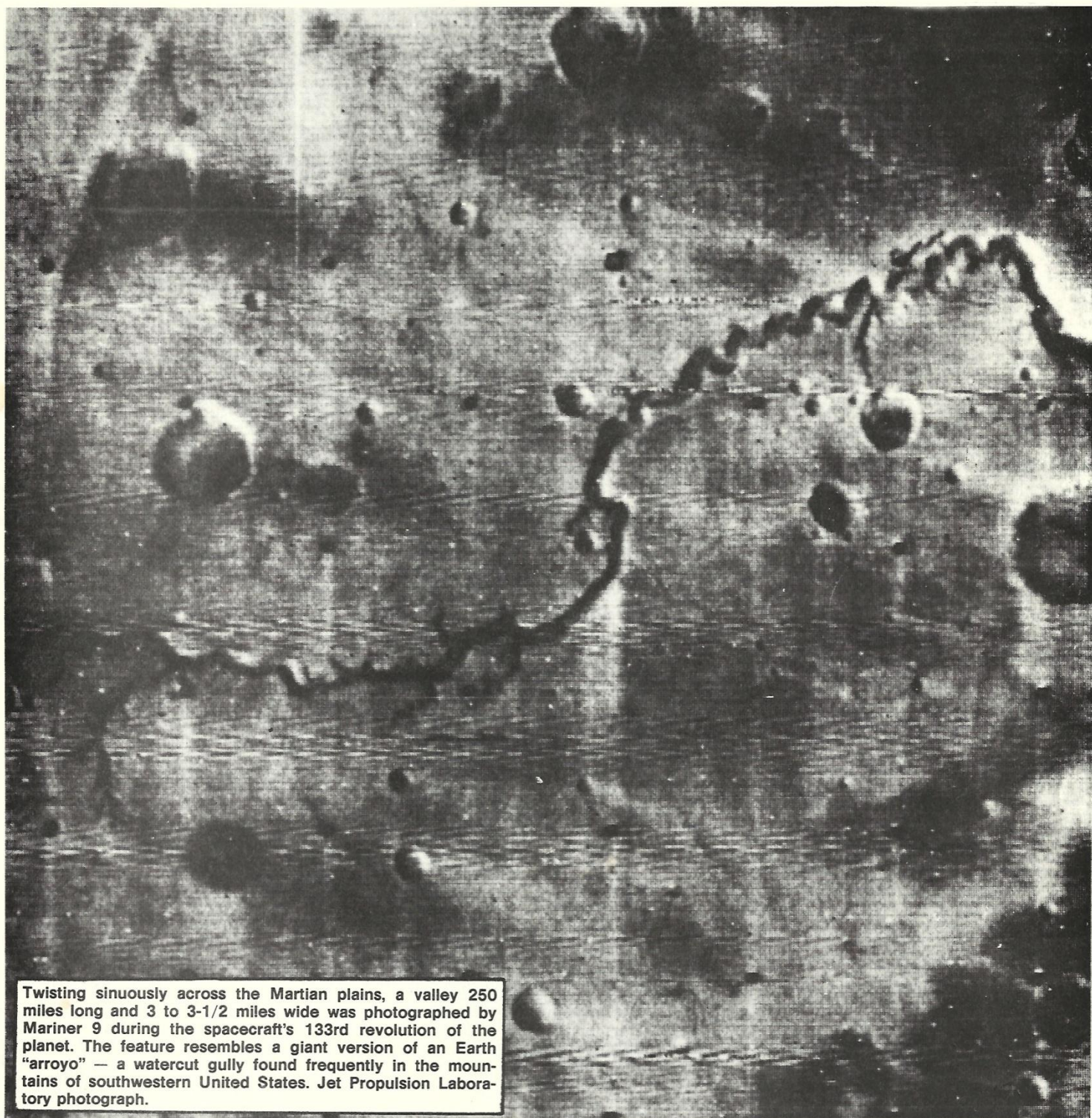




# THE WASP

THE JOURNAL OF THE WARREN ASTRONOMICAL SOCIETY



Twisting sinuously across the Martian plains, a valley 250 miles long and 3 to 3-1/2 miles wide was photographed by Mariner 9 during the spacecraft's 133rd revolution of the planet. The feature resembles a giant version of an Earth "arroyo" — a watercut gully found frequently in the mountains of southwestern United States. Jet Propulsion Laboratory photograph.

## JUNE 1978



The Warren Astronomical Society  
P.O. Box 474  
East Detroit, Michigan 48021

MINUTES OF THE APRIL 20, 1978 MEETING OF THE WARREN ASTRONOMICAL SOCIETY:

Our meeting was opened by President Lou Faix at 8:20 p.m. It was announced that the voting of National officers would take place after mid-break.

Doug Bock reported on the MSU Invitational. It was learned that the affair was a rousing success. Seven clubs were represented with Warren Astro coming in first in the Messier Contest. A prize of a celestial globe was displayed. Of interest is the fact that Ken Kelly acted as group captain. The suggestion that we raffle off the aforementioned sphere was met with mixed reactions by the Society. Roger Civic requested a club vote. He was seconded by Robin Bock. It was also suggested that the sphere be kept in the Club Library in the care of G. Morin. Majority vote left the prize in the Library.

Lou Faix took the floor to discuss the Club's relationship with Camp Rotary. Camp officers have expressed annoyance over lecturers who have failed to show up. Other complaints were brought out and discussion followed.

Larry Kalinowski, chairman of the telescope making group, described a very successful Star Party held for the Warren Woods school district. Over 200 enthusiasts came. He thanked his committee consisting of: Bill Whitney, Carl Noble, Frank McCullough, Kim Dyer and March Groth. He explained his desire to form another group for the purpose of studying the use of calculators for astronomical measurement. He was enthusiastically supported by Lou Faix.

Pete Kwentus then took the floor. As chairman of the Nominating Committee, he requested that candidates see him before the May elections. Pete also has available to members, ball bearing mounts at \$5 apiece. As the organizer of the Eclipse 1979 trip, he requested that those interested make their deposits of \$50 as soon as possible.

Robin Bock volunteered to help with refreshments. A new Roster is needed for the Society. A beautiful pamphlet on Warren Astro, designed by Roger Civic, was then passed around to members. Frank McCullough, program chairman, introduced the Cranbrook program which will feature Mike Newberry on variable stars. Ray Bullock will offer a film on the universe plus a preview of the next Cranbrook Planetarium Show.

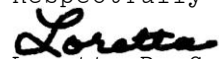
Douglas Smith was presented with a Messier Certificate. He then gave the second part of his talk on Comets. His mathematical calculations and studied complicated equations were a great asset to his lecture.

After intermission at 9:50 p.m., the election of National Officers took place. The following slate was elected: Robert Young, president; N. Lynch, vice president; and, Wilma Cherup, secretary. Ratification of the Great Lakes By-Laws then took place. Bill Whitney expressed his appreciation of all awards.

Jerry Persha then gave a talk on photometry with emphasis on current improvement. He displayed electromagnetic spectra and the entire presentation was detailed and excellent.

Tim Skonieczny showed four slides from last October's cruise. The meeting was adjourned at 11:10 p.m.

Respectfully submitted,

  
Loretta D. Caulley, Secretary

## AURIGA

### The Charioteer

This ancient constellation which includes the beautiful star, "CAPELLA", is difficult to see as a shepherd charioteer. The shape of the large group of stars suggests a crooked kite and even the kite is made by using a taurus star, "El Nath", as one of its five points. According to Greek legend, the figure represents Erichthonius, fourth King of Athens and the son of Vulcan and Minerva. Being lame, he invented the four-horse chariot. This invention secured for him a place in the celestial Hall of Fame.

Another story depicts AURIGA as the son of Mercury and the charioteer of Oinomaus, King of Pisa. He was said to be a skillful horse trainer and his steeds the fastest in Greece.

AURIGA appears in Greek star lists of the 4th and 3rd centuries B. C.

It is of the mighty star, "CAPELLA" that the most interesting stories are told. Mythologically, it represents the She-Goat which suckled Jupiter. In India, CAPELLA was worshipped as the Heart of Brahma. Ancient Peruvians called it "Colca" and connected it also with shepherd activity. English literature calls CAPELLA the Shepherd's Star. In ancient Egypt, the star was an object of worship in the Karnac temples.

"CAPELLA" is a favorite northern star, very bright and beautiful. When near the horizon it flashes red and green highlights. It was the delight of shepherds when her appearance heralded rainy weather to improve their pasture land. However, sailors dreaded CAPELLA for her approach meant storms and difficult navigation.

In northern latitudes, CAPELLA is visible every clear night. It is about 42 light years distant and is receding from us at about 19 miles a second. CAPELLA is really a binary, too close for telescopic observation. The companion was detected by the spectroscope. The two bodies form a double system. In moving around their common center of gravity, the two components have an orbital period of 104 days. They have the same physical condition and are almost of the same mass.

Telescopists are delighted with the clusters and wide doubles contained within AURIGA'S pentagonal structure. Four clusters in the vicinity of AURIGA are well known. They are listed in Messier's catalog as numbers 35, 36, 37 and 38.

Students of mythology are unable to penetrate further into the history of AURIGA. No reasonable explanation can be found for this "Shepherd-charioteer" who still looks down on us from his stars as he did so many eons ago.

Submitted by,



Loretta D. Caulley



## THE APPRENTICE ASTRONOMERS NOTEBOOK

Lou Faix

With warmer nights rapidly approaching from the south and the Summer Milky Way approaching from east, amateurs are once again into an ideal observing season. Just as diffuse and planetary nebulae dominate winter viewing, galaxies prevail in spring. Likewise, the summer skies are embellished by star groupings; doubles and triples, galactic and globular clusters. Summer is the time for precision viewing ~ separating those very close binaries and resolving the individual stars in the majestic globulars. It is a time to be sure that our telescopes are performing right up to their limit. Just like an auto engine must be periodically "tuned Up" to achieve its best performance, telescopes have to have occasional maintenance to achieve their best performance. Three factors should be examined:

- 1) Cleanliness
- 2) Lens and mirror supports
- 3) Collimation (optical alignment)

While there are several good commercial lens cleaning solutions on the market, I've had success with homemade solutions. Before washing a mirror or lens, use a soft camel hair brush to gently sweep off any large (visible) dirt particles. For a first solution use a mild, non-fatty acid, liquid hand soap. A few drops in a pint of water is enough. Pre-wet the glass for 15 minutes and then swab the surface with surgical cotton balls dipped in the soapy water. Rinse thoroughly in clear water and then swab again in a diluted solution (1:4) of alcohol and distilled water. Finally, rinse the surface with distilled water. Drain the excess water by standing the mirror vertically. If a mirror still has a dull, whitish case, it is probably in need of recoating.

Reassemble the mirror into its cell and check for any lateral free movement. Replace any cork or other compressible material which may have lost its resilience and would allow the mirror to move about. Also replace pads which isolate the mirror from the cell hold-down arms. Adjust the hold-downs to be sure that the mirror is securely, but gently, retained in the cell. Any clamping pressure on the mirror may cause distortion and seriously reduce the image quality. Before reassembling the mirror cell into the tube, check the centering adjustments to be sure there is no radial free play and that the mirror is centered in the tube. Keeping the mirror exactly centered while the telescope is in any position is critical to good performance.

Collimation, or alignment of the optics, is the final and most critical operation. To speed the process up, place a small black spot at the exact center of the main mirror. Then cut a wood or cardboard disc to a size that just fits snugly into the open end of the tube. Drill four 1/4" dia. holes in disc exactly one inch in from the edge and equally spaced around the periphery (i.e. 90° apart). Put the disc in the tube and look in through one hole. When mirror optical axis is centered in the tube the black spot will appear centered in the opposite hole.

Be sure you see the same thing through all four holes. The black spot also aids in aligning the secondary diagonal mirror in a Newtonian telescope. Replace the eyepiece with a wood, metal or cardboard disc having a 1/8" hole exactly centered. Look through the disc at the black spot. The secondary mirror is properly aligned when the mirror spot is seen to be centered in the hole which can be seen on the back side of the disc. This completes coarse alignment of the optics. To aid in visibility, I suggest painting the backside of the eyepiece disc white. For best resolution, final alignment must be done at night, using a first or second magnitude star. Wait for a night when the seeing is very good and the stars are not twinkling. Allow the telescope to sit outdoors for at least one hour for all the optics to become temperature stabilized.

Pick a star near the zenith point in the sky and center it in a low power (50x) eyepiece. Increase the magnification to about 200x with a shorter focal length eyepiece or Barlow lens. Slowly back the eyepiece out from the focus position. A series of bright rings should be seen. If the rings are circular and concentric, the telescope optics are perfectly aligned. If the rings are eccentric ellipses, the main mirror alignment must be adjusted. These rings are formed as a result of the wave nature of light. In addition to indicating how well the telescope optics are aligned, these rings can tell you a great deal about the quality of the mirrors or lenses in the telescope.

The following article, reprinted with the kind permission of the Edmund Scientific Company, provides additional valuable information about the light rings and what they can tell you about your telescope.

No. 9540-

# Star-Checking

## Your Edmund Telescope.

by James Mullaney

In his centuries of search for knowledge, Man has used many tools, yet only one has illuminated the silent mystery of the twinkling stars. Only the telescope has enabled Man to see what is out there—the quiet, awe-inspiring beauty of the Milky Way, the mountains and craters of the Moon, the amazing yellow-brown rings of Saturn and the multitude that is our universe. All are there as they were that first dawn, waiting for you to see, to study, to question, to answer.

Your Edmund Telescope is your tool for exploring these universal mysteries. The products of the most intensive development effort ever undertaken by Edmund Scientific Co., they are designed, engineered and built by Edmund to provide the amateur and novice astronomer with the best astronomical viewing.

# Star-Checking

## Your Edmund Telescope

A number of important factors affect the optimum performance and ultimate enjoyment derived from your new Edmund telescope. One obviously is the skill and training of the observer himself, for which many guides and manuals exist including our own booklet, "How To Use Your Telescope."

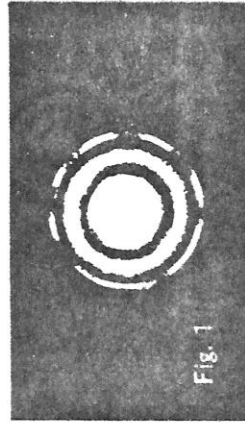
Of concern here are the instrument's optical quality, alignment, thermal condition, and the state of the atmosphere through which it must look. Fortunately, all of these factors can be easily checked using a simple star test provided by nature itself. So, to paraphrase a well-known song, "catch a telling star and put it in your telescope!"

## In & Out of Focus Star Images

The basis of this test is a comparison of the appearance of an ideal star image produced by a "perfect" telescope under "perfect" viewing conditions with that actually observed in your instrument.

For this purpose, select a star of about 1st or 2nd magnitude (not too bright nor too faint) positioned at least halfway up the sky to avoid as much atmospheric disturbance as possible.

Center the test star in your telescope using a low power eyepiece. Then change to a high power eyepiece or eyepiece-barlow combination to achieve a magnification of 40 to 50X per each inch of your scope's aperture—about 250 to 300X on a 6 inch telescope, for example. (Such high relative magnifications cannot be reached with the Edmund No. 2001 telescope, nor is it necessary since this instrument is designed for low-power, wide-field viewing.)



**Figure 1** shows the resulting ideal in-focus image of a star. Rather than seeing a pinpoint of light, we find instead a spurious bright central disk surrounded by faint diffraction rings—the result of the wave nature of light itself. The smaller the size of the telescope, the more pronounced and striking is this interference effect.

The out-of-focus (extrafocal) image of a star is also a valuable indicator of telescopic performance. This can be viewed using medium and, with practice, even low power eyepieces and is useful in checking even special purpose instruments such as the No. 2001 scope.

Begin some distance outside of focus so that the star's image fills perhaps a third of the field of view. Then slowly focus the eyepiece in, causing the extrafocal disk of light to become smaller. As you do, you will notice concentric bright and dark interference rings extending from the edge of the disk all the way to its center.

As you focus in, the innermost rings disappear while the outer ones move in to take their place. With only three or four rings remaining visible as shown in Figure 2, the extrafocal image becomes a very sensitive test of your telescope's optical fitness.



Fig. 2

A reverse sequence of appearing and disappearing rings will be seen on the other side (inside) of focus. If the extrafocal disk is perfectly round and the ring pattern similar on either side of focus, you have good optics.

In theory, any departure from the disk and rings shown in our first two drawings indicates a problem. In practice, some differences are to be expected due to specific telescope designs.

For example, if you are using one of our reflectors, the outline of the secondary mirror (diagonal) and its support (spider) will be found silhouetted against the extrafocal image pattern as shown in Figure 3.



Fig. 3

These obstructions transfer some light from the central disk of the in-focus image into the ring system but have virtually no effect on actual viewing performance.

For simplicity in what follows, only the easily observed multiple ring extrafocal image (seen outside of focus) will be illustrated in the figures.

1  
1  
1

All Edmund telescopes feature exquisite diffraction-limited performance for their respective apertures and focal ratios. They are unconditionally guaranteed to be optically sound.

For your interest, some of the common optical defects found in

Figure 8 shows one of the many weird patterns resulting from grossly defective optics.

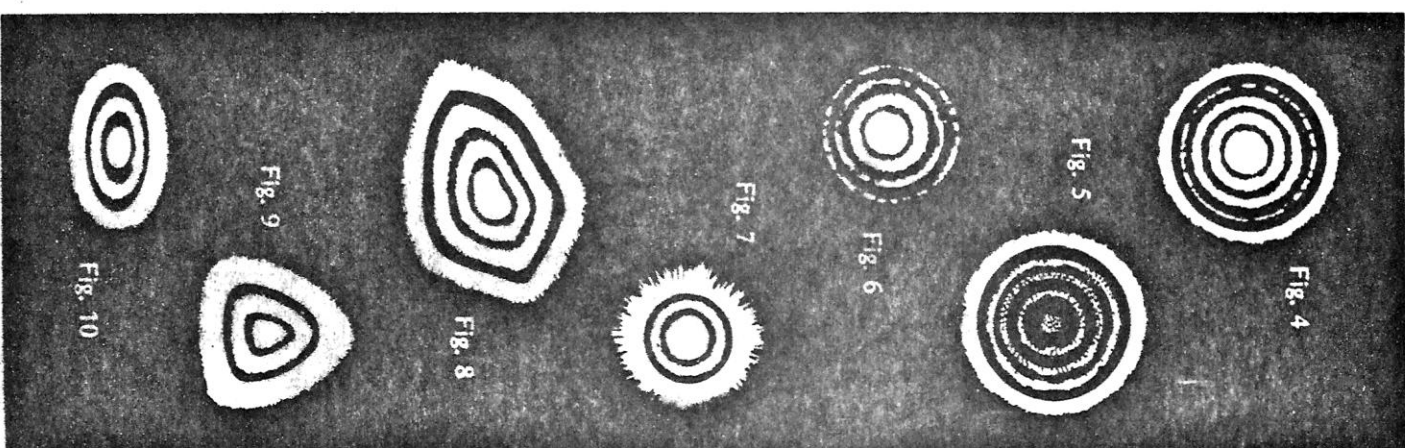
Still other factors can affect the observed diffraction image in your telescope. A lens or mirror too tightly restrained in its cell will show a pinched or distorted image (usually triangular) as illustrated in Figure 9. Care is needed in properly supporting sensitive optical components, for it takes very little pressure even on a thick disk of glass to distort its figure when dealing with surface accuracies measured in millionths of an inch! All Edmund optics (including eyepieces) are mounted to avoid such effects.

Another defect is astigmatism, which causes the telescope to have no true sharp focus. The extrafocal image is elliptical or egg-shaped as shown in Figure 10, its orientation changing by 90 degrees on opposite sides of focus. If severe, a star will look like a plus sign at the position of best focus.

Astigmatism may not be the result of poor optics but rather bad alignment as discussed below. Other causes are bad eyepieces, defective diagonals and even the observer's own eyes.

If you wear glasses to correct for near or far sightedness, they can be removed and the eyepiece focus adjusted to compensate. However, should you be astigmatic, observe with your glasses on—the telescope cannot correct for astigmatism.

Rotating the suspected astigmatic element (eyepiece, observer's head, etc) will cause the axis of the elliptical image to move with it if it is at fault. While conducting this test, be sure to stay on the same side of focus—either in or out.





## Collimation

Probably the most common cause of poor telescope performance and at the same time the easiest to cure is misaligned optics. This produces astigmatism in a refractor and coma in a reflector. Coma is an annoying extension or flare of the in-focus image and a comet-like decentring of the rings in the extrafocal disk, as shown in Figure 11.

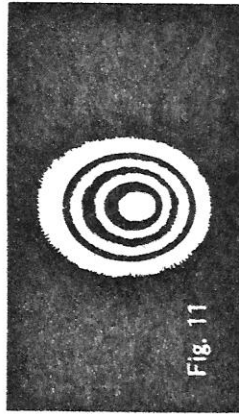


Fig. 11

Refractors rarely get out of alignment (collimation) since the lens is secured in its cell which in turn is threaded directly into the telescope tube.

Jarring a reflector, on the other hand, can cause one or both of its mirrors to move off center if the jolt is

severe enough. Assuming the diagonal mirror is properly positioned within the tube, alignment is easily achieved through trial and error by turning the three adjustment screws on the back of the primary mirror cell. (Complete and simple directions for mechanically aligning mirrors are provided with each Edmund reflector.)

Collimation should be done while observing the in-focus image of a star at moderate to high power. If a flare or tail to the image is apparent, turn the adjustment screws to move the star image toward the direction of the flare extension. It helps here to have someone work the screws while you direct them from the eyepiece.

With practice, this operation can be completed in a matter of seconds and may be considered permanent. It is a good idea, however, to check the collimation of your telescope from time to time. (The No. 2001 scope has no provisions for this since it has been permanently aligned at the factory.)

## Thermal Collimation

Optimum performance from any telescope can be achieved only when it is at the outside air temperature during actual use. In taking your instrument from a warm house out into the cold night air, a certain "cool-down" time is required for all the optical and mechanical parts—as well as the air in the tube—to reach the ambient temperature. Usually about 15 minutes does the job; perhaps somewhat less in summer and more in

winter, depending on the actual temperature differential.

During this cooling period, a look at the in-focus image of a star reveals a shimmering blob of light and no true focus. The extrafocal image will be greatly disturbed and even distorted like the view in Figure 8.

Thermal currents within the tube caused by warm air rising along the walls also contribute to image deterioration during cool-down. The

star test will show the familiar patterns once optical and mechanical equilibrium has been reached.

Another important factor that can result in poor image quality is a heat source near the telescope. These include heat radiation from warm

driveways or pavements (summer), heated roof tops and chimneys (winter) and even the body heat of the observer and others standing about the telescope. A grassy area free of buildings, lights and people offers the best observing environment for your telescope.

## State of the Atmosphere

There exist two distinct and different conditions of the ocean of air through which the observer must look to see his beloved stars. One of these is called "transparency" and refers to how clear the sky is—how bright the stars look. The other is known as "seeing" and is a measure of how steady the air is—how much the stars are twinkling.

Generally, the one condition is good while the other is poor. On cold, dark, winter nights, for example, the sky is often crystal clear but the stars are scintillating wildly. Transparency is good, seeing is poor—a fine night for low power viewing of deep-sky objects. Conversely, hot muggy summer nights often bring hazy skies but the stars are shining steadily. Seeing is good, transparency poor—a good time for high power views of the moon, planets and close double stars.

Atmospheric conditions not only affect the types of celestial objects to be observed on a given night, but also the apparent state of your telescope's optics as indicated by the star test. Variations in transparency simply cause the star image to be brighter on some nights than on others.

Bad seeing on the other hand produces moving waves or ripples

across the extrafocal image of a star, as seen in Figure 12. This boiling effect often causes the out-of-focus images of stars in the field to flicker on and off like fireflies in the night. For a dramatic demonstration of this effect, try looking at a bright star cluster like the Pleiades out of focus on an unsteady night!

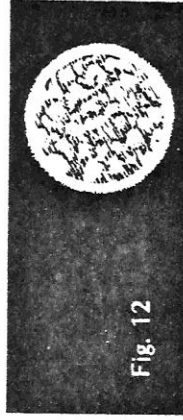


Fig. 12

Testing your telescope on a night of poor seeing is virtually impossible since the true image condition is masked by high level turbulence. Thus, the extrafocal image of a star cannot only tell you when it is best to check out your scope but also something about the state of the atmosphere overhead as well.

Given a calm, clear night, together with well-cooled and properly aligned optics, your new Edmund telescope is an open window on the incredible universe in which we live. Through the porthole of your telescopic spaceship, you can embark on exciting nightly voyages of celestial exploration into realms vast and beautiful!



THE OUTER PLANETS  
PLUTO  
THE LAST PLANET ?

By: Jeff Stanek

Pluto, the outermost known planet, is a deviant. It has the most eccentric orbit: an eccentricity of .25 compared with Mercury's .21 and a maximum of .09 for the other planets. Its orbit has the greatest inclination with respect to the ecliptic plane. Pluto's orbit is inclined by 17 degrees while Mercury's is inclined by only 7 degrees and the other planets are all inclined by 4 degrees or less. In a drawing of planetary orbits Pluto sticks out.

Pluto will reach perihelion, its closest possible distance from the Sun in 1989. Its orbit is so eccentric that for many years at the end of this century, up to 1998, the planet will be on the part of its orbit that is inside the orbit of Neptune. So in a sense, Pluto will be the eighth planet for a while. Even at perihelion, no features can be seen on Pluto. It appears only as a dot in the sky, and its observed diameter seems to be about 0.2 second of arc, right at the limit of our seeing capability. It does fluctuate in brightness periodically, and this has been interpreted to be the result of a rotation of the planet bringing areas of different albedoes toward us. So the rotation can be accurately determined to be 6 days 9 hours 16 minutes 54 seconds with an uncertainty of only 26 seconds.

Even such basics as the mass and diameter of Pluto are very difficult to determine. The discovery of Pluto was a result of a long search for an additional planet which, together with Neptune, was causing perturbations in the orbit of Uranus. The best known searchers in the first three decades of this century were Percival Lowell in Arizona and W. H. Pickering of Harvard, but they were not successful in locating the unknown planet near its predicted position, which was fairly uncertain. Finally, in 1930, Clyde Tombaugh, after a year of diligent study of photographic plates at the Lowell Observatory, found the dot of light that is Pluto. From its slow motion with respect to the stars from night to night, it was identified as a new planet.

But the predictions that led to the discovery also predicted that the planet would be 6.6 times the mass of the Earth. If Pluto's diameter is as small as it seemed to be from direct measurement of the size of the disk--much smaller than the giant planets just inside it--its density would be impossibly high. This density would be many times greater than that of any other object in the solar system. To resolve this difficulty, we must be as certain as we can be that we are using correct values of mass and radius. It is very difficult to deduce the mass of Pluto because the procedure requires measuring Pluto's effect on Uranus, a more massive body. Moreover, Pluto has made less than one revolution around the Sun since its discovery. As recently as 1968, Pluto was thought to have a mass 91 per cent that of the Earth. The latest studies of the orbit of Uranus indicate that Pluto may have a mass only 11 per cent that of the Earth, but these observations are very uncertain. On the basis of current data, we are not able to reliably determine Pluto's mass; the value given may be off by a factor of two or more,

The best method for determining the radius of Pluto, as it is for Neptune, is to observe a stellar occultation. It was predicted that Pluto would pass near a 15th magnitude star in 1965, and so the passage was observed very closely by several observatories to see if the star would be occulted. We knew the orbital path of Pluto in the sky very accurately, but since a planet's gravity acts as though it were concentrated at the center of the planet, we only knew the path that the CENTER of Pluto would take. According to the prediction, the center of Pluto would pass within one second of arc from this star, which appears, of course, as only a point of light. If Pluto's radius subtended a large enough angle at this distance from the Earth, at some moment Pluto's surface would hide the star from view. But the star was never hidden from view, and from this fact astronomers knew that Pluto appeared smaller in the sky than the minimum angular separation. Since we know the distance to Pluto, simple trigonometry gives a limit to the radius of Pluto. This observation showed that Pluto had to be smaller than 6800 kilometers across, which confirmed that Pluto was closer in size to the terrestrial than to the Jovian planets.

Pluto could be substantially smaller than this. In 1976, infrared spectral studies carried out at Kitt Peak showed the presence of methane ice on Pluto's surface. Since ice has a high albedo, the planet would not have to be very large to reflect the amount of light that we measure. The smaller the true value of Pluto's diameter, the larger the density we derive. So the diameter of Pluto is uncertain, and the mass of Pluto is even more uncertain. We cannot, therefore, make a good estimate of the density.

We can calculate the effect that Pluto would have on the orbits of Uranus and Neptune by using the latest value of mass instead of the value that had been deducted in the original discovery predictions. The calculations show that Pluto's mass is far too small to cause the perturbations in Uranus' orbit that originally led to Pluto's discovery. It is now thought by many astronomers, therefore, that the pre-discovery prediction was wrong and that the discovery of Pluto was purely the reward of hard work in conducting a thorough search in a zone of the sky near the ecliptic. If we were standing on Pluto, the Sun would be over a 1000 times fainter than it is to us on Earth, and we would need a telescope to see its disk. Pluto is far away from the Sun, almost 40 A.U., and therefore so cold, about 43 K, that any of the common gases except neon would be frozen out of an atmosphere. Right now, Pluto is in the constellation Virgo, the Virgin. It is at R.A. 13 hours and 18 minutes and at Dec. +10 degrees 40'. Pluto's magnitude now is + 14. A 12 inch telescope is required to be able to see Pluto.

FROM THE I.A.U. CIRCULARS

By Ken Kelly

COMET MEIER (1978f)

This comet was discovered by Rolf Meier of Ottawa, Ontario with a 40 cm (16 inch) f/5 reflector at 56x on April 27 at 2H UT. It is diffuse with a nucleus. It has been observed with an 11 cm (4¼") reflector by D. Machholz in Los Gatos, Calif. It is now in the constellation of Lynx, moving southeast. It will pass near 26 Lyncis on the evening of Sunday, May 21. It is gradually getting brighter and will attain naked eye visibility near perihelion on October 15, but at that time the elongation from the sun will be small. The magnitude was reported to be 10.1 on May 3, brightening from 10.6 on April 28.

The following elements are provisional, being computed from three observations of April 27 to May 4, and are computed for epoch 1950. The time of perihelion is 1978 Oct. 15.053, the argument of perihelion is 234.° 443, the ascending node is at 357.516 the inclination is 40.526, and the perihelion distance is 0.86084 A.U. The following are approximate positions for 0H UT on the given dates:

		R.A. (1950)	Declination
May	19.0	7H 46.49M	+480 30.9'
	20.0	7 47.92	+48 15.9
	21.0	7 49.34	+48 0.9
	22.0	7 50.6	+47 45.9
	23.0	7 52.32	+47 30.3
	24.0	7 53.87	+47 14.7
	25.0	7 55.43	+46 59.1
	26.0	7 56.98	+46 43.5
	27.0	7 58.54	+46 27.8
	28.0	8 0.09	+46 12.2
	29.0	8 1.64	+45 56.6
	30.0	8 3.20	+45 41.0
	31.0	8 4.75	+45 25.4
Jun	1.0	8 6.31	+45 9.8



COMET MEIER — Last minute update from IAUC # 3220, May 11.

Improved parabolic elements satisfying six precise positions were calculated by Brian Marsden as follows:

T = 1978 Nov. 8.840 ET      w = 231°.967  
q = 1.10480       $\Omega$  = 349°.362 (1950)  
i = 43°.469

1978 ET	R.A.(1950)	Dec.	$\Delta$	r	m
May 12	7H 36.38M	+50° 16.4'	3.170	2.824	10.5
22	7 50.19	+47 48.3			
June 1	8 05.09	+45 15.9	3.147	2.596	10.1
11	8 20.89	+42 37.6			
21	8 37.40	+39 51.7	3.085	2.366	9.7
July 1	8 54.48	+36 56.3			
11	9 12.07	+33 49.5	2.983	2.135	9.2

On May 8.15, S. O'Meara, Harvard College Observatory, 23 cm refractor, describes it as follows: Magnitude 10.3, comet very condensed, 5' tail in p.a. 115° 2' tail in p.a. 55°.

Ken Kelly

APPARENT DISTANCE (") AND POSITION ANGLES (°)  
OF SATURN'S SATELLITES FOR 10 P.M. E.D.T.

Computed by Ken Kelly

	DATE	TETHYS		DIONE		RHEA		TITAN		IAPETUS	
		AD	PA	AD	PA	AD	PA	AD	PA	AD	PA
	May 18	16	115	33	247	48	248	173	268	427	272
	19	22	283	55	82	56	96	182	263	449	272
	20	29	97	43	274	66	76	166	258	468	272
	21	34	373	12	175	34	288	126	251	484	272
	22	38	89	42	74	76	261	73	236	497	272
	23	41	267	55	265	16	162	37	170	506	272
	24	43	84	33	99	77	86	82	108	511	272
	25	43	262	17	44	28	52	130	95	514	272
	26	42	80	49	258	69	270	166	89	513	272
	27	37	255	53	87	46	248	178	84	508	272
	28	36	75	22	291	52	97	165	80	500	272
	29	31	251	28	243	67	77	127	73	489	272
	30	25	66	54	81	30	292	73	58	475	272
	31	19	237	45	272	76	262	35	346	458	272
June	1	13	40	12	146	15	176	82	286	438	273
	2	9	183	38	71	75	86	134	274	415	273
	3	10	357	55	264	31	57	168	267	390	273
	4	16	114	37	97	65	271	177	263	362	273
	5	22	283	13	27	52	251	160	258	332	273
	6	28	96	46	256	48	98	121	251	301	273
	7	33	272	53	87	68	78	70	235	267	273
	8	37	89	26	285	26	297	36	168	232	274
	9	10	24	23	237	75	263	81	107	196	274
	10	9	194	53	81	18	205	126	96	160	274
	11	42	262	48	270	73	87	162	89	120	275
	12	41	80	16	126	35	60	174	84	82	278
	13	39	257	33	68	62	272	161	80	43	285
	14	35	74	54	263	55	253	123	73	18	310
	15	30	251	40	94	44	100	69	57	36	25
	16	24	65	11	3	69	79	34	345	72	71
	17	18	236	42	254	22	304	80	285	110	67
	18	13	40	53	86	75	263	131	274	151	90
	19	9	184	30	281	18	206	164	268	188	91
	20	10	0	18	228	71	88	172	263	223	91
	21	16	113	48	78	38	63	156	258	257	91
	22	22	282	49	269	59	273	118	251	289	92
	23	28	96	19	114	57	254	68	235	320	92
	24	32	272	28	65	40	103	36	167	349	92
	25	37	89	52	261	70	80	80	107	375	92
	26	39	267	43	92	19	314	125	95	400	92
	27	41	84	11	337	74	264	159	89	422	92
	28	41	262	38	252	20	218	170	84	442	92
	29	40	80	53	84	69	89	157	80	459	92
	30	38	257	34	278	41	66	121	73	473	92

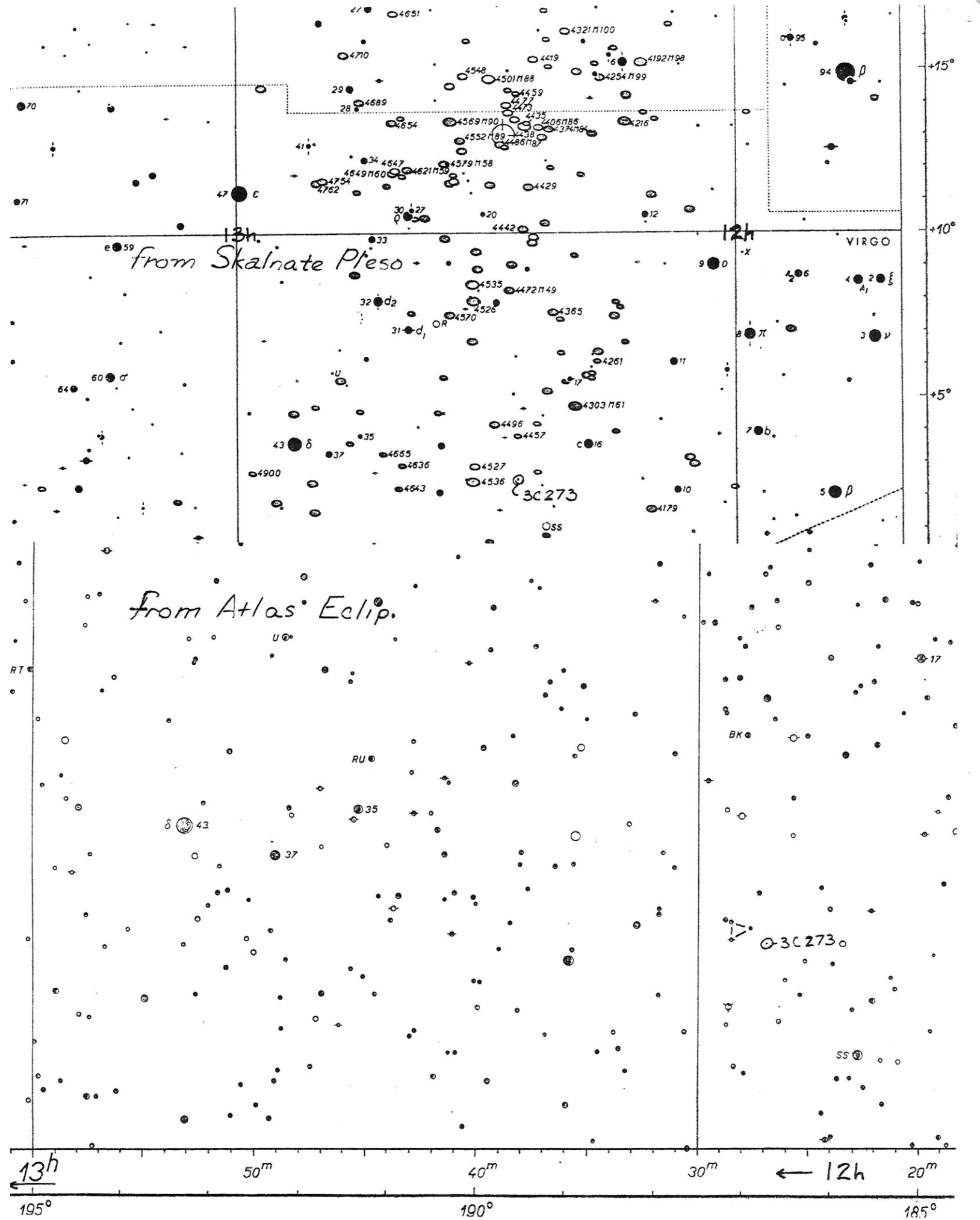
# NIGHT WATCH

Most amateur astronomers are under the impression that Quasars (QSOs) are fantastically faint objects that are just too faint for their instruments. This is true for the most of them but there is one very notable exception.

First I should tell you why an amateur should even bother to look at a QSO. Quasi-Stellar Objects, Quasars or QSOs are very distant objects, if we can rely on the red shift of their spectrum as a fair indication of their distance. (I will not talk about the red-shift controversy here,) An average distance is on the order of two to four billion light years, as we now understand it. At the same time these objects, to even be seen at such distances must be incredibly bright. Their luminosities must be greater than the giant elliptical galaxies, the brightest galaxies known. Yet the most unbelievable item of all is that these brightnesses themselves can change from year to year or even in some cases day to day! For such changes to take place implies sizes of less than one light year to only several light days!! This makes them smaller than globular clusters. What this may mean is that the brightness comes from this small area, and that this same area should have an amount of material in some proportion to the light emitted or an amount near that of such elliptical galaxies. This has astronomers and physicists stumped. The usual method used when a science is met with an insurmountable situation is to work on collecting further data. This is the stage QSO research is in now. Also, this is a stage the amateur can make his mark in. It has fallen on the shoulders of the amateur to do some of the data collection in visual light, and in some limited cases, radio. With QSOs this involves the estimation of brightness and reporting that to a central organization from which the astrophysicists can draw. In this case the best organization to report to is the American Association of Variable Star Observers, 187 Concord Ave, Cambridge, Mass, 02138.

The first QSO to be positively identified as such was 3C-273. The designation means it was the 273rd object in the 3rd Cambridge Catalog of radio objects. It also happens to be the brightest of all the QSOs. It is equal in brightness to 5 trillion suns (Our galaxy is equal to 3 trillion suns). At its terrific distance of 2.934 billion light years it shines at only a paltry 12.5 to 13.2 magnitude. Its spectrum shows it to be moving at one sixth the speed of light, or 15.8% c, or 29,000 miles per sec. I have seen this in a 4" aperture but I regularly monitor its light in my 6" RV-6 Dynascope using only 63X or on evenings of poor sky as much as 85X. The field is not too hard to navigate in having neither too many or too few stars. The far greater problem is the number of galaxies in the way for it is located near the Realm of Galaxies. The charts on the following pages should help you locate it. Do not be easily discouraged, I have heard of one variable star observer who lived in the city who with a six inch f/8 rfl. was able to work in the 12th magnitude range. Remember it will appear star-like, hence the name 'quasi-stellar object'. So now, after observing 3C-273, you will be able to answer the public when they ask, "How far can you see with this?" by saying, "To the ends of the universe!"





122402

(b)

## 3C-273 VIRGINIS

Scale 60" = 1mm

1900

12<sup>h</sup> 24<sup>m</sup> 0

+ 02° 36' 2

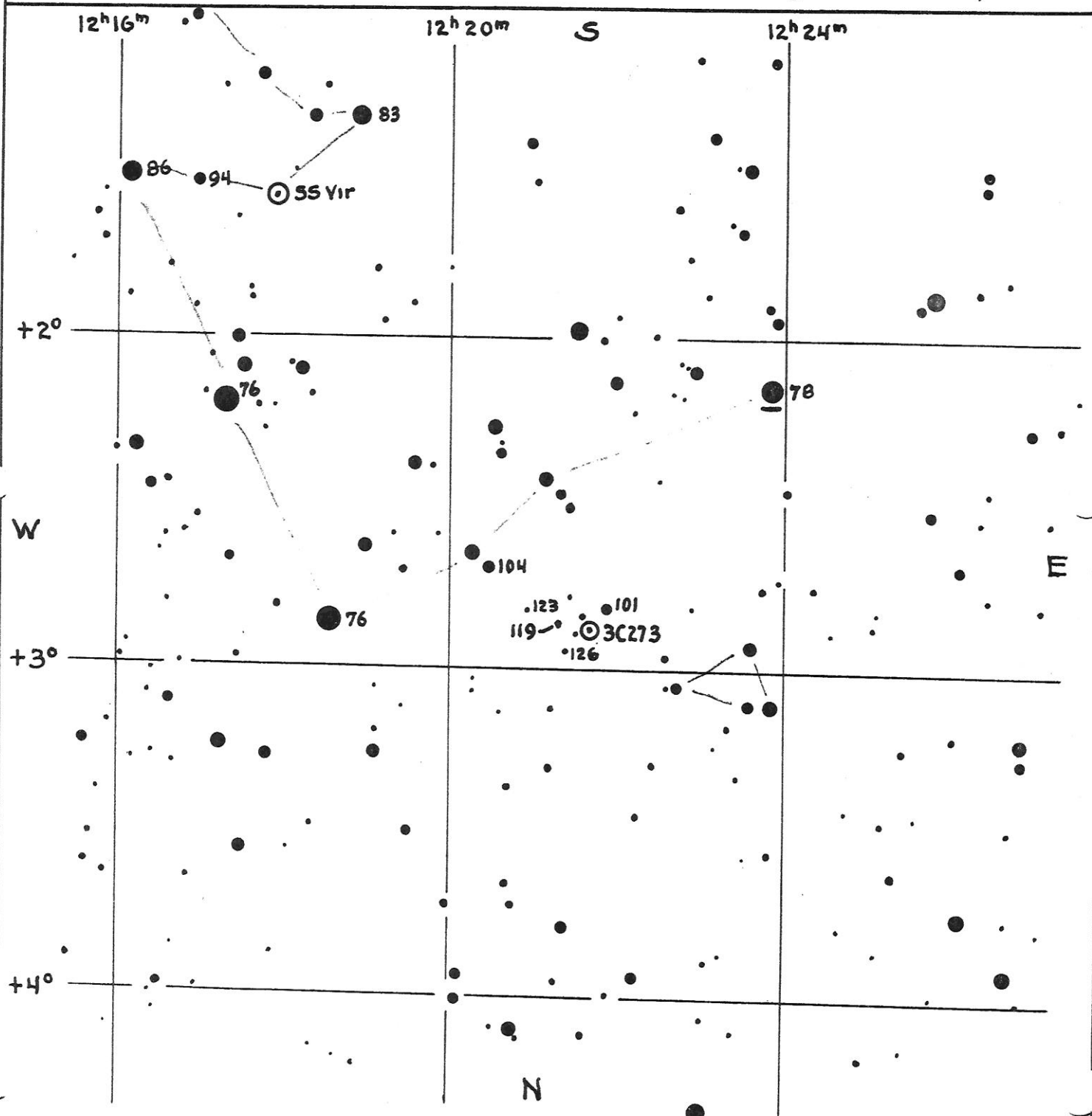
2000

12<sup>h</sup> 29<sup>m</sup> 1

+ 02° 03' 2

Sp. Quasar

Per. Irr.

Mag. 12.2 - 13<sub>p</sub>

From TAC Seq: 1963

AAVSO Chart (b)  
Coordinates 1855Drawn by CBF 1960  
Traced by RNM 4/71

122402

(d)

3C-273 VIRGINIS

Scale 20" = 1mm

1900

12<sup>h</sup> 24<sup>m</sup> 0

+ 02° 36'.2

2000

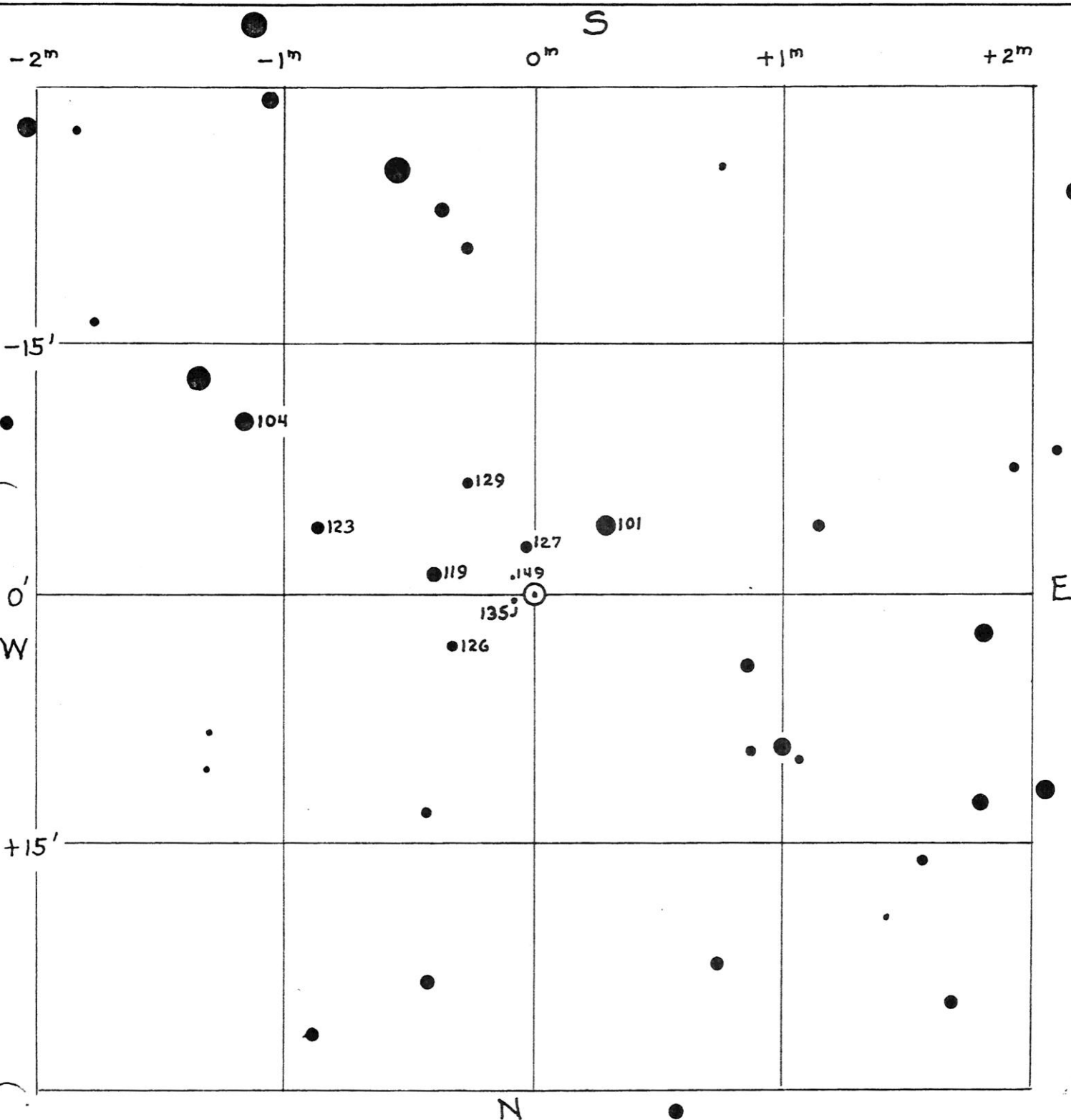
12<sup>h</sup> 29<sup>m</sup> 1

+ 02° 03'.2

Sp.(Q50)

Per. Irr.

Mag 12.2-13.0 p

From TAC sketch  
Seq. 1963

AAVSO Chart (d)

Drawn by CBF 1968  
Traced by RNM 5/71