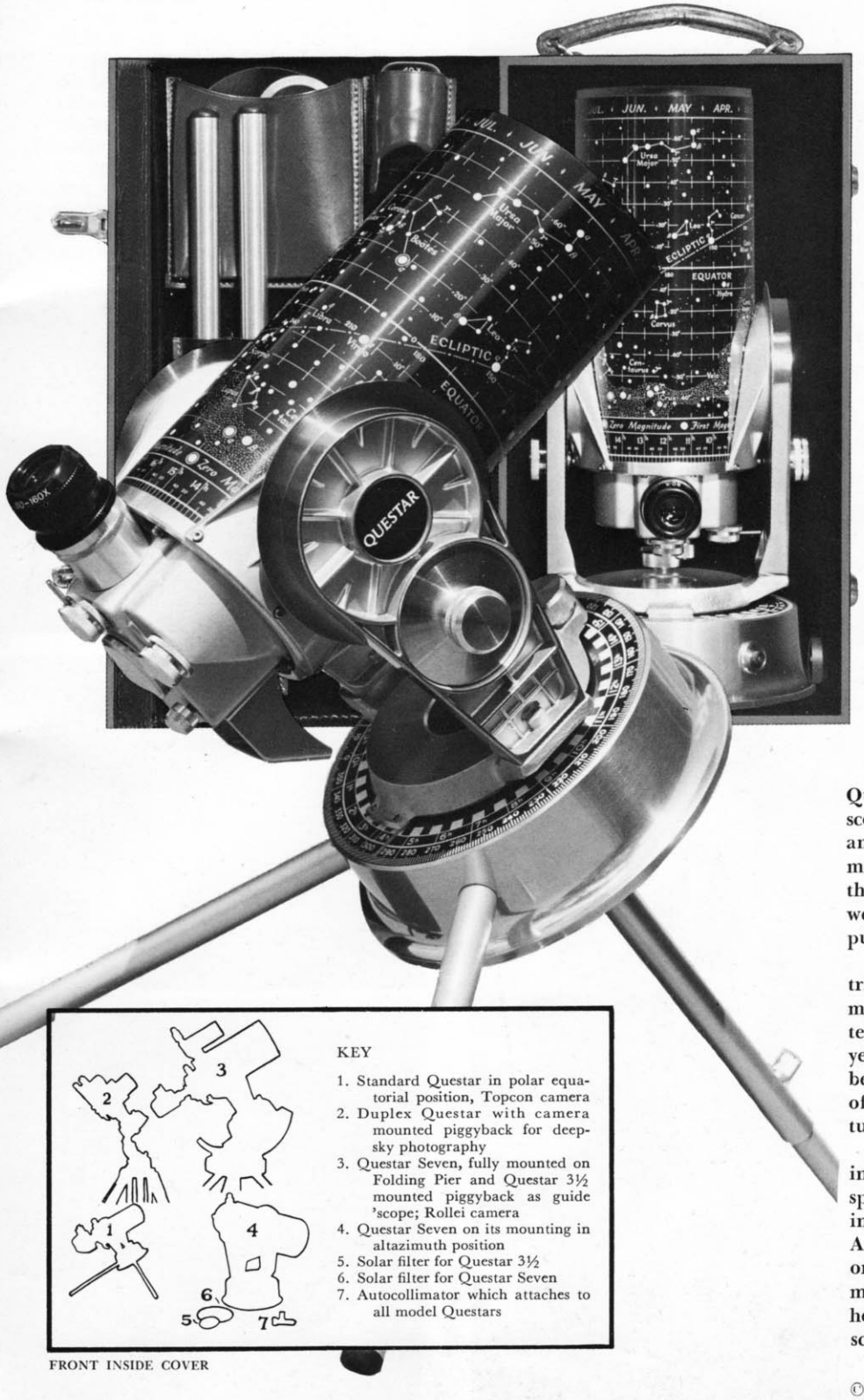
QUESTAR

–the fully mounted astronomical telescope that is also . . .



a complete portable observatory

a telescopic lens for still or cinema photography

a general observing 'scope

a television lens

a laser component

a long-distance microscope

a deep-sky guiding and photographing 'scope

a tracking device

an autocollimator

an educational tool

and a versatile system for many other research and industrial applications where fine optics are mandatory

KEY

1. Standard Questar in polar equatorial position, Topcon camera
2. Duplex Questar with camera mounted piggyback for deep-sky photography
3. Questar Seven, fully mounted on Folding Pier and Questar 3½ mounted piggyback as guide 'scope; Rollei camera
4. Questar Seven on its mounting in altazimuth position
5. Solar filter for Questar 3½
6. Solar filter for Questar Seven
7. Autocollimator which attaches to all model Questars

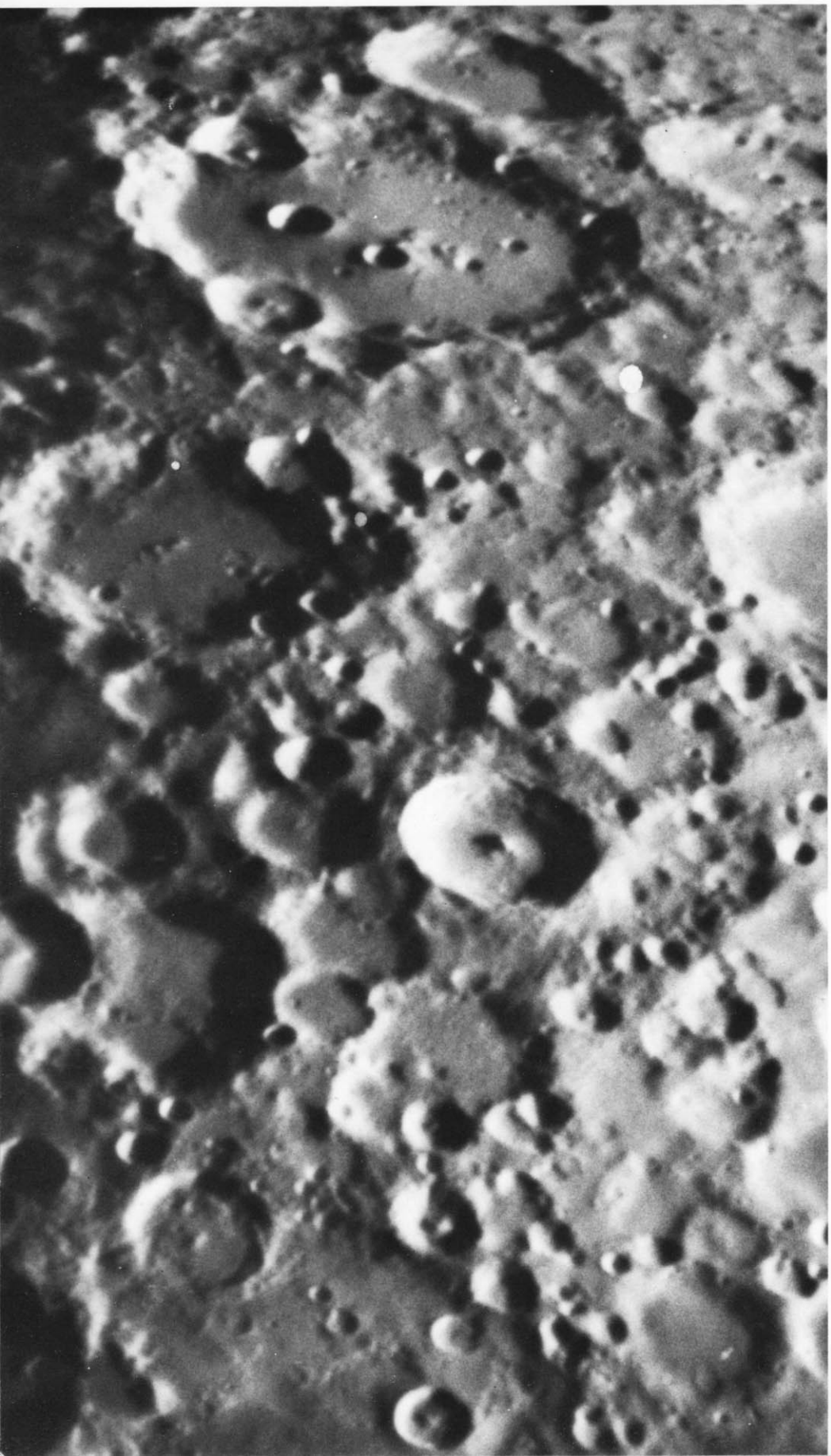
FRONT INSIDE COVER

Questar is the finest and most versatile small telescope in the world. It does so many things so easily and conveniently that you might well ask why for more than 200 years, until Questar appeared on the scene, such an instrument never existed. Why were there only the ancient, cumbersome, single-purpose conventional telescope?

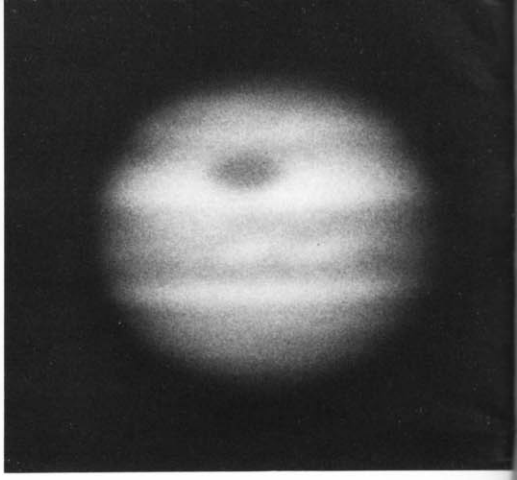
The answer is that the new family of catadioptric, or mixed systems, had to be discovered to make possible the miniaturization of the classical telescope. When this happened, more than 20 years ago, Questar's inventor, Lawrence Braymer, began the painstaking job of designing a telescope of 56 inches focal length compressed into a closed tube only 8 inches long.

If you are acquiring your first telescope, or looking for a fine optical system to do any number of special jobs, the Questar story will be of particular interest and can save you many costly mistakes. And if you are still using a conventional reflector or refractor with its shaky tube and unwieldy mount, perhaps it is because you may not have heard how Questar brought the astronomical telescope into the twentieth century.

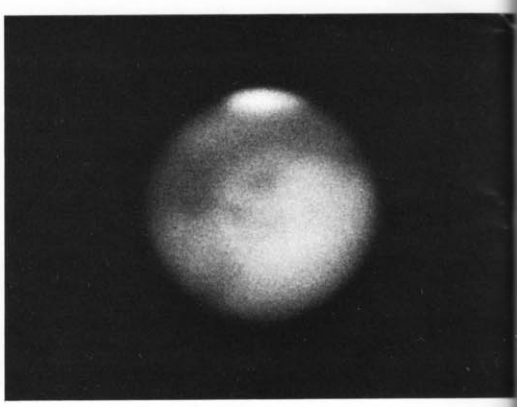
QUESTAR . . . the portable observatory, turns its superb resolution on the moon and planets

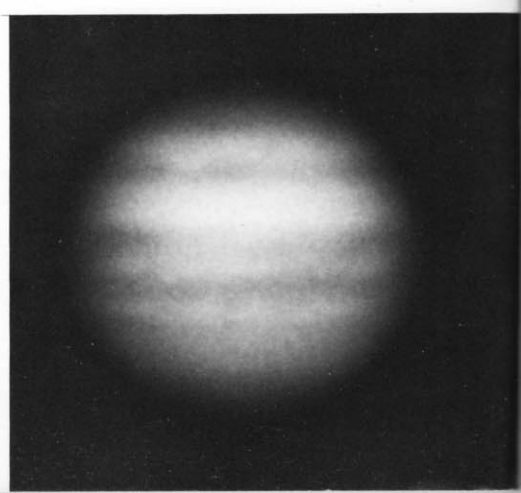


RALPH AND DORIS DAVIS. HIGH CONTRAST COPY FILM, BARLOW AND 2 SETS OF EXTENSIONS.



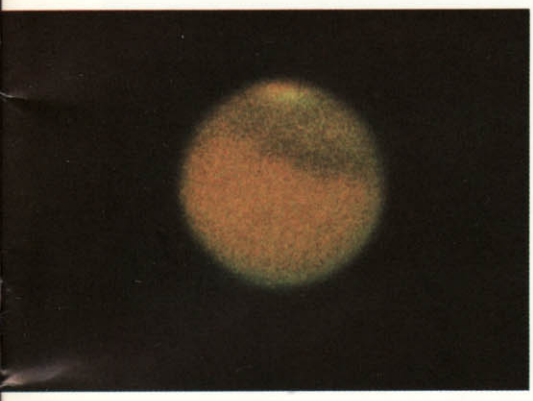
Photographs throughout the booklet were taken by Questar owners and, allowing for the unavoidable loss of detail in the reproduction process, permit Questar to speak for itself. You might find it interesting to compare the moon shots with some taken by the great observatory telescopes, for Questar's performance is best demonstrated when its work is placed side by side with pictures taken by telescopes many times its size.

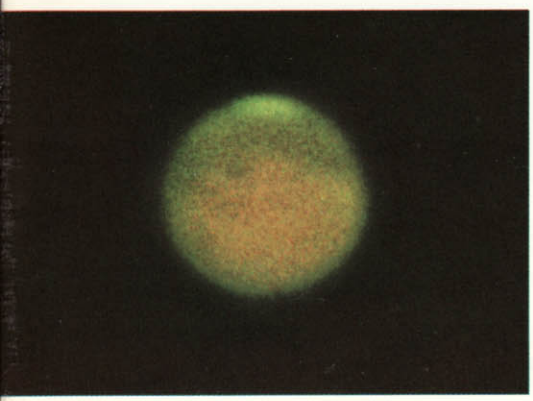




In a previous collection of sky photographs we showed Clavius by Ralph and Doris Davis of Sarasota, Florida, who recently surpassed their own efforts with the one on the opposite page. Mars, Saturn and Jupiter are by Robert R. Richardson with the Questar 7. Above, Mars with the Questar 3½ by the Davises, LEFT, and by Ralph Shook, RIGHT, who did the beautiful bald eagle photograph on page 24. All planet shots were made in the latter half of 1971 or early 1972, when both Mars and Jupiter made very exciting observing. Excellent photographs of Mars in the 1971 opposition have been coming in from all latitudes. Above, Comet Bennet by Captain Harry M. Grubb, 58 mm. lens, f/1.4, Questar guided, on H.S.E., 5 minute exposure.

The opposition of Mars was disappointing here in the Delaware Valley due to fog and smog, but on those few available clear nights Robert Richardson was able to get some interesting detail in color with the Questar Seven, as well as photographs of Jupiter and Saturn. The slides are beautiful—show much detail in the bands of Jupiter, as well as the red spot, and great delineation in Saturn.





Questar is the answer to the shortcomings of all other astronomical telescopes. No telescope since Galileo so frees you from the fetters of the trembling, awkward reflectors and refractors, whose design has remained unchanged for two centuries. The Questar 3½, the first modern telescope, weighs only 12 pounds complete with its leather case, from which it emerges fully mounted for general viewing from any handy surface. At a sturdy table, for example, the observer may sit facing the control box that provides him with a finder view, high powers from 80 to 160, without changing eyepieces, and a focus control from less than 10 feet to infinity, a range that has never before been possible in any instrument.

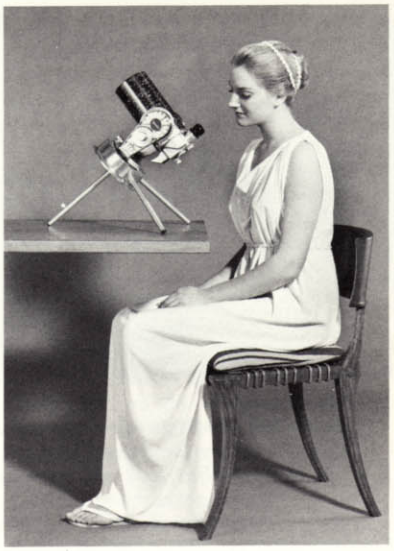
In a pocket of the outfitted case, the astronomer will find anodized aluminum legs for tilting the telescope into its polar equatorial position, with the center leg adjustable for varying latitudes. Only a moment is needed to locate the pole star in the finder, shift the telescope's position to approximate the earth's axis, adjust and clamp the center leg. Now it is possible to follow manually any celestial object in one continuous motion of the azimuth control, or automatically, by connecting the cord for the synchronous drive to house current or to the Questar Powerguide.

We have tried to think of everything that would make observing relaxed and pleasurable. Questar's slow motions are smooth as velvet. They turn effortlessly in continuous 360° rotation, a convenience afforded only by modern observatory instruments. The control box, described above, also furnishes a convenient means of attaching a camera at the axis, and an eyepiece can be placed there also, when it is desirable to use the telescope from this viewing angle. See the diagram of the optical system on page 31.

The photograph on page one illustrates Questar in its polar equatorial form and shows how legs, cord, extra eyepiece and sun filter are carried in pouches on the door of the handsome leather carrying case.

QUESTAR . . . for astronomical observing and photogaphy

Improved color films are making it possible to photograph features of the moon and planets that just a few years ago was possible only with black and white Microfile. The Questar Seven reveals great detail along terminator with Ektachrome, a 6 sec. exp., f/32, Robert Richardson.



In 20 years of making the world's most convenient telescope, we have learned that nothing surpasses the observing comfort of sitting in a relaxed position, looking down into an eyepiece that can be swiveled from side to side when the body changes its position. Everything you need for observing is built into a Questar with its fingerflick controls.

Many advantages result from Questar's basic new concept of observing from a table. The observer is seated in the easy attitude of study. You look down to scan landscape or heavens. Your body is relaxed, unstrained. You may vary your position, rest elbows on table, cover one eye with your cupped palm if you wish, to avoid squinting. Arteries to eye and brain are not constricted by a bent or twisted neck, and visual acuity is at its peak, so that the longer you look the more you see. Rock-steady images and elegant controls all contribute to your comfort and convenience.

If you really relax and utilize that seated, restful position, you will be spoiled for observing with all other telescopes. Moreover, you can take this portable instrument with you wherever you go, carrying it easily in its leather luggage-like case.

Questar introduced the new catadioptric optics to the world in its daringly short, table-top design in early 1954. Since then its performance has firmly established the role of this superfine small telescope as an astronomical tool, as a powerful viewing 'scope for terrestrial activities, and as the sharpest lens for all photographic purposes, all of which has led to the adaptations shown on our inside-cover pages, and the many applications touched upon in this booklet.

Questar is a completely beautiful instrument, yet its entire design is functional. Take the patented star chart, for example. This is a work of art, yet it serves several purposes. It locates celestial objects and relates them to the setting circles without need of calculation. It takes the place of twelve monthly maps and gives accurate positions for 340 stars. It turns so that the current month is uppermost, with early evening objects on top of the barrel. As the night grows later you revolve the chart to keep pace with the changing sky. It also slips forward to become a dewcap, to protect the front lens from fogging over on moist nights. And underneath it, the barrel itself is covered with a large map of the moon for a handy reference to its salient features.

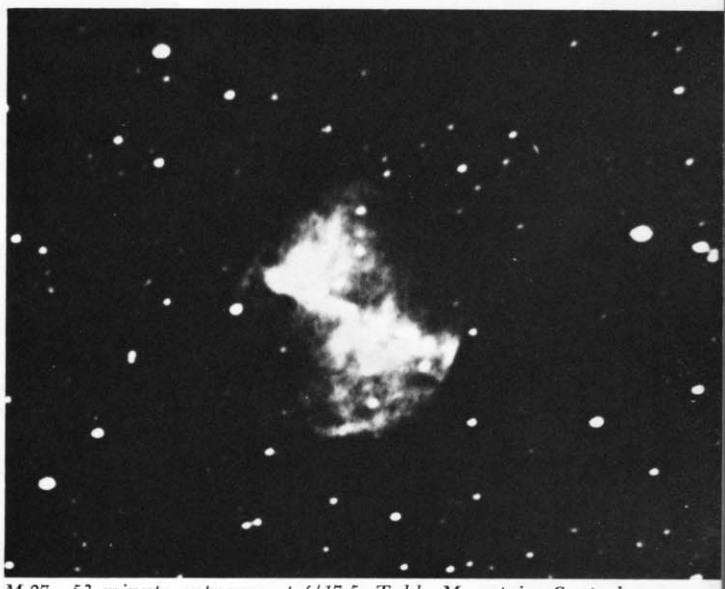
QUESTAR IS A DEEP-SKY CAMERA

In the past we have shown beautiful photographs of deep-sky objects taken with a 35 mm. camera riding piggyback on Questar which was acting as a guide 'scope. Now, Questar owner Hubert Entrop has demonstrated that for many objects, when you have a superb guiding system like Questar's, it is possible to take long exposures through the telescope itself. Initially he tried mounting a Field Model on the Standard Questar to provide a separate sharp view for guiding, while the driving Questar took the pictures. Then he found he could do the whole job with one Questar. His success is demonstrated in the collection of Messier objects shown on this page and on page 9. Mr. Entrop points out that when you are photographing with 1600 mm., the guiding must be extremely accurate—much more so than when taking pictures with a regular camera.

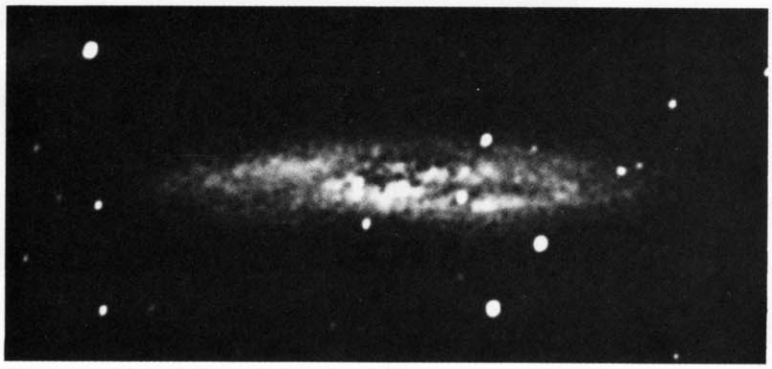
• • •

Encouraged by Mr. Entrop's fine results, we have developed the Questar Starguide following his design. The Starguide comprises an Off-axis Tracker and Declination Vernier Drive. The Tracker consists of a prism which intercepts a small portion of the ray bundle and directs it to a guiding eyepiece. The Vernier Drive adapts to Questar's Declination Drive, permitting miniscule corrections over this extremely accurate drive on a ratio of 10 to 1.

M 57—20 minute exposure at f/17.5 through Questar, Seattle.



M 27—53 minute exposure at f/17.5, Table Mountain, Central Washington.



NGC253—2 hour exposure through Questar at Beatty, Nevada. Winds of 40 MPH made guiding difficult.

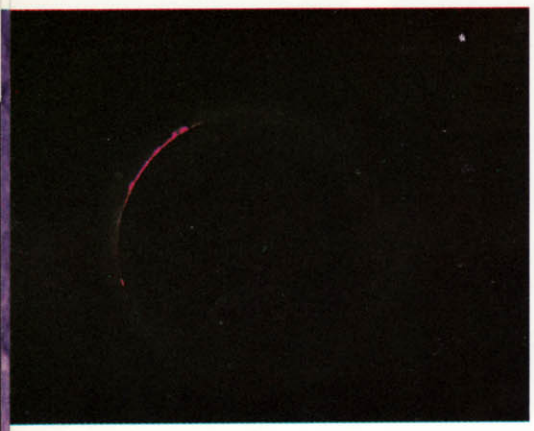
M 13—1 hour exposure, through Questar, at Elko, Nevada.

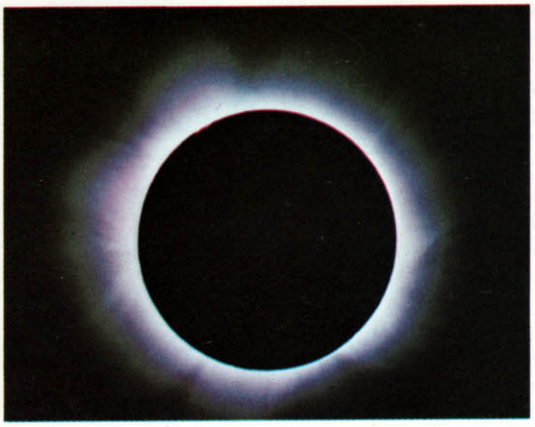
M 20—1 hour exposure, Bristlecone Pine Country, Eastern California.

"On the deep-sky shots I am using a new method. I use a single Questar for both guiding and taking the picture. I rob some light from the edge of the taking image, project it out just ahead of the camera and magnify it to use for guiding.

"While it is true that many telescopes of this and larger apertures can take this type of photograph, most do not have the motor drive capability of guiding for an hour or more with such accuracy, especially in winds gusting to 40 m.p.h., which is how some of these were taken. So these results are a tribute not only to the optics but also to the Questar design and drive mechanism." Above pictures taken on a vacation tour.

QUESTARS PHOTOGRAPH THE ECLIPSE



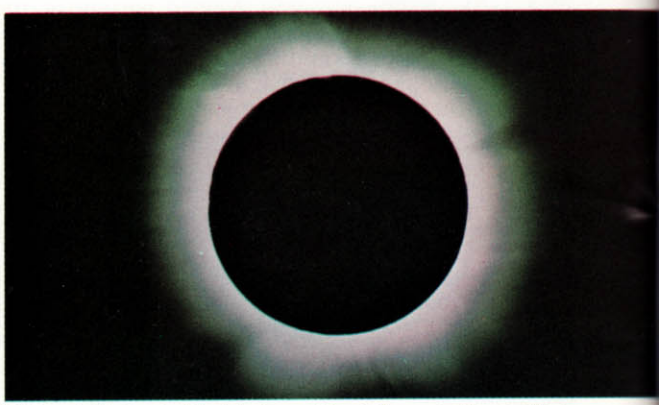


Questars were very busy during the March 7, 1970 eclipse with both individual owners and university teams stationed throughout the path of totality to photograph the event. Coverage by the television networks was accomplished with Questars, too.

From every site where the weather was cooperative, the photographs poured in to us, many more, of course, than we could possibly publish. The most complete series we saw was made by the brothers Michael C. and Patrick D. McDonald, who took their Questar to the Dismal Swamp in North Carolina. They made 25 exposures on Kodachrome during the 2 minute 40 second totality, capturing on film all stages of the corona, Baily's beads, the "diamond ring" effect, and the beautiful "electric pink chromosphere," showing great detail in the prominences. Six representative ones were selected for these pages, the five across the top and the tall one at the bottom of this page.

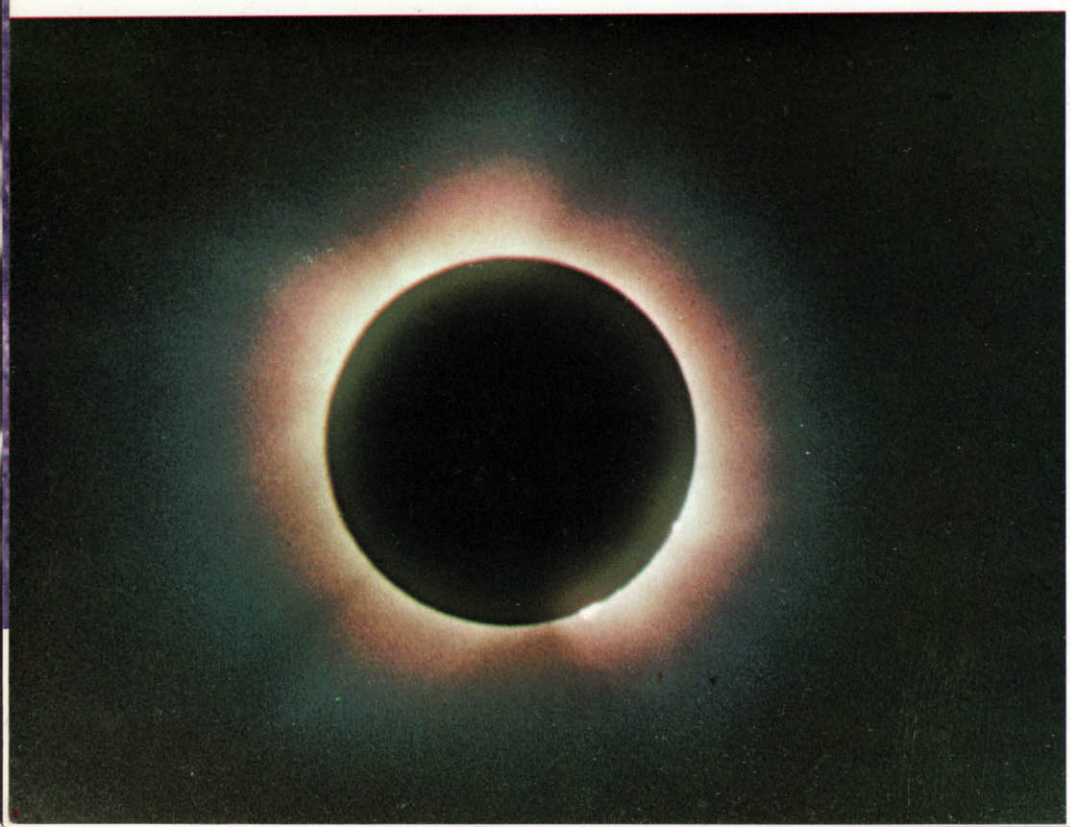
• • •

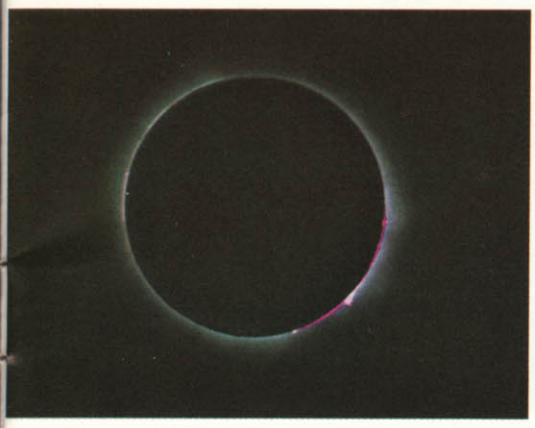
The photograph below was taken by Charles Wyckoff with a Questar 3½ from a TC 135 Air Force Transport Plane, on the new EG&G XR (extended range) color film. Dick Hoagland, Coordinator of Scientific Events for CBS said the Questar shots were so successful that for the first time the separation of two color coronas was indicated. The quality of the 35 mm. film withstood the tremendous enlargement given it by LIFE Magazine when used as a double spread. Hoagland said there were three Questars on board the jet, two 3½s and a Seven which was used with other instrumentation.

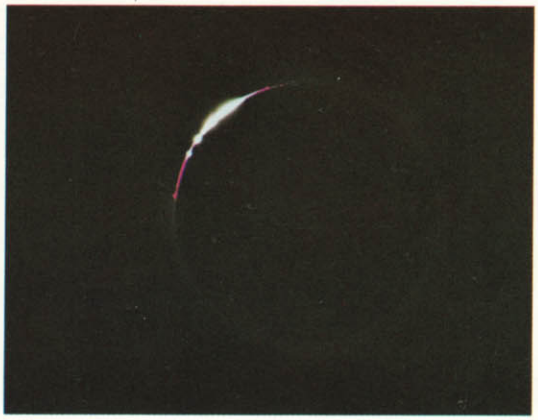


Richard R. Lowell's photograph, taken at Nantucket, shows the characteristic delicate pink of the inner corona, changing to pale green in the intermediate corona, with the prominences still visible.

ALL PHOTOGRAPHS WERE TAKEN WITH THE QUESTAR 3½. NO OTHER TELESCOPE IS SO CONVENIENT FOR SUCH AN EVENT, SO EASILY PORTABLE AS QUESTAR IN ITS CUBIC FOOT OF LEATHER CASE. QUESTAR OWNERS ARE NOW PLANNING FOR THEIR NEXT ECLIPSE.







Eclipse photographs at top of pages 6 and 7, and bottom right, page 6, by Michael C. and Patrick D. McDonald.

Mexican children crowd around the Questar for a look at the eclipse. Photographed near Mitla by William A. Steward, who had his Questar set up during the entire event for the local people.

QUESTAR

. . . the first safe and distortionless solar telescope

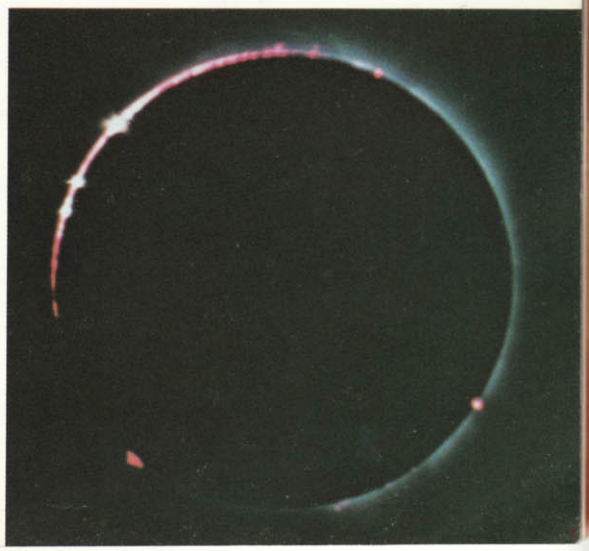
A time-honored way of viewing the sun was to project its image through a telescope onto a white wall or screen. This primitive method, which has been used since the days of Galileo is, of course, lacking in sharpness. Moreover the intense beam of concentrated rays that traverses the eyepiece will, in a few seconds, burn up the cement between the elements of any first-class modern eyepiece.

Lawrence Braymer, the inventor of Questar, often demonstrated the power of the sun's rays by holding a cigarette at the point where, reflected from an optical mirror, they came to focus. After seeing the flame at the end of the cigarette, one needed no further warning of what could happen to the human eye should those rays be viewed through the telescope, or should an old-fashioned glass filter over the eyepiece suddenly crack from the intense heat. His concern was to perfect a totally safe filter that would keep the sun's rays *out* of the telescope, which, strangely enough, no one in over 200 years had thought to do.

And so it remained for Questar to bring to the market a sun filter which leaves the heat outside the telescope where it belongs, where it cannot warp lenses or mirrors, or damage the observer's eye. Only one part in 50,000 of the light enters the 'scope at all, the rest being reflected by a measured thickness of chromium metal evaporated onto a polished parallel flat, which then is mounted in front of the lens. Then there is a second small filter that hinges over the finder mirror to keep all light from the finder system out of the control box. The choice of chromium is a happy one: it transmits all colors with a minimum of selective absorption.

On the following page are two sunspot pictures by Hubert Entrop, taken during the present cycle. Plainly visible are the granules so widely discussed in the literature as being so difficult to view and photograph. Their small size of 1 and 2 seconds of arc, or less, requires unusually fine seeing which some observatories afford because they are located on a mountain above the greater part of the earth's heated air. However, these photographs were taken at sea level in Seattle.

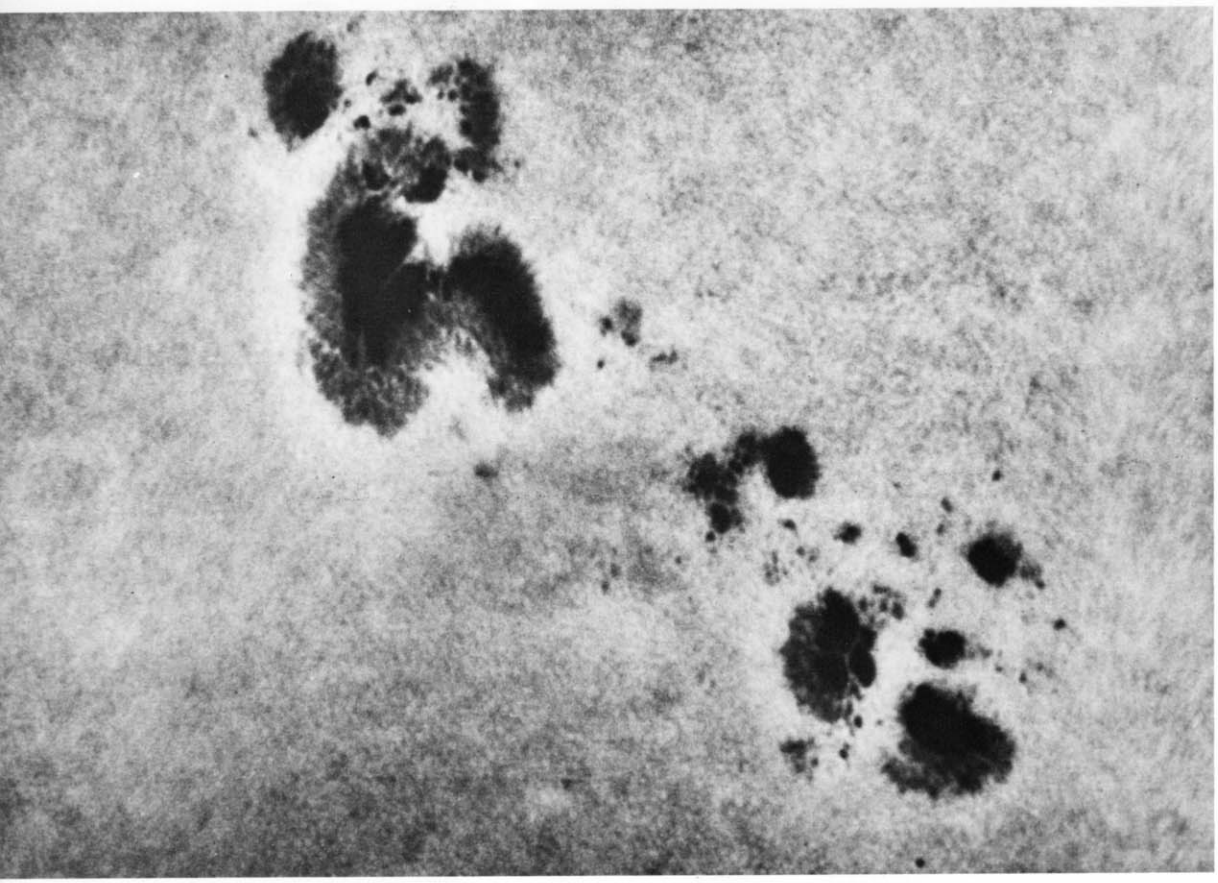
Solar photographs of this kind should only be undertaken by someone who has had a lot of practice in taking pictures with his Questar and knows exactly what he is doing. The technique used in capturing this tiny detail on the film involves keeping the telescope capped until ready to take the picture, then removing the cap for the briefest exposure and recapping it quickly. Because this is a dangerous method for both telescope and observer, we urge that extreme care be used.



This is one of the photographs Dr. Burke Arehart took during the November 12, 1966 eclipse, at Cachamarea, Peru, S.A. This reproduction is made from an excellent photoprint.

QUESTAR 3½ PHOTOGRAPHS THE SUNSPOTS

In spite of the difficulties that his sea-level location presents, Hubert Entrop has produced some extraordinary solar photographs showing great detail in the spots and in the "rice grain" texture. These were taken during the present cycle. See page 7 for a general description of the method used in this type of work.



QUESTAR . . . an astronomical telescope for the finest telephotography

Questars are being used for many types of photography—for moon and planetary detail, for deep-sky objects, for intimate views of the tiny inhabitants of gardens as close as 8 feet, or for wildlife 1000 feet, or more, distant; for close shots of difficult processes in the laboratory or for catching people in action on the top of tall buildings; for the sharpest detail of whatever object is in view, or for just charming, artistic pictures. Questar, which started out as the finest and sharpest lens, has become also the most versatile, the all-purpose, all-things-to-all-photographers instrument. Many of these uses are illustrated throughout the book, and an interesting letter from Dr. R. C. Ashley on page 22 talks about his experience with light itself in relation to his long experience with his Questar. Questar has provoked creativeness and a flare for experimentation in people who have never taken photography seriously before. It has taught people in all disciplines to see more, to see better and to use this prime tool of science for their own purposes.

Questar's general design makes it a pleasure to use for photography of all kinds: its light weight, which makes it so easily transportable (The Field Model, for example, sometimes preferred for terrestrial work or special applications, weighs only a little more than 2 pounds), the ease with which a 35 mm. camera can be attached to the control box, the wide-view finder system which helps you to quickly locate an object before you focus it on the groundglass, and the ease of focus, whether your subject is at a great distance or nearby.

Questar has been prodding the camera industry for fifteen years to produce cameras that were suitable for long-focus lenses—urging the manufacturers to make shutters without recoil, mirrors without slap—all those unnecessary vibrations that cause motion on the film and produce fuzzy images. Groundglasses, too, have been part of our crusade because it is not possible to get a fine focus on a coarse screen.

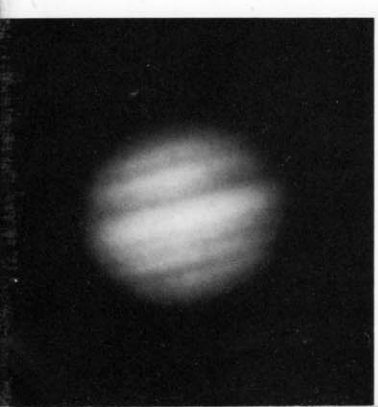
Working with a long-focus lens is always a challenge. In sky views the astronomer must first cope with what he calls "seeing," choosing his time when there is a minimum of turbulence in the atmosphere to distort the image. A tranquil air path is essential in long-distance terrestrial views, also. Heat waves rising from a hot macadam road or a hot roof, which are present no matter what sort of lens you are using, are quite visible in the eyepiece of a fine telescope, and the Questar photographer learns to avoid shooting over such obstacles. And so there is much of interest that can be learned in the way of technique.

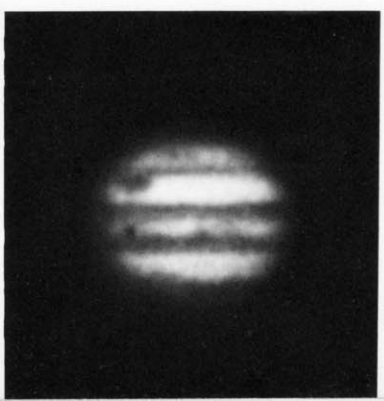
The remarkable lunar detail at the top of the page, showing the cleft of Hygenus and the Triesnecker rille, were taken with the Questar 3½, as were the other pictures on this page. ***Ralph Davis.***

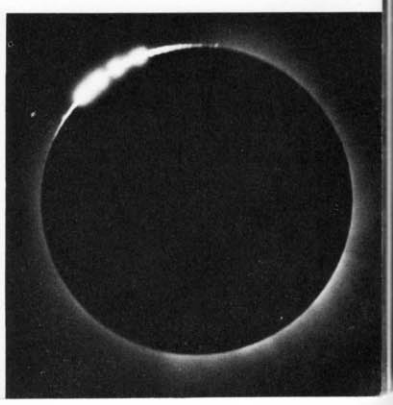
Below it, Messier 8, another of the group by Hubert Entrop described on page 5. 60 minute exposure.

At bottom of page, left, Jupiter by the Davises. Next, Jupiter and Saturn by Robert Richardson, Jupiter at 9-sec. exposure on High Contrast Copy film at f/47, and Saturn on H. & W., 8 seconds at f/80.

At far right, a 1970 solar eclipse photograph by Martin R. Willard.







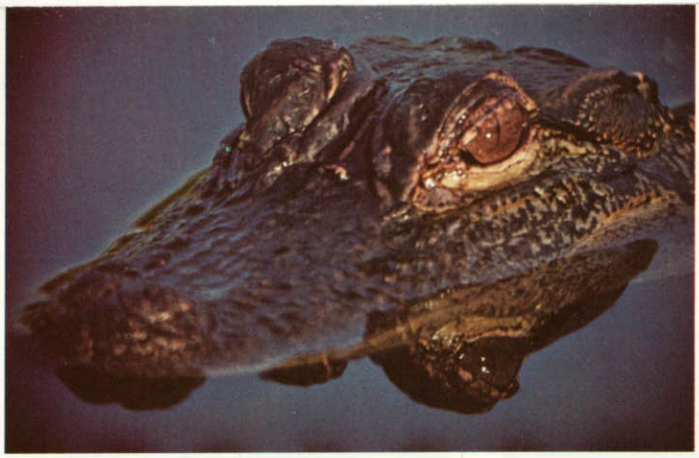
QUESTAR GOES ON SAFARI

Mrs. Coleman in her rig, with safari guide, Mike Harsley. Above, a cheetah almost invisible against the color of the landscape.

Mrs. George L. Coleman took a Questar with her on safari in Kenya and brought back this bag of big game. She wrote us to say how much she was enjoying her Questar. "I could not have captured the expressions on those cheetahs with anything but a Questar," she said.

Her experience prompts us to remind you again to take Questar with you—on your motor trips, to the mountains, to the seashore, or wherever your particular brand of action is. Set it up on whatever is convenient. Even in the city there is no lack of fascinating views—a harbor, a bridge, an airport. Much can be seen from a skyscraper window.

The distances of these animals from Questar vary from about 100 to 150 yards. The cheetah heads are done with the photographic Barlow, the other shots without Barlow amplification.



Robert C. Ashley

QUESTAR CAN PENETRATE NATURAL CAMOUFLAGE

Any device that can bring the distant object closer to the eye is a telescope. Binoculars and spotting 'scopes are the most familiar forms, but when you are accustomed only to binoculars, Questar's sharp images at tremendous magnifications will be a new experience. Sometimes you are actually astounded to see at close range the things that have totally escaped your unaided vision.

The smooth controls that make astronomical observing so relaxed and enjoyable serve the terrestrial viewer just as well. The control box provides easy focusing on objects near or far, at several powers without a change of eyepiece. Every unique feature of the Standard Questar except the electric drive, has been designed for terrestrial use. But if you prefer, there is the Questar Field Model which is simply the barrel of the telescope and its control box. You attach it to a tripod, as you may all Questar models if you wish. Either way, with Questar on your garden table or on a sturdy tripod, the world of nature is yours.

Michael T. Clark

Dale Rex Coman

Dale Rex Coman

Dale Rex Coman

Robert C. Ashley

QUESTAR keeps its eye on the cellar door, the picture window and the back fence

Ground Squirrel—Panatomic X, 1/60 sec., distance 75'.
Flicker and Squirrel in Tree—TRI-X, 1/125 sec.

"The condominium is not a new idea," said the Davises who took these pictures. "Birds and squirrels have been sharing our trees for years." They caught the baby ground squirrel emerging from his hole in the center of the road as they traveled over Tincup Pass, Colorado.

Do you have a surveillance problem? These animals and birds weren't even aware their privacy was being invaded.

Pileated Woodpecker—Panatomic X, 1/25 sec.

QUESTAR . . . where the action is

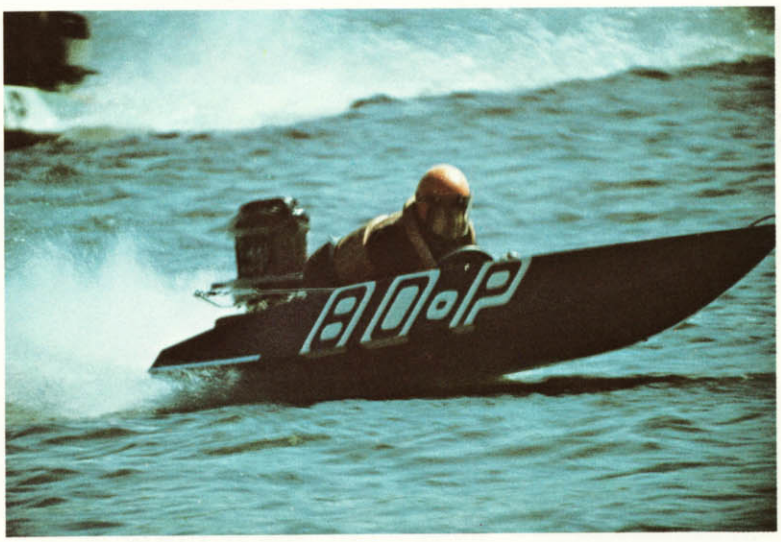
The picture at the upper right corner, taken with a 50 mm. camera lens, shows boats approaching the Questar from about ¼ mile away. The other three shots taken through a Questar, hand-held, were on Kodachrome, at 1/250 second, at distances of about ⅛ to 1/16 mile.

You might not think of a long-focus telescope as a lens for action shots of this kind, but this is the thing that most appeals to Michael T. Clark, who took these photographs of a boat race on the Delaware river, near here, with his Field Model Questar. In looking at them in relation to the speed at which these boats were traveling, they are pretty incredible, and demonstrate how fast you can really shoot with a Questar. Note the sharpness of the numbers, and the recognizable faces.

Mr. Clark describes his method as follows: "I use a gunstock of my own design. First I try to find a convenient place to brace myself, then I lock up the mirror if possible. It is not impractical to hand-hold a long lens; the biggest problem is vibration, but in bracing yourself you stop most of the lens movement and the mass of your body will absorb most of the remaining mirror and shutter vibration. . . . On fast moving subjects I prefocus, and when the subject is sharp in the groundglass I make the exposure. One has a lot of maneuverability with the Questar hand-held, as it is only ten inches long and weighs less than 3 pounds."

In our literature we have always stressed the total elimination of vibration, first from the camera itself, and then by using the sturdiest support you can get. And, of course, this is an absolute necessity when photographing moon and planetary detail. Yet here, and on page 14, where we show some of Mr. Clark's bird pictures, the exception proves the rule and very exciting pictures are achieved—once more scoring for Questar's versatility.

Perhaps the most important thing to expect of a Questar is that you will find yourself using it more often than you ever expected. You will probably discover that daytime terrestrial observing, just looking at everything in sight wherever you find yourself, is more downright fun than you ever thought possible. Questar's portability combined with its versatility can give you a lifetime of enjoyment.



Mrs. Coleman of the safari on page 10, also tried her hand at photographing the action and came up with this charming shot of a surfboard rider. How recognizable the features, although in rapid motion at 150 feet. BELOW.

QUESTAR brings the wild life closer

When you can't walk right up to your photographic subject, Questar can bring it to you. These wild inhabitants of the shore and marshland will not hold still to have their pictures taken, but they will never know it if you sit quietly with your Questar.

Michael Clark, who took the shots of the boat race on the preceding page, also tried his hand-holding technique with the three bird close-ups below. Again, we must say that many people could not hold a long-focus lens steady enough to get such fine shots, but on the other hand, if fast shooting *is* necessary, hand-holding is better than losing your bird! His pictures are on High Speed Ektachrome, 1600 mm. at F18.

Dale Rex Coman

Robert C. Ashley

Dale Rex Coman

Dale Rex Coman

A PORTFOLIO OF FAMOUS PROFILES

Left, Michael T. Clark, distance 25', 1/60 sec.

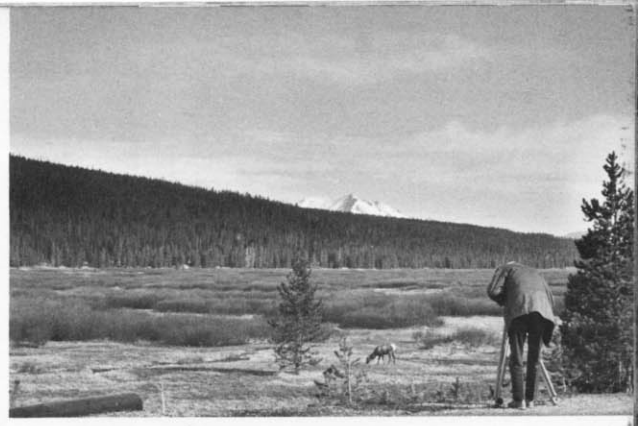
Michael T. Clark, above 25', 1/250 sec.
Michael T. Clark, below, 25', 1/125 sec.

Left, Robert C. Ashley
Below, Harry L. Zobel

Ralph Davis, Ektachrome X, 1/125 sec.

NO MATTER WHERE YOU LOOK YOU SEE *MORE* WITH A QUESTAR

1.



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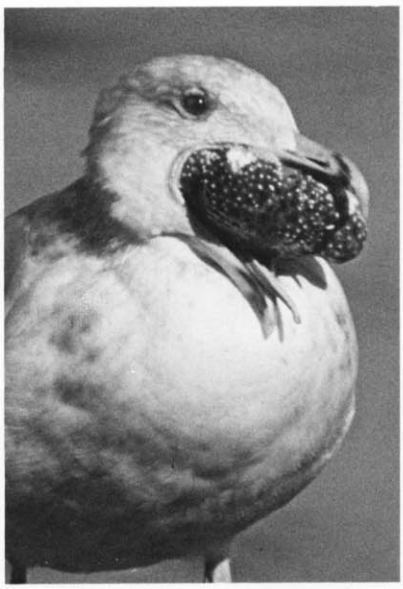
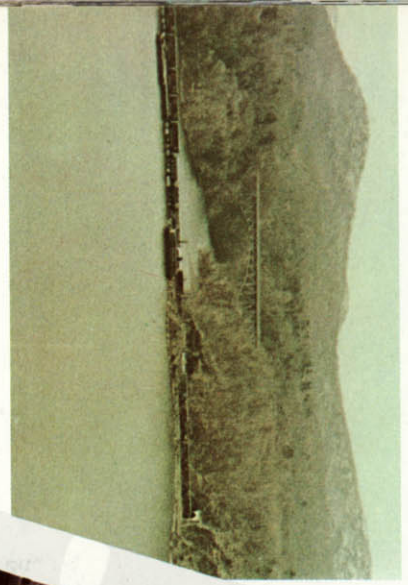
3.



5.

1. Flying Squirrel. The size of the film box tells the whole story and you can even read the fine print at 40 feet. Doris Davis.
2. A view of the scene in Yellowstone National Park, taken with a regular 50 mm. camera, shows the elk 150′ away. Questar brings his head sharply into focus. Ralph Davis.
3. You might never get close enough to see a gull swallow a starfish except with a Questar. Distance 75′. Franklin P. Enos.
4. The burrowing owl is only 9 inches long and his site is well hidden in the concealing grasses. Franklin P. Enos.
5. A kildeer protects her chick from the hot noonday sun, an act seldom witnessed by bird lovers, but easy to do with a Questar. Although it is 65 feet away, you can see the fluffy bundle with its bright eye. Doris Davis, on Tri-X, 1/250 sec.

4.



This short sequence showing a train going through a tunnel, was clipped from the David Quaid test film described on the opposite page. It was photographed across the Hudson and appears in the cover shot at right, taken with a 50 mm. lens. The movie film is Ektachrome 5234 with a #85 filter, and is shot at 24 frames per second.

The second short strip from the same test film shows a plane taking off at Newark Airport from a distance of 3 miles. At a certain point in the takeoff the plane has a sudden lift upward, which is noticeable in the filming. Taken at 24 frames per second with a #85 filter.

One of the most exciting things we have seen at Questar recently is a test film shot by David Quaid with our new Cinema Model attached to the Arriflex 35. It begins with the motion of the moon drifting slowly across the field of view, follows a train along the bank of the Hudson river, three-quarters of a mile away, pans the New York skyline and climbs the Pan Am and Chrysler buildings, three miles away, inspects the Statue of Liberty from five miles, zeroes in on a flying helicopter at two and a half miles, watches a grazing cow with its accompanying cattle egret at two hundred yards, lifts to a mockingbird singing on a branch at three hundred feet, follows a vapor trail until it catches up with its jet at ten miles, and watches a plane take off at Newark Airport and approach the camera, finally passing overhead. The film closes with the sun setting behind some fishermen in a boat three and a half miles at sea.

And all this with no lens change—just with the Questar which, as David Quaid says, can focus from the eye of a fly to the craters of the moon . . . instantly!

The sequences on this page were shot with the Questar and Cinema Beaulieu, by the Davises. The fisherman is on a bridge 2000 feet from the Questar, shown in the cover shot at the top of the page. The truck is on an island 1/3 of a mile away, in the cover photograph at the bottom of the page. The sequences were on Kodachrome II Movie Film, which has an ASA rating of 25, at 16 frames per second. With the Beaulieu's variable shutter, the shutter speed was 1/58 second.

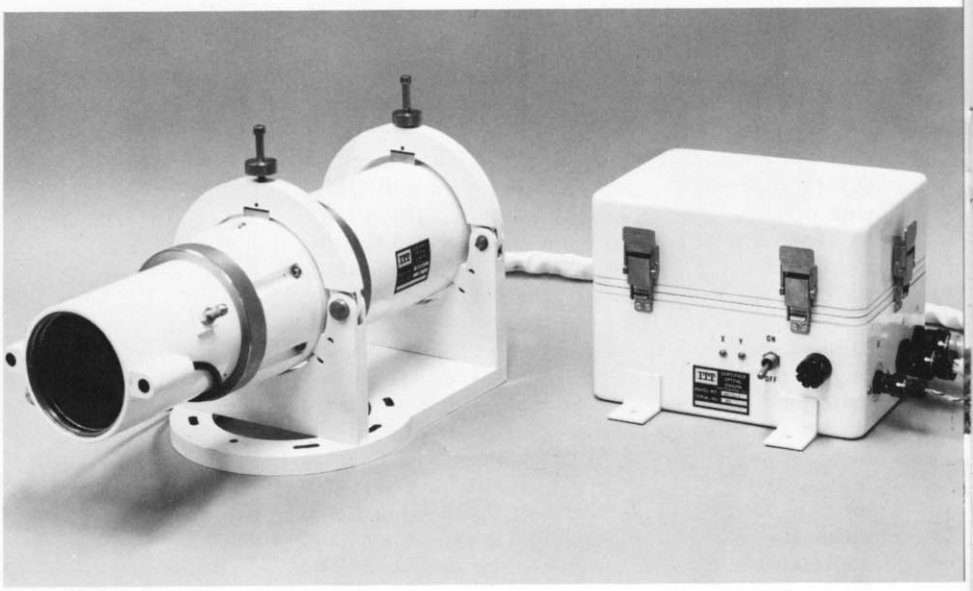
Since these Davis photographs were made, Questar has perfected its Fast Focus which is so much more convenient to use with a super 8 or 16 mm. camera, as well as with the professional 35. It has had wide acceptance among Questar owners, whether they are professional cameramen or hobbyists. Questar permits the cinematographer to do something he has never been able to do before—to adjust his focus from an extreme telephoto situation to a macro-closeup within the same film take.

QUESTAR SPECIAL APPLICATIONS . . . OPTICAL DATA CORRECTOR OFF-AXIS STAR TRACKER NON-CONTACTING PROFILOMETER RANGE GATED VIEWING SYSTEMS

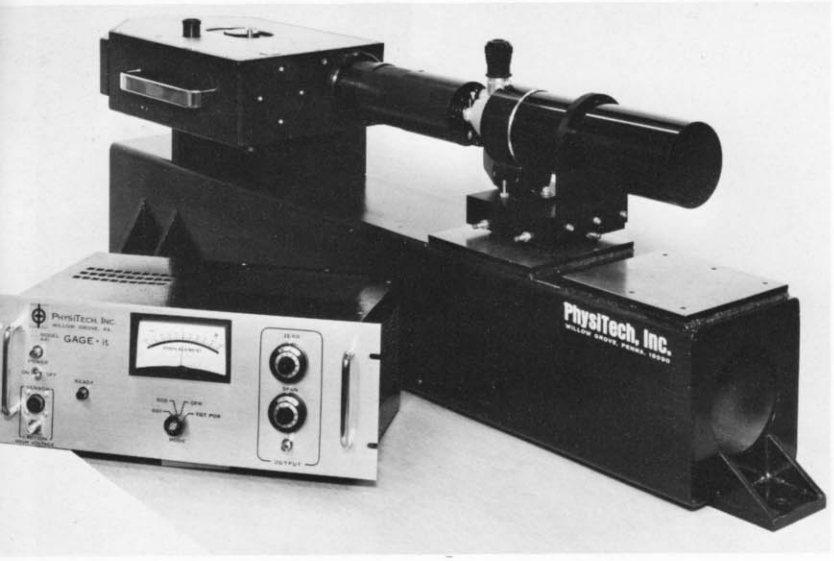
Questars are used in many special applications and here we mention a few of some very interesting ones that have come to our attention.

They were essential components in two projects of ITT—one in an Optical Data Corrector, shown at right, in a contract with Federal Electric Corporation. This project required the development of a star tracker to be mounted on the elevation trunnion of a radar, and used for alignment and calibration of the radar. The performance characteristics include a ± 8 arc minute field-of-view and a signal null precision repeatable to ± 1 arc second.

The second project was part of the development of a star tracker featuring off-axis tracking and integrated circuits, for use in the SPARS (Space Precision Attitude Measuring System), developed for Lockheed Missiles and Space Company. Test results showed a null accuracy greater than 1 arc second.



Optical Data Corrector by ITT



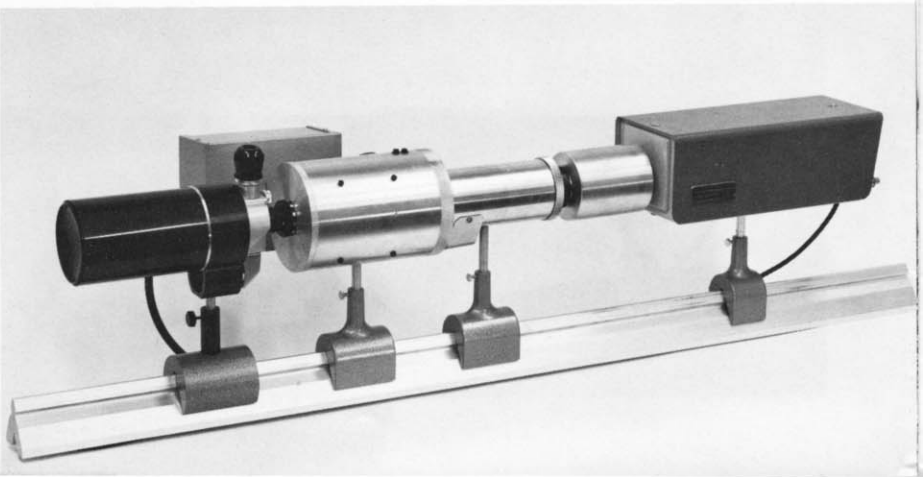
Questar is the optical component of a non-contacting Profilometer developed by PhysiTech, Inc. for the Argonne National Laboratories. The Profilometer inspects revolving fuel elements and is capable of 100% rod inspection with 15 microinch resolution and better than 100 microinch accuracy, permitting direct calibration without disturbing the sample. Applications for this Prolifometer are the measurement of materials that are hot, cold, radioactive or otherwise inaccessible to direct contact.

A similar application was developed at the Canadian nuclear power station at Douglas Point, Ontario, where a Questar was set up for scanning fuel elements with suspected damage. Fine hair line cracks showed up clearly in 20 feet of water and Polaroid pictures were taken through the Questar of the damaged fuel elements.

Another remarkable application of the PhysiTech Profilometer is the measurement of the structural sway of skyscrapers in a high wind.

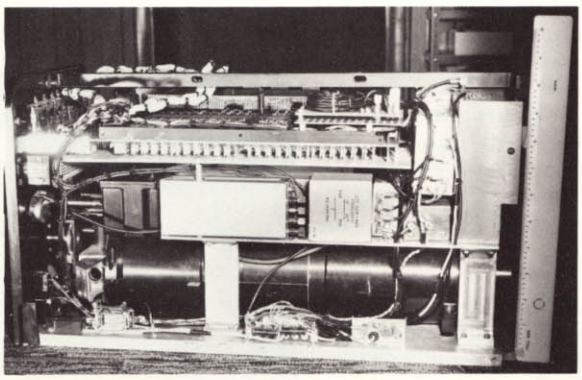
Non-Contacting Profilometer by PhysiTech, ABOVE—BELOW RIGHT, *Range-Gated Viewing System by Wheeler*

Wheeler Laboratories uses Questar in an image-intensifier system developed for Hazaltine Corporation. The receiver, of which Questar is a component, is used with a high-power laser illuminator to obtain range-gated TV pictures. Such systems are projected for long-range, all-weather, day-night seeing. Mr. Richard P. Flam, the senior development engineer on the project wrote us "Needless to say, we have been delighted by the Questar. Its optical quality has exceeded our requirements, and the ease of operation has been a great time saver in system alignment."



QUESTAR SPECIAL APPLICATIONS . . .

RANGE MEASUREMENT
LASER SENDING AND RECEIVING
SUPERVISORY AND MAINTENANCE INSPECTION



Laser Systems and Electronics, Inc. produces the Rangemaster I, an instrument with which range calculations are made automatically and displayed on numerical lights. It will measure from zero to beyond thirty miles daytime and forty miles at night, with a claimed accuracy of ± 5 mm + 1 ppm. of the distance measured. Questar optics, of course; shown at lower left of photograph above.

Distance: 25 miles; Power: 1/25th that of an ordinary flashlight; Alignment: slightly off beam axis to avoid overexposure.

QUESTAR used in atmospheric studies at Spectra Physics

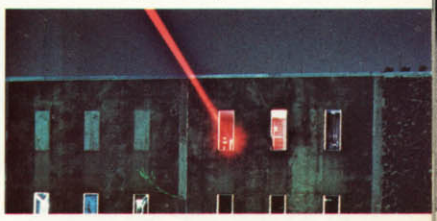
Curious to observe the effects of the atmosphere on a laser beam of extended length, Spectra-Physics scientists recently sent the light from a Model 125 gas laser on a 50-mile round trip between their plant and a retro-reflector on Mt. Hamilton, site of the James Lick Observatory. Emerging from the laser in a 1/16″ diameter beam, the intense, highly coherent light was sent through a 4″ transmitting telescope and aimed at the reflecting target on the mountain.

At Mt. Hamilton, the arriving beam had enlarged to approximately 3 times its 2-foot calculated diameter, and cast shimmering, horizontally-striated patterns on the base of the observatory. For the observer looking directly down the blindingly brilliant beam, it was hard to believe that the power was only about 1/25th that of a 2-cell flashlight. And though only a small percentage of the arriving beam was reflected back to the source, the dancing spot of light from Mt. Hamilton was easily the brightest thing in the sky.

Questar is shown in lower photograph at right.

At top, approx. 1 per cent of transmitted beam is returned from retro-reflector. Note back-scatter from transmitted beam.

Photo taken of beam "on target" at the retro-reflector approximates size, but not brilliance, seen by the naked eye.



Small-angle forward scatter from atmospheric particles makes the beam brightly visible at the transmitting end.

If a building supervisor had a Questar set up on this street corner, he could zero in on what goes on up in the air two blocks away, as shown at right. Questar is the greatest idea yet for on-site inspection, for maintenance, for surveillance. It keeps your eye on things.

QUESTAR SPECIAL APPLICATIONS

. . . IN THE SPACE AGE

Questar was not only the first telescope to photograph the earth from outer space, but was used on both the launch and recovery shots to bring the events to your living room through TV. The photograph at left, sent to us by the American Broadcasting Company, shows the television cameraman aboard the U.S.S. Guadalcanal setting up his Camera with the Questar to photograph the recovery of the GT-10. William Waterbury writes us, "The Questar is a great lens, especially when the parachute and capsule fill the vertical frame at 7½ miles, as they did on GT-9." This was one of the shots you saw on your own TV.

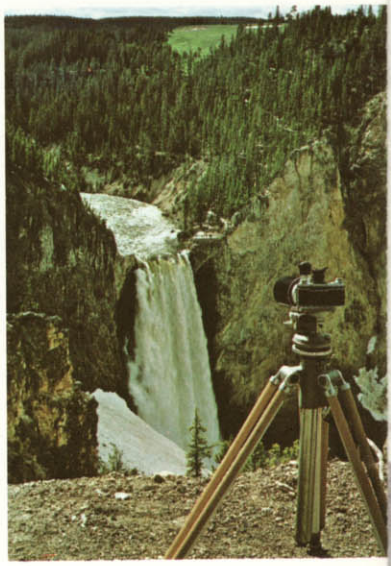
Many of the sports events you watch—skiing, baseball, golf—are more interesting because Questar brings you a close view of the man careening down the snowy slope, the pitcher on the mound as the ball leaves his hand, the expression of the pro as he misses that putt.

In this age of fantastic technical achievement, Questar's experience and skill has met the challenge of the ever-widening demand for special applications. It has led us into the development of the Questar Cinema Model, a Questar system for closed-circuit television, and the Questar Autocollimator (see a description of the latter on page 30).

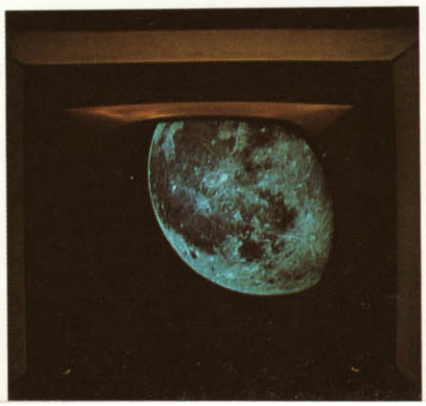
RCA's magazine BROADCAST NEWS in an article by Jerome L. Grever suggested to the newscasters that they could enliven their broadcasts by televising the moon, that this would have particular appeal during the Apollo moon landings. To demonstrate how well this could be done with Questar, Mr. Grever tells how he organized a televising in his own backyard and in the process also entertained the neighbors.

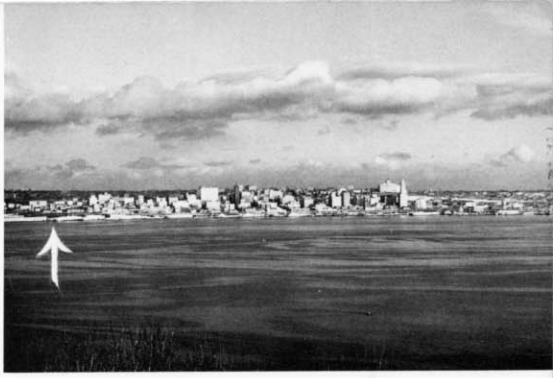
The photographs below show the Questar mounted on the RCA TK-43 camera, and the moon itself photographed as it appeared in the monitor. To create the most pleasing effect of the moon's motion, it was positioned at the left of the raster and allowed to drift to the right. The motion across the screen was at the rate of one inch every fifteen seconds.

What color is the moon? is a question the RCA account raises. "Ask three or four people what color the moon is and you may hear three or four different answers. Is it really silver or is it white? At dusk it's not quite red nor is it pink. In winter it seems whiter, or perhaps pale blue. On a dry summer night it can be a dull bronze, its light filtered by scattered dust." In the monitor here, it has a bluish appearance, as did the photographic slide by Robert Richardson which we reproduced on page 4. And if *your* moon turns out to be different colors, they may all be right!



At right, a photograph of the Lower Yellowstone Falls, in Yellowstone National Park, taken with a 50 mm. camera lens and showing Questar in the foreground. The distance from this point to the overlook, just visible opposite the Falls, is approximately 2000 feet. Let your eye travel to the picture below on the opposite page for a close-up of visitors at the overlook, taken on Tri-X film at 1/125 sec. on a cloudy day. By Mr. and Mrs. Ralph Davis.





WOULD YOU BELIEVE–

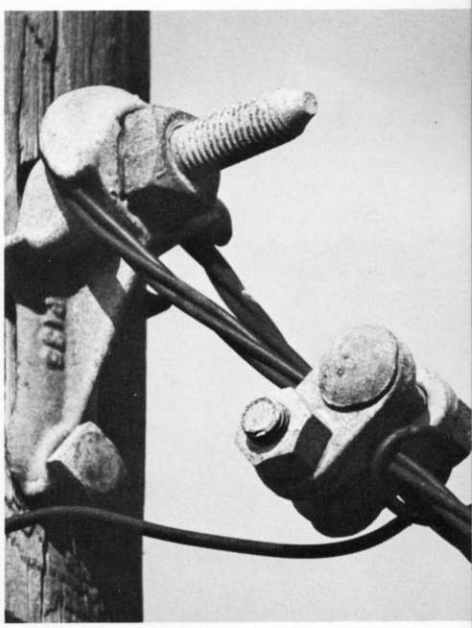
License plates 2.2 miles away?
Ground installations photographed from helicopters?
Faces photographed at 2000 feet?
Corrosion at 75 feet?

The photograph at right is a view of Seattle across Elliott Bay, a distance of 2.2 miles, made with a 50 mm. lens. Clearly visible in the Questar shot below it are the license numbers on the cars parked below the viaduct, where the arrow points in the cover shot, and you can read the "No Parking" sign on the wall. The width of the "1" in the Saab license "371" is ¼ inch. Photographed on KB 14, 6 seconds, 2 Barlows and 2½" extension tubes.

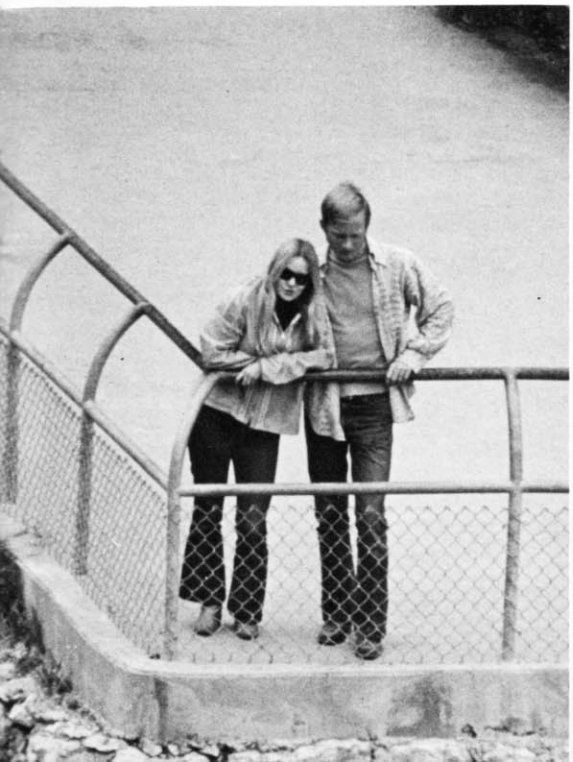
In the photograph just below it, an attachment on a pole 75′ distant, allows easy inspection of the corrosion present, and demonstrates how viewing with Questar could save much pole climbing and at the same time, a photograph would make a permanent record of equipment that might need periodic replacement.

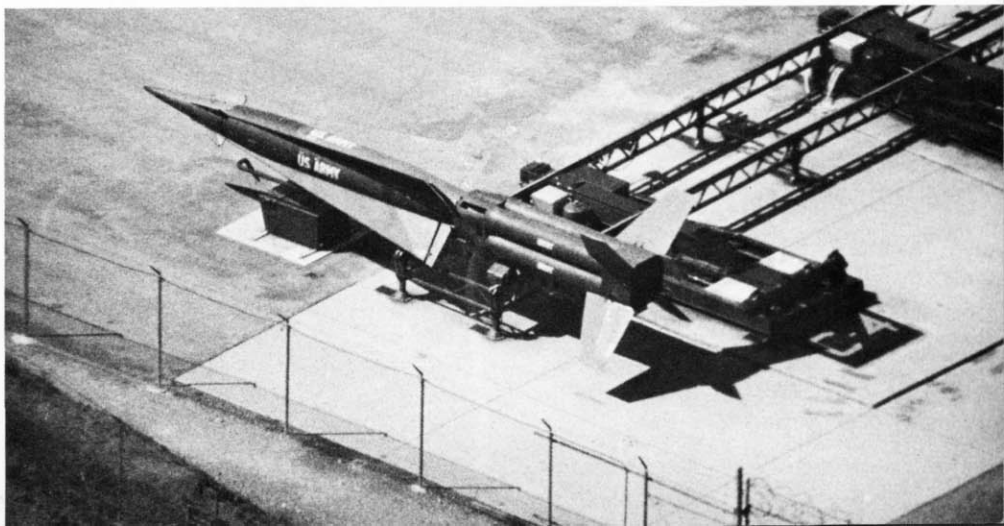
Next left, is a cover shot of the landscape surrounding a rocket installation, to be compared with the Questar closeup at the bottom of the page. This type of photograph is commonly used now in aerial surveillance, and in a vibrating aircraft a stabilizing system is required, such as that developed by Tyler Camera Systems who provided this picture. Note the clarity of the printing on the rocket. In its report Tyler says "the resolution of the Questar lens is impressive and appears capable of resolving 0.4 inches or better at 1000 feet." Questar's small size and complete portability make it the obvious choice for jobs on board aircraft.

All photographs with the Questar 3½.



Below is the Questar close-up of visitors at Yellowstone Falls, taken from the point shown in the photograph on the opposite page. Distance 2000 feet, Tri-X film, 1/125 sec. Cloudy day with strong wind currents.





Birds seem to pose for Dr. Ashley's photographs. Distance about 150 feet, 1/4 sec. on Kodachrome II.

QUESTAR . . .
the long-distance microscope

When we first discovered that this amazing optical system could work at both ends—"from 8 feet to thousands of light years away", as Questar owner Hubert Entrop says—we coined the phrase "long-distance microscope" to describe this new phenomenon in optics. For many people, this ability to capture in the sharpest detail an object that is near by, yet just beyond the reach of normal vision, is one of Questar's greatest charms. When you aim at a distant flower on the edge of the lawn, you usually get a bonus —a bee or a butterfly in action.

Dr. Robert C. Ashley, who has been taking bird photographs with his Questar for many years, is not to be outmaneuvered when he is in the mood to take pictures. If the birds don't turn up, he composes one of these lovely flower shots, and with it he often gets one of its hidden visitors.

Describing some of his picture taking in a recent letter, he talks about light. "It is never twice the same. It changes according to the time of day, the kind of day, the angle of the source in the sky, the angle of the shot, the season of the year, the humidity and the temperature of the air, and probably much more. Artificial light, however tempered, is never as rich or satisfying to the human eye, for the eye was brought up on natural light and interprets color values accordingly, as a matter of built-in "natural" appreciation. My opuntia shot, for instance, taken with Questar, looks almost like a flash picture, but it is richer and has a third dimension and would not be likely to be reproduced by strobe or flash.

"Besides the very agreeable color value in Kodachrome, there is the matter of the background of the Questar pictures as compared

with the strobe or just plain camera shot. The nearest you can photograph with a Questar is around 8 feet. At this distance a sharp focus on the subject in the foreground throws the background, even the near background, out of focus and this produces amazingly beautiful effects."

Another of Dr. Ashley's predilections is to photograph from inside his car, where he can sit quietly and wait for a bird to put in an appearance. Then leisurely he focuses and shoots without disturbing his game. For his greater convenience he has developed a window platform to support his Questar, and he uses an air release with a long hose so that he can hold it in his hand and squeeze the bulb the instant the picture is properly framed and focused. He says that for a lazy man this beats chasing the birds around in the woods.

Dr. Dale Rex Coman, who has a collection of beautiful bird photographs, prefers to get action into his shots when possible—he thinks birds are more interesting that way than when sitting quietly on a branch. Here are four of his Questar photographs of an osprey bringing building materials to the nesting site. Though the bird is in motion and at a distance of about 150′, you can distinguish the sticks it carries in its claws. What such pictures lack in sharpness they make up for in dramatic interest and prove once again that you can do practically anything with a Questar.

Dr. Coman says that ospreys make interesting subjects to observe and photograph. Since they will use a nesting site that is prepared for them, it is possible to watch the birds from the beginning of nest building to the day the youngsters are sent off on their own.

Also partial to photographing from inside his car when possible, he has designed a wood block that fits snugly over the glass of the car window. To the top of this he attaches his panhead which in turn supports his Questar Field Model, giving it the necessary mobility.

The fifth osprey, below, is by Harry L. Zobel. More photographs by Dr. Ashley and Dr. Coman are on pages 11 and 14.

QUESTAR SPIES ON A BALD EAGLE

The photographs were taken by Ralph L. Shook on a bitter cold day in February, with the wind at 15 miles per hour. He spent many hours waiting for his eagle to visit this favorite perch. The picture below shows the whole scene—his Field Model Questar set up in a blind, 150 feet from the bird's tree. His modified Nikon with through-the-lens meter is close-coupled to the telescope and the arrow points to the empty branch. Questar photograph cropped from an 8 x 10 enlargement of 35 mm. Tri-X, taken at f/16, 1/250 second.

QUESTARS IN EDUCATION

IF YOU THINK YOUR SCHOOL CAN'T AFFORD AN OBSERVATORY BECAUSE IT WOULD COST THOUSANDS OF DOLLARS—PLUS THOUSANDS MORE FOR A LARGE TELESCOPE—AND IF SOMEONE POINTED OUT THAT YOU COULD HAVE A NUMBER OF FULLY-MOUNTED SUPERFINE QUESTARS FOR THE PRICE OF ONE LARGE, CONVENTIONAL TELESCOPE, AND THAT THEN A WHOLE ASTRONOMY CLASS COULD OBSERVE AT ONE TIME—AND IF THEY COULD BE CARRIED TO ANY LOCATION, SO THAT NO SPECIAL HOUSING WAS REQUIRED—would you listen?

And if they could be used in the daytime for safe solar observation, as well as at night, and could be picked up at a moment's notice and taken into the field for nature work, and used day and night to teach photography, and used in the laboratory for special projects in research, wouldn't this all add up to an exciting curriculum as well as a practical investment of school funds?

Both the Questar 3½ and the Questar Seven are ideal for student use and instruction in schools, colleges and planetariums. Both are portable and accept the same broad line of fine accessories. For a basic course in astronomy, the Questar 3½ is more than adequate. Where serious research programs are to be undertaken, the increased light grasp and resolving power of the Seven are important. Valuable photographic and photoelectric work can be accomplished with this instrument, and its performance, just like that of the Questar 3½, is always greater than is expected of its aperture. This is due not only to the exquisite quality of optics, but to mechanical perfection as well, which combines the finest controls with a ruggedness that gives both the greatest stability.

Teachers in astronomy and other science courses particularly are grateful for the ease with which Questars can be stored on the shelf with the microscopes, and are ready for instant use. No longer do they need to unlimber a piece of unwieldy equipment on a cold night, or even a night of doubtful "seeing", and then take an hour to batten down observatory and telescope after the students have gone.

Servicing of Questars for educational institutions is done at cost here, which is no strain at all on the school budget. Occasionally they may need cleaning and inspection, but we seldom find anything seriously wrong. The drives will show wear, just like the brakes on your car, in proportion to the hours of use, but this is a simple replacement.

In this regard we have the following letter from Howard L. Weisbrod, Instructional Consultant of the San Diego City Schools, who wrote us in regard to the servicing of their Questars. "Thank you very much for your excellent service. In my opinion it matches the high quality and performance of the Questar itself. Our teachers have been most enthusiastic in the use of the Questars in our secondary schools and they are constantly in demand."

• • •

What about a gift for your school? From a graduating class, the Alumni, the PTA? You could drop a few hints and begin to accumulate Questars.

NO MATTER WHERE YOU LOOK YOU SEE MORE WITH A QUESTAR

Did you ever try to photograph an all-black bird against a dark background? We have seen such slides, taken by various Questar owners, of rather dim scenes which have beautiful color and resolution, and we regret that we could not get them into this collection. They were taken with Questars that had our special coatings.

The broad-band coating increases the reflectivity of the mirror to 99%, and the very-low-reflection coating applied to both sides of the front lens reduces the light loss at each surface to less than 1/10 of 1%. All frequencies of the visible spectrum are transmitted and the total light grasp is increased by approximately 22%.

This new phenomenal light-gathering ability of Questar will come as welcome news to the serious amateur astronomer, and to research and industrial users. The photographer will be astonished at the new visibility within shadows and the sharper contrasts he can obtain for more sparkling pictures.

In commenting on the new coatings when they first tried them, the Davises wrote us "The broad-band and low-reflection coatings are very superior. The extra light punch, both visually and photographically, will produce sharper negatives. They permit exposure speeds of 1/125 to 1/250 on Plus-X film and the extra efficiency enables one to use Kodachrome."

NOTES OF GENERAL INTEREST TO QUESTAR PHOTOGRAPHERS

To take advantage of the superior resolution and fine-grain characteristics of High Contrast Copy film, Robert Richardson has perfected a method of dual development which produces negatives of continuous tone and controllable contrast. Lunar and planetary negatives obtained with this method allow 20 to 30x enlargements on normal contrast grades of paper. His method was discussed in SKY AND TELESCOPE, in the November 1971 issue.

The Davises write us "We seldom use the photographic Barlow lens on any subjects other than astronomical. For terrestrial subjects we increase the size of the image on film by using extra extensions. On the sky, however, using a Barlow instead of extra extensions decreases the amount of outboard weight the drives have to handle."

Catching a shot of the bird on the wing or scavenging a distant beach is not what one might expect to do with a long-focus astronomical telescope, but this is one of the enjoyments most treasured by Questar owners. In fact, Questar is being used for so many individual hobbies that a whole family sometimes discovers it is their most prized possession, in use by day for terrestrial observing and for astronomy at night.

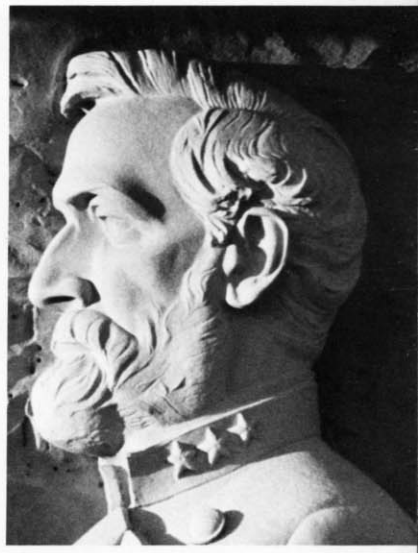
• • •

Questar's relationship with its customers has been, we believe, a unique experience in the world of business. Those who first enjoyed the instrument as a new observing experience soon wanted to start taking pictures, but to work with a variable system without firm guidelines was a new idea. All we could tell them, to begin with, was that Questar was photo-visual, that

(continued on page 28)

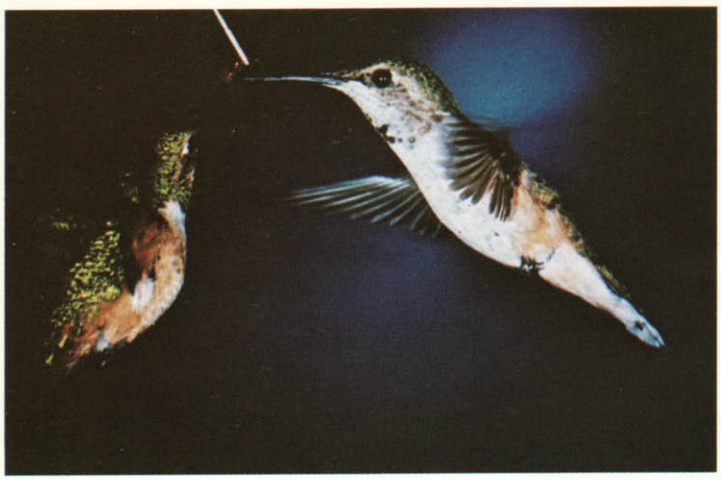
Another of those "impossible" views with a Questar

At historic Stone Mountain near Atlanta, a carver works on the Confederate Memorial. (See covering shot below taken with 50mm. camera lens, showing Questar Field Model mounted on Linhof tripod, Topcon camera attached, and worker indicated by black arrow.) The Questar photo, above, on Tri-X, 1/60 second, shows him in constant motion as he swings from a harness on the sheer granite wall, guiding himself with his feet and vibrating with the thrust of his powerful thermo jet torch. The photoengraving process permitting, you will notice such detail as his belt loops and a band around his left ankle. Photographs by Mr. and Mrs. Ralph Davis of Sarasota.



QUESTAR STOPS THE ACTION

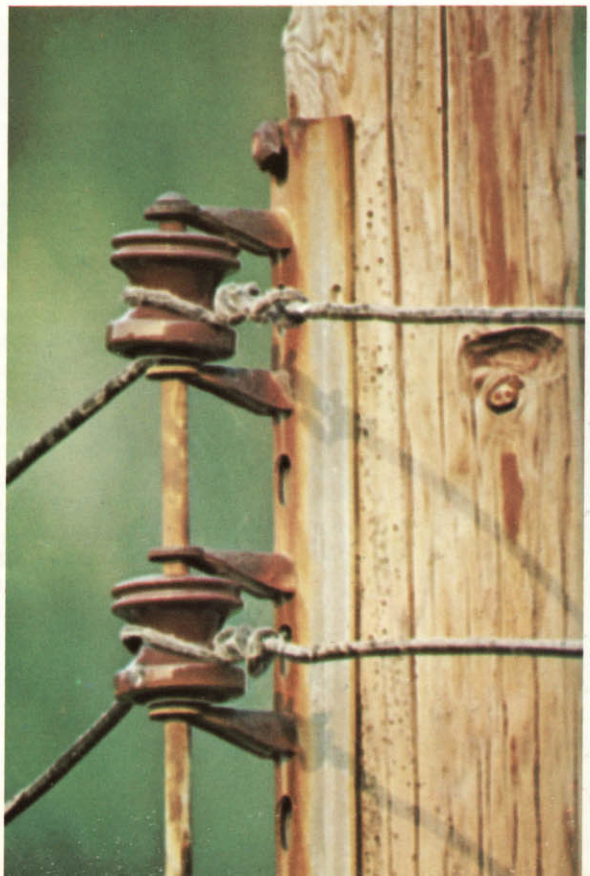
Many Questar owners have tried their hands at photographing hummingbirds, but we think the collection sent in to us by Hubert Entrop was perhaps the most impressive. There were 35 slides, all so beautiful it was hard to choose. Many shots actually showed the structure of those vibrating wings. These are the western species, or Rufous Hummingbird, male, female and immature. More of those "long-distance microscope" shots—photographed at 8 feet.

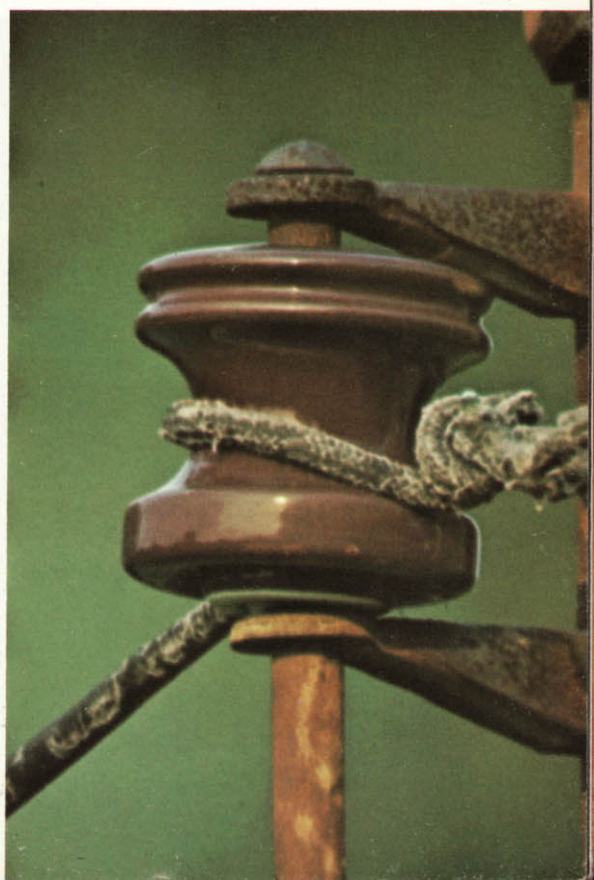


THE QUESTAR SEVEN . . .
Twice The Resolving Power—
Four Times The Light Grasp

Previously in this booklet we have shown photographs of astronomical objects taken with the Seven. This is Questar's great contribution to the serious astronomer, an instrument with the same superb quality as the 3½ but with twice the resolving power and four times the light grasp. And like the 3½ it surpasses what is expected of an aperture of its size and outperforms telescopes many times its size on planetary and lunar detail.

The photographs on this page remind us that the Seven is also a powerful instrument for terrestrial use and for all the industrial applications we have mentioned previously. Two shots were taken across the Delaware River here, shown in a covering shot with a 50 mm. camera lens on a mile line of sight. The other two were taken across a lawn at a distance of 150′ focusing on a pole insulator in late afternoon sunlight. The first shot is at prime focus and the second with a photographic Barlow and extension tubes. All four pictures show the sharp detail that can be captured with even the grainiest, fast color film.





This is a very fine example of guiding with the Questar 3½. It is a portion of an 8 x 10 enlargement of a 2¼" negative, taken with a Hasselblad mounted piggyback on the Questar. Ralph Davis

The two photographs at right, Copernicus at top and the area of Theophilus below, are more of the new series taken by the Ralph Davises in December 1971. They were photographed on High Contrast Copy film with a Barlow and extension tubes, exposure time 4 to 5 seconds.

(continued from page 25)

what you could see could obviously be recorded on film.

We knew that improved films were being developed, but there remained the question of a suitable camera, and how to adapt it to the 'scope, and how to provide a groundglass that was fine enough to reveal an image from a long-focus lens. We pointed out to the camera manufacturers that recoil in the camera itself would reduce the chances of fine photographs. Some listened to our argument and saw the logic of a vibration-reduced shutter and mirror, and realized that releasing each independently would halve the problem, and so they embraced the Questar modification.

However, all this took time and meanwhile pictures began coming in from customers who had accepted the challenge. We enjoyed saying to those taking successful photographs, that they were working on the frontiers of a new development in the art. The quiet cameras that we have since been able to offer with their Questar modifications, have made the job easier.

We wish we could publish all the pictures that come to us. This is the third collection, and we hope you enjoy them as much as we have. They indicate, among other things, the great range of interests that Questar owners share and the many ways they find to use their Questars as important adjuncts to their hobbies.

Notes to QUESTAR From Alpo Observer Rodger W. Gordon

Rodger Gordon, our critical "seeing eye" writes us, "Just a note to let you know that the Questar Seven is doing a really superb job on Mars. Amazingly we had three straight good-seeing nights and I can say right now the 'scope is everything you claim it is and more. On Saturday night I had probably my best view of Mars that I've had since 1963. At 300x, the Seven breaks up the Martian mare (dark areas) into a complex of dark and light patches, lines, spots, etc. The melt band around the south polar cap was very dark. I made a pencil sketch of the planet, but one of these nights I'm going to try a color drawing as the planet is very colorful.

"On Jupiter—well, what can one say; it breaks up the Jovian polar regions into a series of fine belts and various flaky details—all very difficult to see in mediocre seeing, but easily held in the steady moments. The red spot is no longer just a spot. The following end has a darker nodule in it and there are streaks across it. It is an orange-red color, best described as brick red."

Writing again about Mars, Gordon says "Seeing has not been too good, but at 200x the Seven does very well. Just last Saturday night I detected a rather indefinite rift in the south polar cap and although I saw the rift in the 3½ later on, I doubt if I would have paid attention to it had I not seen it in the Seven first.

"I'm hoping to get one complete drawing of Mars every 15° of longitude apart so that I can make a complete map of the surface based on the 3½ and Seven Questars. I've got 5 drawings so far pretty well spaced. The critical thing is to get the clear skies and seeing to do this. I just haven't been able to use the magnifications I'd like to this year due to Mars' low declination. In 1967, when Mars was higher in the sky and much smaller in diameter, I was consistently using 250x-400x on the Questar 3½. Now I'm lucky to be able to use 200x on either the 3½ or the Seven."

WHAT WE HAVE LEARNED ABOUT SEEING AND RESOLUTION

(continued from page 31)

Questar's 3.5-inch aperture is far less affected by such waves or cells since "if a telescope of 4 inches aperture or less is used it will examine roughly one cell at any one instant of time." The paper continues, "The diameter of the central disk is equal to the resolution of the telescope . . . poor seeing conditions destroy this image and scatter the light energy over a large area. The larger the image, the worse the seeing. . . ."

Words of the experts help to explain why the minuscule Questar performs so much better than people expect; but it is also due partly to the stubborn policy of Questar's makers, who continue to reject every set of optics that does not surpass Rayleigh and Dawes criteria.

Bell also removes some mystery about exceeding Dawes' limit by discussing in THE TELESCOPE, quoted in the caption above, "the beautiful work of the late Mr. Burnham, than whom probably no better observer of doubles has been known to astronomy. . . . With a six-inch aperture Burnham reached in the average 0.53 of Dawes' limit . . . and also fell well inside Dawes' limit with a 9.4-inch instrument. With 12-, 18- and 36-inch apertures he failed to reach it and in fact fell short of it by 15 to 60%."

There is no magic to it. Nature always favors the small aperture, especially when a small telescope is as fine as the hand of man can make it.

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WHAT THEY SAY ABOUT QUESTAR

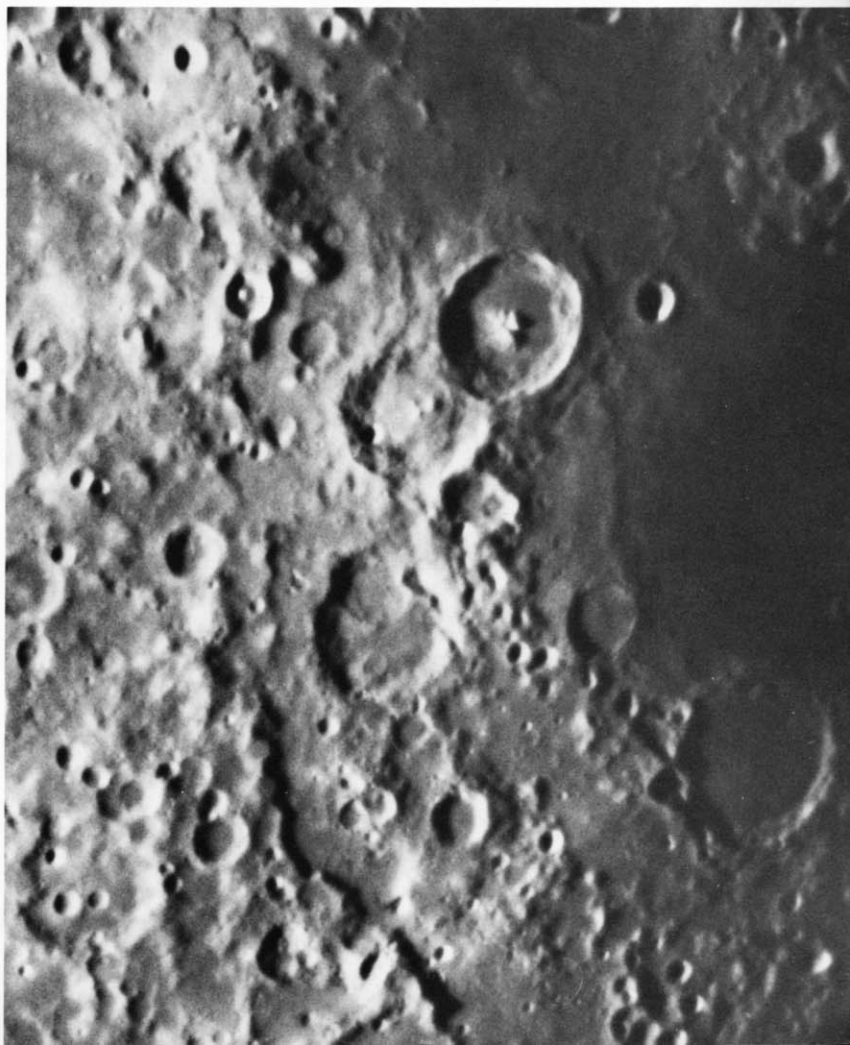
"I am an engineer with perhaps 25 years' experience as an advanced amateur photographer. I am not so advanced an amateur astronomer. Astronomy has always fascinated me, but I had a traumatic and colorful experience with the aberrations of a three-inch refractor about 15 years ago which rather persuaded me that amateur astronomy was not for a man who is fussy about the quality of images but too clumsy and impatient to grind his own mirror.

"I was wrong. The quality of the Questar design and workmanship, optical and mechanical, is superb. The proof is in the image, and I think I am a competent judge. Almost as impressive is the human engineering—the lightness and portability, and the convenience of the controls. I have used it with my heavy Linhof tripod on Jupiter, Mars, Mizar, and the crescent moon; also on an oil refinery on the far side of Los Angeles. I am delighted." Robert T. Smith.

• • •

Questar constantly keeps an eye on the development of new materials and techniques that will increase the efficiency and performance of its product. This is why we offer the versatile material Cer-Vit® which has essentially zero expansion, so that when your instrument has reached thermal equilibrium it will maintain its stability.

As a testament to Cer-Vit's indestructability, a Questar owner sent us a photograph showing the total destruction of a Questar in a house that burned completely to the ground—total, that is, except for the Cer-Vit mirror, which was shown with most of its coating burned away. The incredible part is that without refiguring the surface we recoated it and found its performance unaffected; its resolution was just as fine as before the fire. We would not have thought of such a drastic method of testing, but it says a great deal for the temperature stability of this fabulous material we use to make Questar mirrors.



Questar customers often use the words "dedication to quality "and "pursuit of excellence" in describing their pleasure with the optical and mechanical perfection of the instrument. We love to hear these things, but probably even more we like to know that Questars are capable of sharing in community enterprises, where their rugged quality and convenience permit them to be used by many people without fear of damage.

Donald E. Ehlers, Director of the Observatory and Planetarium at Southern Connecticut State College wrote us an interesting report on their activities during the 1970 solar eclipse, saying "I opened our observing facilities to the New Haven community as well as to the faculty and students of the college. At the time of maximum obscuration we counted approximately 150 observers on the observatory deck. About 75 of them were students in the New Haven public school system. Our observations contributed little to the knowledge bank of the world's scientific community, but for a few hours a cross section of the New Haven community coalesced to share a common experience.

"Among the instruments made available to the visitors were five 3½-inch Questars with solar filters. One was used to photograph the eclipse in its entirety."

• • •

A tribute to Questar's durability comes from George Kocher, Department of Geophysics and Astronomy at the Rand Corporation. "This instrument was purchased three years ago for the recreational use of RAND employees and has seen almost constant service by dozens of people. We are returning it for a general cleaning and checkup. Since Questar is used by so many people (unfortunately sometimes carelessly) and in frequently hostile environments (such as the desert and at seaside) it is a tribute to you that it is still in such serviceable condition."

• • •

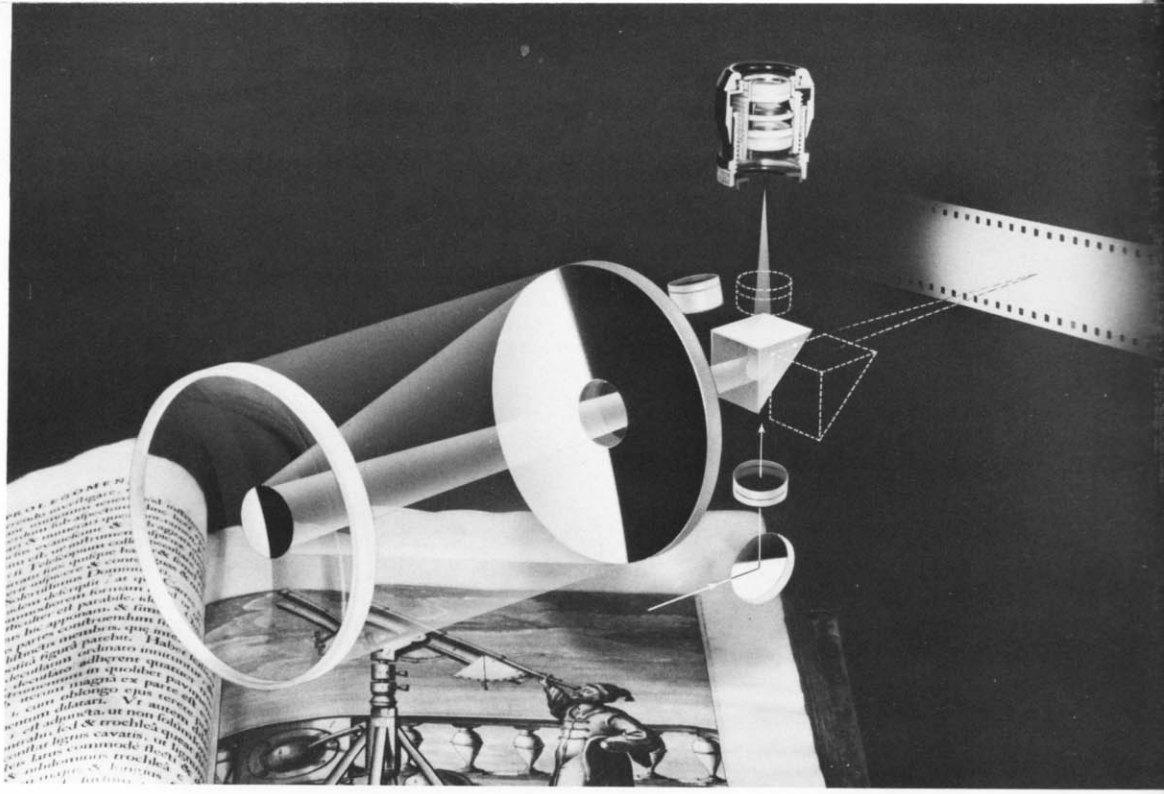
The need for superfine optics in so many fields led to many of the Questar developments. In the laser field alone it was in demand for both sending and receiving applications, and was quickly adapted to CAT detection, bio-medical studies, range measurements, star tracking, and many other projects, some of which we have talked about on pages 18 to 21.

A critical industrial requirement led to Questar's recent development of the Questar Autocollimator, which, because of the superb Questar optical system, is difficult to match for accuracy. By simply attaching a small device to Questar's control box, it becomes a multi-function intermediate and long range autocollimator, for alignment, target collimation, optical leveling, and similar uses. It features, for the first time both a wide-field and high-power finder system, interchangeable reticles, unusually bright images, extended eye relief, AC and DC operation, plus a complete line of accessories.

Questar's small size and easy portability make it the ideal instrument for all applications where size is of the essence. If *time* is of the essence for you, as well; if fast delivery an important part of your research and development project; if you haven't time to wait for a specially designed optical system that may take several months to deliver, why not have the finest optics that money can buy, and have them instantly? We often refer to Questar as the "on the shelf" optical system, for we almost always have star-tested instruments in all models ready for delivery the day an order is received. We suggest that this is a logical way to meet the bidding competition.

When we try to summarize briefly Questar's contribution in the field of optics, we think of the honor paid it at Canada's Expo in 1967, where in the "Man the Explorer" Pavilion it occupied the adjoining space with an ancient reproduction of Galileo's own telescope. There they were, the oldest telescope in the world and the newest; the first to turn its eye on the heavens, and the latest example of technical achievement, side by side.

Ralph & Doris Davis



This is the Questar optical system. Its correcting lens and mirror are but 6 inches apart. Perspective makes the 3.8" mirror look smaller than the lens, but it is really larger. Note that moving aside the diagonal permits the axial rays of main system to enter camera attached to the control box at the axis, and at the same time the view from finder system enters eyepiece above. When diagonal is in system, it diverts axial views to eyepiece for high powers. For increased power, Barlow lens is moved into position above diagonal.

WHAT WE HAVE LEARNED ABOUT SEEING AND RESOLUTION

The requirement of absolute perfection distinguishes the *astronomical* telescope from all other optical instruments. 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? With this class of instrument we are satisfied only with the ultimate–with an image sharp and clear at powers so high that only external causes such as turbulent air or dimness of object sets the limit of their useful magnification.

Few subjects are as complex as astronomical telescopes. Time was when textbooks could glibly state that "resolving power (the ability to discern fine detail) was proportional to aperture," sometimes adding "in perfect seeing" which is a wonderful joke because there really is no such thing on earth. Only when we lift telescopes into the vacuum of space are they completely free of the terrible effects of the hot and agitated ocean of moving gases we live under and look through, because poor seeing is due to heated air, to the fact that gases of different temperatures bend or refract light much or little. And this is the reason why the world's largest telescope can only photograph lunar detail two or three times smaller than Questar does, instead of 57 times smaller, as you might expect.

In the preface to the great "Photographic Lunar Atlas," 1960, University of Chicago Press, Chicago '57, by its Editor, Dr. G. P. Kuiper: "The purpose of this Atlas is to present the surface record of the moon as shown on the best photographs now available. The selected photographs were taken at five observatories: Mount Wilson, Lick, McDonald, Yerkes and Pic du Midi. The best resolution obtained is about 0.4 sec. corresponding to about 0.5 miles or 0.8 kilometers. This matches the optical resolving power of an 11-inch visual telescope used under perfect conditions." Also, "with large apertures and the best conditions visual observations have a resolving power of about 0.1 sec., about four times better than the best photographs."

Lunar photographs that we have published show rilles and craterlets smaller than one second despite engraving and printing losses. And visual resolution with Questar of stars 0.6 to 0.7 seconds of arc apart continue to be reported to us, in spite of the fact that Questar's 3.5-inch aperture is supposed to be limited to resolving two 6th magnitude stars 1.4 seconds apart by the Rayleigh theoretical formula, and 1.3 sec. apart by the empirical Dawes' criteria. Often glimpses may be had of detail too small and too evanescent to be recorded on emulsions. Also, it is well known that celestial negatives usually have fine detail that can be clearly seen but will not print on photographic paper.

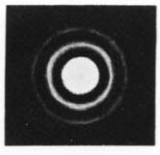
Since the subject of seeing and resolution cannot be covered in a booklet this size, let us recommend two more professional sources:

In AMATEUR TELESCOPE MAKING, BOOK TWO, *Scientific American,* 415 Madison Ave., $6.00, is reprinted an 1897 paper by Prof. A. E. Douglass titled "Atmosphere, Telescope and Observer." This historic work was written at the time when great telescopes were first being built upon mountain tops in climates of good seeing. If you do not have this book, you should, for the vast store of information it contains. The three ATM books represent the lifelong devotion to telescopes of the late Albert G. Ingalls of *Scientific American.*

O. Richard Norton, Director of the Atmospherium-Planetarium of the Desert Research Institute of the University of Nevada at Reno, has written in *The Review of Popular Astronomy* a paper called "Seeing Through the Sea of Air," which describes researches into sources of poor seeing within and near the large telescopes themselves.

We like this able paper of Dr. Norton's because it helps explain to us why nature favors the small aperture. He refers to thermal cells and waves of turbulence about 4 inches from crest to crest.

(continued on page 29)



RIGHT, *A first-class star image: the outer ring fades below threshold of vision on stars of lesser magnitudes and in unclean air. 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."*

LEFT, *This conception is the "diffraction solid," due to M. Andre of France, and is from Bell's* THE TELESCOPE, *McGraw-Hill, 1922, now out of print. About 85% of a star's light should be in the central disk. Bell notes that if the disk's center is of unity brightness, the first ring has a brightness of only 0.017, the second, 0.004, and the third ring 0.0016. Diffraction losses take energy from the central cone and put it into the ring system when secondaries become too large. Too much energy in rings lays a veil over the image as a Questar can demonstrate with the extra rings caused by too-near focusing. Contrast is greatly reduced.*

QUESTAR SPECIFICATIONS, 3½-INCH

TYPE: Maksutov Cassegrain Catadioptric. No coma, astigmatism or spherical aberrations.

CLEAR APERTURE, 3.5 inches, 89 mm.

FOCAL LENGTH, Basic Visual, 50.5 inches, f/14.4, 1300 mm.

FOCAL LENGTH, Camera Close, 56 inches, f/16, 1400 mm.

FOCAL LENGTH, Camera with Ext. Tubes, 64 inches, f/18, 1600 mm.

FINDER LENS, 4″ Fl., 4x and 8x, Field 12° and 8°.

POWERS, 40—80x eyepiece, field 55 min—24 mm.

POWERS, 80—160x eyepiece, field 42 min—16 mm.

POWERS LIMIT: Resolves 1 sec. arc at 50 feet EFL.

FIELD OF VIEW, photographic model, 1°30 min.

LENS, BCS2, passes UV to 3300 A, IR to 1 micron, parfocal. Has negative FL of minus 28 feet, 336″ or 8500 mm.

MIRROR, F2, Pyrex, or Cer-Vit®. AlSiO coated 3.800″ dia. (All Questars for UV or IR on special order.)

SPECIAL COATINGS. On special order, broad-brand dielectric coating applied to Cer-Vit mirror, which increases its reflectivity. To both sides of front lens, a VLR (very low reflection) coating is then applied which reduces the light loss at each surface to less than 1/10 of 1%. It transmits all frequencies of the visible spectrum and improves total light grasp by approximately 22%.

EYEPIECES, 24 mm. Brandon, 50° Ap. Field; 16 mm. 4 lens Brandon, 50° Ap. Field.

AMPLIFYING OR BARLOW LENS, minus 43.9 mm. FL.

ERECTING SYSTEM, Star Diagonal type, 90°.

BARREL ASSEMBLY

BARREL, forged aluminum, machined full length.

LENS CELL, aluminum 24S-T4, black anodized.

REAR CLOSURE PLATE with stainless steel CENTRAL TUBE—precision machining and alignment after assembly.

DEWCAP. Internally black-flocked Synthane seamless tube 1/32″ thick, to which is bonded a pre-rolled aluminum sheet.

FOCUSING MECHANISM. Mirror thimble, stainless steel sliding tube. Slides on stainless, fixed, light-baffle tube, with front-end insert tube of .010″ wall thickness. Conical s.s. spring-loaded. Focus rod s.s. 303, ground shaft, 56 T.P.I. precision-ground threads.

KNOBS. Aluminum 24S-T4, corrosion-resistant, hand-turned on turret lathe, stainless steel shafts and levers.

EQUATORIAL MOUNTING AVAILABLE

BASE. Aluminum sand casting, virgin alloy 356-T6 heat treated. Toolroom hand-turned and polished. Highly corrosion-resistant. Jig-bored and precision-burnished for legs. Bottom flange 7″ o.d. Fits tripods with 1/4–20 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. Butyl rubber tips.

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, 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.

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

ALTITUDE or DECLINATION CIRCLE. 3-15/16″ diameter, 302 s.s., cemented and 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, 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. Ratio 31 to 1.

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

QUESTAR SEVEN SPECIFICATIONS

TYPE: Maksutov Cassegrain Catadioptric

CLEAR APERTURE: 7 inches, 178 mm.

FOCAL LENGTH: Basic visual, 100 inches, 2540 mm. Camera close, 112 inches, 2800 mm.

PHOTOGRAPHIC FIELD OF VIEW: 1°15′

FINDER LENS: 23 mm. dia., 184 mm. FL, 7x and 14x

ERECTING SYSTEM, Star Diagonal type, 90°.

EYEPIECES, 24 mm. Brandon, 50° Ap. Field; 16 mm. 4 lens Brandon, 50° Ap. Field.

AMPLIFYING OR BARLOW LENS, minus 66.06 mm. FL.

CORRECTOR LENS: BSC2, passes UV to 3300 A°, IR to 1.5 microns, parfocal.

MIRROR: F2, low-expansion Cer-Vit® (for greatest thermal stability), or Pyrex, AlSiO coated, 7.600″ dia.

BARREL. Special extruded and stress-relieved 2024-T4 aluminum, machined full length O.D. and I.D.

LENS CELL. Aluminum 2024-T4, black anodized.

REAR CLOSURE PLATE. Aluminum 2024-T4, black anodized.

MAIN TUBE MOUNTING PLATE. Aluminum 2024-T4.

FOCUSING MECHANISM. Mirror Thimble, precision machined and ground stainless steel, rides on bearing, linear ball type, over a fixed, hardened and ground stainless steel light baffle tube. Conical stainless steel spring-loaded. Focus rod stainless steel ground shaft with precision ground 1/4–32 threads.

CONTROL BOX. Aluminum construction, special aluminum paint, baked, clear-lacquered and again baked.

KNOBS. Aluminum 2024-T4, turned on turret lathe. Stainless steel shafts and levers.

MOUNTING BASE. Husky mount made of 2024-T4 black anodized aluminum, wide-bearing surface with both 1/4–20 and 3/8–16 tapped holes for mounting on any suitable tripod.

EQUATORIAL MOUNTING AVAILABLE

BASE. Aluminum sand casting, virgin alloy 356-T6 heat treated. Toolroom hand-turned and polished. Highly corrosion-resistant.

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

LEGS. Aluminum 61 S-T3, anodized. Center leg adjustable.

SYNCHRONOUS DRIVE MOTOR. Cramer, 1/4 R.P.M. 110 V. 60 cycles; other cycles, voltages and direction of rotation available. Sealed, lubricated gear train, 2.7 watts.

RIGHT ASCENSION GEAR. Bronze, 7.5″ pitch diameter, 48 pitch worm gear, driven by #303 stainless steel 48 pitch worm.

SIDE ARMS, INNER FORK BRACKETS. Castings of corrosion-resistant aluminum alloy 13. Toolroom milled, jig-bored, tapped and reamed. Special aluminum paint, baked, clear-lacquered and again baked.

ALTITUDE or DECLINATION CIRCLE. 8″ diameter, 302 s.s, cemented and riveted to bracket ring assembly, 1° divisions.

CLAMP. Bakelite padded s.s. stud clamps dec. circle to side arm.

AZIMUTH OR R. A. CIRCLE. 11-1/2″ diameter, 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. Ratio 28 to 1.

DIMENSIONS. Height, upright 28-1/4″. With barrel horizontal, 20″ high.

®Registered Trademark of Owens-Illinois, Inc.

This cutaway shows some of the many innovations Questar has brought to the art of telescope design.

Questar is a mixed lens-mirror system which is figured as a matched, inseparable team. One of the advantages of this design is that the correction for spherical aberration is not on the main mirror but on the front lens, which serves as corrector and secondary mirror, whose position is nearer the radius of curvature of the primary, hence allowing elimination of off-axis coma as well. The primary mirror is a sphere, finished to an accuracy beyond quantitative observation. In fact, all surfaces in this system are figured to the limit of laboratory measurement procedure.

In looking back over our years of experience, we think we may have learned quite a bit about making fine telescopes. We have learned, for one thing, that the best way to assess the quality of a complete optical system is on a star, under the conditions in which a telescope actually will be used. Therefore, all Questars are star tested, and even now, having passed all laboratory tests, many still do not pass the star test and must be rejected.

KEY

8. Questar Seven barrel and control box on tripod
9. Questar Field Model with Beaulieu Super 8 and Questar Fast Focus mounted on Linhof Tripod and Panhead
10. Questar Cinema Model with Arriflex 35
11. Questar Field Model with Nikon Camera mounted on Davis and Sanford Tripod and Panhead
12. Duplex Questar in polar equatorial position
13. Standard Questar


ARRIFLEX
CINE 60