



VESPA

THE JOURNAL OF THE WARREN ASTRONOMICAL SOCIETY



the Trifid nebulae, (top) and Lagoon (bottom)

SEPT. 1977

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

The Warren Astronomical Society (W.A.S.) is a local nonprofit organization of amateur astronomers. Membership is open to all interested persons. Annual dues are as follows; Student- \$9.00, College- \$11.00, Senior Citizen- \$13.50, Individual- \$16.00, Family- 21.00, the membership fees listed here include ~ one year subscription to Sky & Telescope Magazine.

Meetings are held on the first Thursday of each month at Cranbrook, and the third Thursday of each month at Macomb County Comm. College, in the student union building.

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OBSERVATORY SCHEDULE

Lectures for the coming month are listed below.

**THIS MONTH, THE OBSERVATORY CHAIRMAN,
DENNIS JOZWIK WILL CONTACT EACH
LECTURER WELL IN ADVANCE OF HIS OR HER
NIGHT AT STARGATE.**

The lecturer may select either the Friday or Saturday, depending on the Weather and their personal schedule.

In the future, some of our younger members will be assisting the senior lecturer. These members are, Bob Dennington, Dave Locke, Doug Holmes and Joe Tocco.

•buy- sell- trade•

The L.F.K. Astrophotographic Guide. Special price to Club members ... \$1.00
Contact Larry Kalinowski, 776-9720.

WANTED: A new or used 8" mirror blank or tool to be used as a tool- to grind my mirror with. Call, Chris Edsill at 774-0007 with offer.

FOR SALE: 10" Newtonian telescope. Factory mirror, yoke equatorial mount that is portable. 70 power eyepiece. For only \$300.00, also a 40mm Polaris finder scope-12X, \$25.00. 18mm Kellner eyepiece, \$18.00. All in good condition. Call Doug Tracy- 882-4499.

MINUTES OF JULY 21, 1977 MEETING OF THE WARREN ASTRONOMICAL SOCIETY
HELD AT MACOMB COMMUNITY COLLEGE.

President Lou Faix opened the July meeting at 8:25 p.m. by asking for the Treasurer's Report. Gary Morin thereupon announced that there is a \$376.49 balance in our treasury. He also offered books for use such as an Index of Astronomy and Telescope Making. Observing Handbook copies are available for \$2.50.

Dennis Jozwik reported on the Observatory. He noted that there are new astro-cards and that the mirror is back in operation. Stargate will again be open in August. Lou Faix then spoke at length about security problems at Camp Rotary. In discussing the problem in general with Mr. Bloom, chief custodian, it was pointed out that full time security is provided for us. Since we enjoy a privileged relationship at the Park, Lou read the Code of Conduct which appears in this month's newspaper.

Gary Morin gave an account of the Great Lakes Convention at Oakland University. The Star Bowl was won by the Warren Society with over 85 members in attendance. An eye piece was given to our group as a prize. He then thanked Frank McCullough for his slide show presentation, Rick Hill for his lecture on diffraction and Dave Harrington for his talk on private observatory building with its pitfalls and triumphs. We were pleased that Gary was elected as regional chairman. Gary outlined his plans for going to the National Convention in Colorado in August. He is open for suggestions. Plans for special benefits to members were then given to the group. Lou Faix wants to open a direct line of communications with all societies in the League. He praised the staff of Vespa and also announced that Frank McCullough would be the editor of The Star.

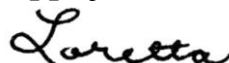
On August 13, we will feature a Messier Contest in conjunction with viewing the Perseid Shower. The party will be held at Stargate and prizes will be awarded. Members were asked to bring their own telescopes. Arrival time has been set at 8:00 p.m. The August meeting to be held at Cranbrook will feature a talk by Mike Newberry on Messier Objects. Rick Hill will discuss variable stars. At the general meeting August 18, slides will be shown of the Great Lakes Convention. All members are welcome.

Frank McCullough gave a brief talk on photographing the Perseid meteors. Diane McCullough then read a communication from Ken Wilson. She disclosed his new address to members who may wish to contact him. His address is Mr. Ken Wilson, 406 Maple Apt. 2, Mill Valley, Cal. 94941.

"Solar Eclipses" was the title of the talk given by Dr. Paul Strong. On the staff of Macomb College, Dr. Strong's presentation included history, research and the physics of the Corona of the Sun.

Ken Jozwik asked Don Metchell for copies of schematic drawings from U. of M. to be made available to members; Frank, Pete Kwentus and Lou then showed their very interesting slides. Lou Faix closed the meeting at 11:22 p.m.

Happily submitted,



Loretta D. Caulley, Secretary

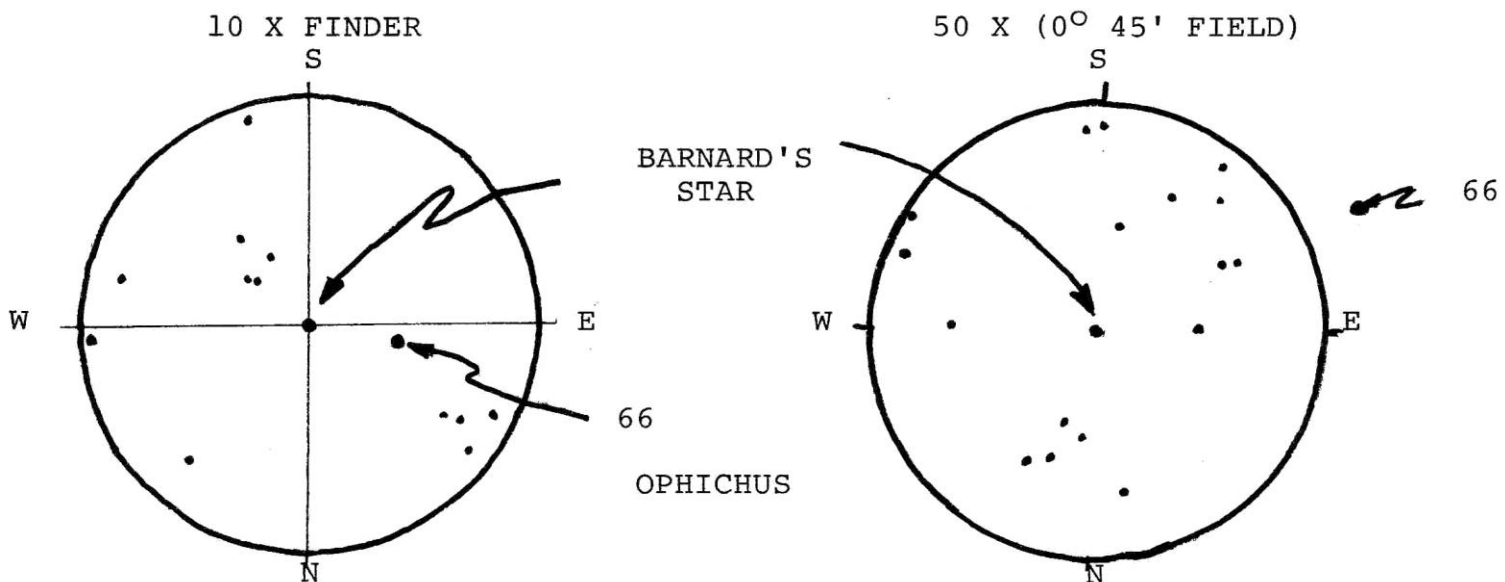
THE APPRENTICE ASTRONOMERS LOG BOOK

LOUIS J. FAIX

This month's offbeat viewing object is Barnard's Star. Although somewhat unspectacular as a viewing item, the sheer volume of study devoted to this faint red dwarf warrants at least a look see by any amateur observer. Lying in the constellation Ophiuchus, the Sun's third nearest companion can be found four degrees due east of Beta and within a degree of 66 Ophiuchus. For setting circle buffs it is found at 17h 55m R.A. and + 4°24' Declination. Moving northward at a record clip of 10.3 arc seconds per year, Barnard's Star moves a distance equal to the moons diameter in 180 years. While the M5 spectral classification suggests a deep red color, I see it as a pale orange-ish hue in a 10" Newtonian at f/5.8. With a visual magnitude of 9.5 the star is not uniquely conspicuous in a fairly rich area at the edge of the Milky Way. The nearby reference, star #66, is blue white by comparison.

The star's astounding Proper Motion was discovered by Edward Emerson Barnard (1857-1923) in 1916. This pioneering American observer pushed the development of astrophotography, discovered Jupiter's fifth moon and demonstrated the dark zones in the Milky Way are not gaps, but areas of dark obscuring dust and gas. He also discovered sixteen comets, but failed to publicize his observations of Martian craters made with the Lick 36" refractor in 1892-1893.

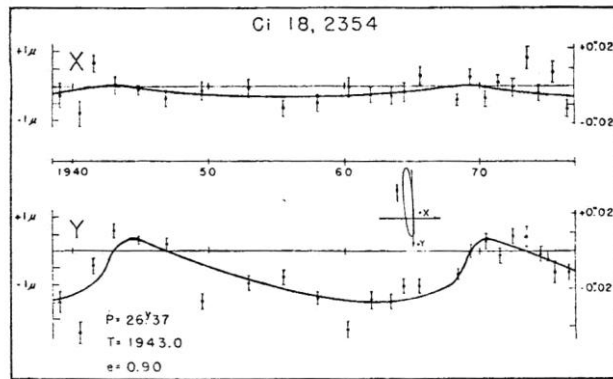
The current interest in Barnard's Star centers around Peter van de Kamp's lifetime observations which suggest this dwarf has a planetary system of its own. While his studies are not confirmed, data published in 1975 imply two orbiting planets have masses of 1.0 and 0.4 times that of Jupiter. They are believed to orbit at periods of 11.5 and 22 years at radii of 2.71 & 4.17 astronomical units. Barnard's Star is approaching our Solar system at a speed of 67 miles per second. In about ten thousand years it will be the nearest of all stars. Amateur photos spanning a four year period should make this celestial racers movement conspicuous.



A planet for a third nearby star?

If a visible star has a dark companion (dead star or planet) orbiting it, the companion will cause a cyclic wobble in the motion of the visible star across the sky. If the wobble is large enough and the star near enough, the wobble can be discovered by measuring photographs of the star taken over a period of years. Quite a number of dark stars have been

discovered by this method, but when it comes to planet-sized bodies, the wobbles are so small that the star has to be very near, and even then a claim causes a lot of controversy. Nevertheless, the existence of planets or planet like bodies accompanying two stars has been claimed for two cases, Barnard's star and Epsilon Eridani, by Peter



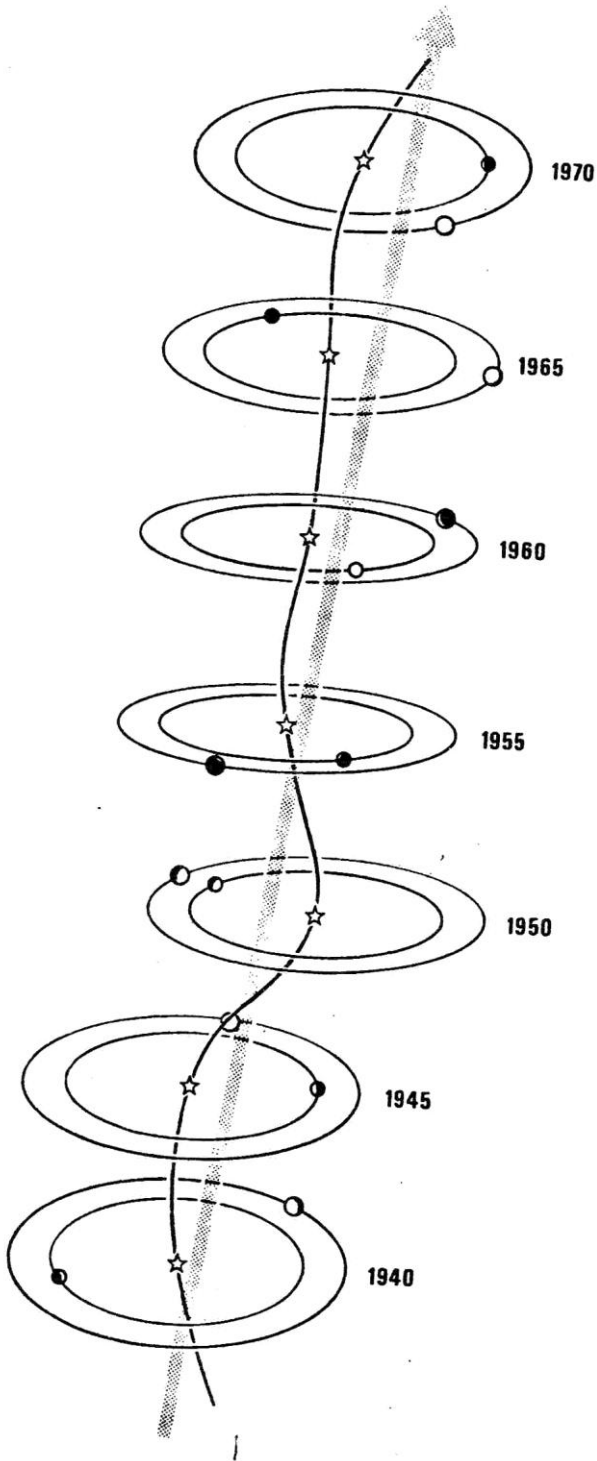
Cyclic wobbles in two dimensions plotted for Cincinnati 2354 and the companion's highly elliptical orbit derived from them.

van de Kamp of Swarthmore College's Sproul Observatory. At the American Astronomical Society meeting in Atlanta last week, the director of the Sproul Observatory, Sarah Lee Lippincott, added a third possibility, an 11th-magnitude star a third as massive as the sun called Cincinnati 2354.

Cincinnati 2354 is one of three nearby (16 light-years) red dwarfs recently studied by Lippincott and the only one of the three likely to have a planetary companion that shows up in the evidence. The evidence comes from photographic plates that represent 287 nights of ob-

serving between 1938 and 1966. All the plates were re-measured on a new, very accurate Grant plate-measuring machine. From the results, Lippincott calculates the existence of a companion with a period of 26.4 years. The mass of the companion may lie between that of a large planet and that of the smallest possible star depending on whether it is totally dark or whether it contributes something to the brightness of the image. Lippincott says, "My inclination is that the mass is well below stellar, about 6 or 8 times that of Jupiter."

The level of precision required to measure a Star's "wobble" in its Proper Motion greatly exceeds the capability of amateur telescopes. While the charts displayed above do strongly suggest the presences of planets orbiting nearby dwarf stars, not all professional astronomers agree. Some believe that atmospheric distortion is too great to make such minute measurements plausible. For more conclusive results, we'll have to wait for years of observations from the Large Earth Orbiting Telescope which will be hoisted aloft by the Space Shuttle in 1981. The absence of air will not only improve the positional resolution, but make possible better infrared studies of the stars. Cool red dwarfs are probably the only types of stars which we will ever be able to detect wobble in. Larger hotter stars, like our Sun, would be too massive to demonstrate any detectable wobble caused by orbiting planets. It is unlikely that life, as we know it, could evolve on a planet around a red dwarf.



The orbits of two planets around Barnard's star are deduced from the wobble of the star's observed motion. After Peter van de Kamp.

OBSERVING THE OUTER PLANETS! PART II

Neptune

BY DAVID DOBRZELEWSKI

Let's now travel out farther still to a planet which, at times, is farther from the sun than Pluto. The forgotten orb of Neptune is a 7.7 magnitude object which is very much worth pursuing. But unlike what your periodicals and astronomy texts might imply, Neptune is not an object to star-field sweep for, as was Uranus. In fact, its discovery came only through diligent searching and accurate calculations. After several years of following Uranus traverse the sky on its lonely journey around a distant sun, two astronomers, Adams and Leverrier, independently searched in 1846 for the cause of observed perturbations in Uranus' orbit. Each deduced that the cause was another planet, beyond Uranus. Sir George Airy noted, upon examining each result, that each had plotted a proposed position, one degree from one another- neither party knowing of the other's endeavors! Each asked a different astronomer to search for the missing world, but only one, German astronomer Galle succeeded. Nonetheless, both Adams and Leverrier are given credit for Neptune's discovery.

Today, in 1977, Neptune's 2" arc diameter disk is embedded in the southern Milky Way in Ophiuchus; which means a good star atlas should be used to insure success. A major problem in finding the outer planets-especially Neptune-is confusing it with background stars.

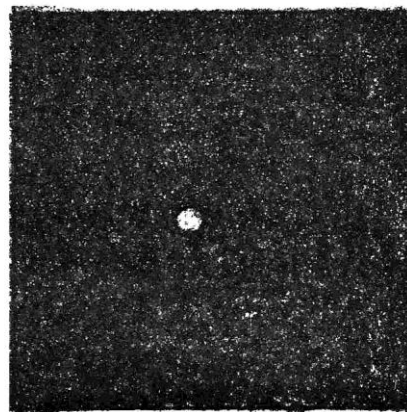
To find Neptune, I used Atlas Eclipticalis at Stargate, on April 25, 1977. I started at Eta Ophiuchi, and moved down toward Sabik (Nu Oph.). Midway, is 4.4 mag. Zeta. (From here, all directions are given telescopically oriented). Zeta is the vertex of a long, nearly isosceles triangle with two, equi-bright stars at its base (to the left). Still moving to the left, (in reality, westward) the two equi-bright stars form the right side of a parallelogram of stars. Finally, the left two members of the parallelogram form the right side of a trapezoid. I identified Neptune next to the upper left star in the trapezoid asterism. Each asterism mentioned above is outlined on the chart on the next page. I find "asterism-hopping" the most efficient object locating method for myself, as most everyone, I'm sure, has his/her own methodology.

By May 9, Neptune had shifted considerably. It was then that I decided to plot a graph of its motions so I could follow it. However, once Neptune is found, it is not difficult to relocate, even after an extended absence from observing. Finally identifying the outer planets can really be a fulfilling and rewarding experience that is uncommon to any other observational accomplishment.

To reveal Neptune's 2" arc disk, any telescope is theoretically perfect optics and excellent viewing conditions, in the case of a 2-inch. Of course, such is not often possible. Even my RV-6 left me in doubt as to whether I was seeing Neptune or the Airy Disk of a star. But given stable air, and reasonably good optics (don't go by my scope, it's in horrible condition!) a 6-inch should be sufficient.

Atmospheric detail? Not Quite. To be specific, let me just say that if you chance to catch an obscure band on Uranus, you might then consider Neptune an outlandish possibility. The clouds of Neptune are plainer still than Uranus', and we're looking out over a billion miles more than Uranus to view Neptune!

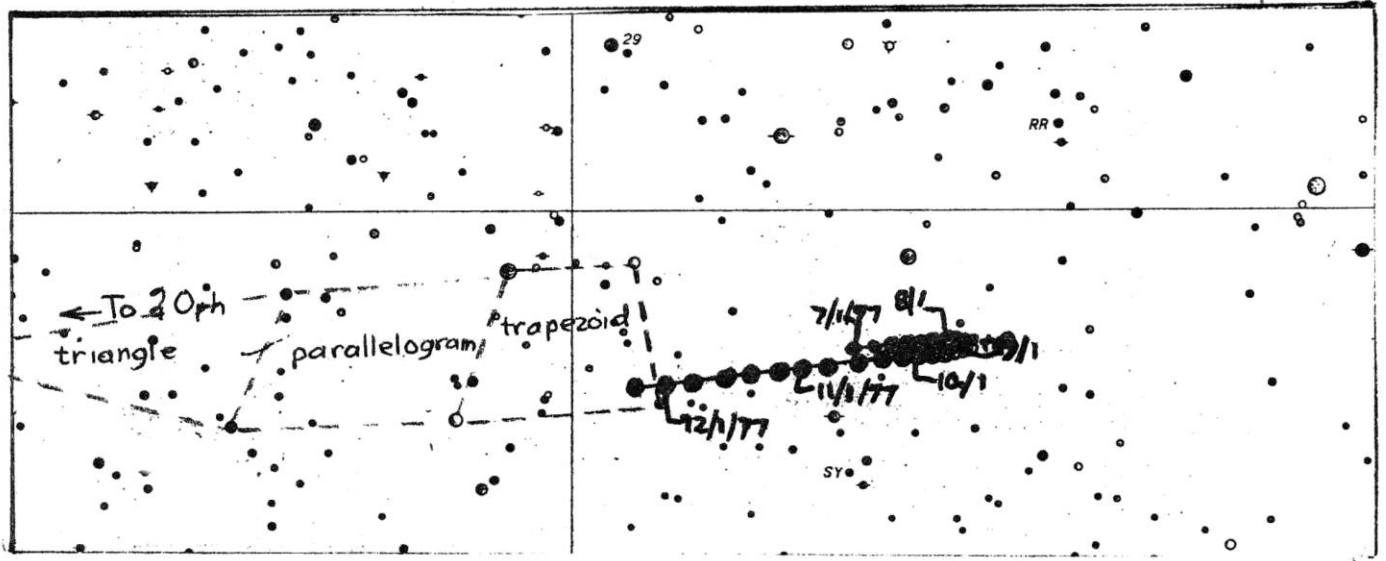
Nevertheless, Neptune is still a nice attraction, because although detail is absent, coloration is not. The orb's pale turquoise gives Neptune a quieting beauty all its own. The actual tint may vary from observer to observer, since the coloration is much more subtle than with Neptune's green twin.



Rendering of Neptune with 12½" stargate scope. 12mm eyepiece.

Neptune is also accompanied by two moons, Triton (14th mag.) which is the largest in the solar system, and tiny Nereid (19th mag.). Triton is the only moon known to travel "backwards", or retrograde around its parent.

Each dot represents 5 days. Charted on Atlas Eclipticalis, stars to 9th mag.



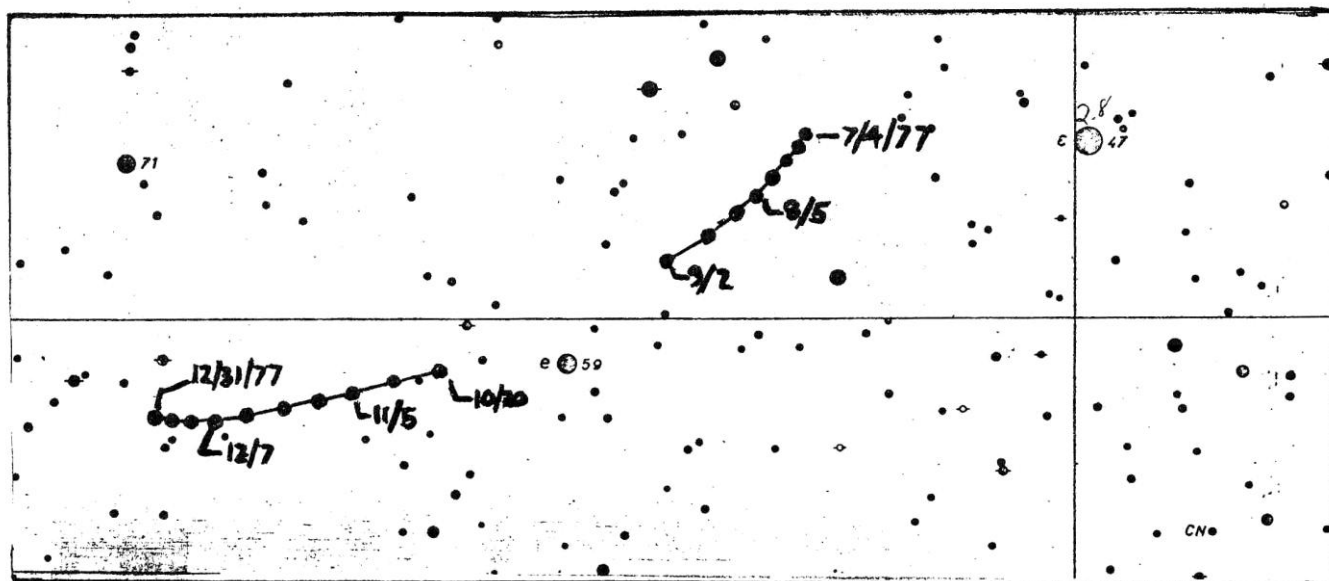
Photographically, Neptune is no harder to capture on film than Uranus, The only difference is the time factor. On the 12½" cass. at Stargate, I tried some prime focus shots with Tri-X. At 10 seconds, an image started to appear. A 60 second exposure should give a good solid image. But, again, don't expect any detail. The most important thing is to get a clear disk to pursue fine resolution. Or perhaps a long exposure (say, 5 min. or more) to try to capture the moons. But remember that, although any telescope can do, as was said before, the larger your aperture, the better your chances of success, whatever you do with the outer planets.

Pluto

And finally, I close with some remarks on Pluto. Pluto is not, to say the least, an object for star parties. Only the 200-inch Palomar telescope has photographed the pale-yellow disk of Pluto. But a large-aperture scope (say, 12" or larger) can view Pluto as a minute speck of light. This lost hunk of rock was discovered in 1930 by a young student astronomer, by the name of Clyde Tombaugh. The search for Pluto somewhat resembles that of Neptune, though on a much more sophisticated level. In spite of Pluto's extreme brilliance-14th magnitude-many an unwary observer will venture out to seek this planet, only to be helplessly caught in the barbs and thorns of those star fields!! (Horrors!) What the unwary observer forgot was a star chart plotted to at least 14th mag. The Palomar Sky Survey would be a handy reference, but how many of us can afford one?!

But take heart. You're awfully lucky to live in this time period. Pluto happens to be approaching perihelion in the next decade. This means that Pluto will be closer to us now than ever again in our lifetimes. In turn, this means that Pluto is at its brightest for a long, long, long time, too! Secondly, the tiny world is at a high point on the ecliptic. Well, actually it's even 10 degrees above the ecliptic, which puts Pluto at a favorable position for observing. And finally, Pluto is fairly close to the north galactic pole (which is in neighboring Coma Berenices), which means the planet is in a fairly sparse star field, comparatively speaking. By the time the next generation grows up, they'll be combing the star clouds in Ophiuchus (which itself will be dimming as it speeds toward aphelion)!

However, it is my objective to encourage observing the outer planets, and that I will do. About the best way to see Pluto is on a photograph. With a telescope of reasonably large aperture and some high speed film, success may be in store. A few shots taken on a given night would be wise. By doing this, you can distinguish clumps of film grain and dust that is incidental to a given frame of film. Long exposures are necessary to get a solid image of Pluto. Then repeat the same procedure at a later date, say a week or two later. Pluto will reveal itself by its displacement on the films taken on different dates.



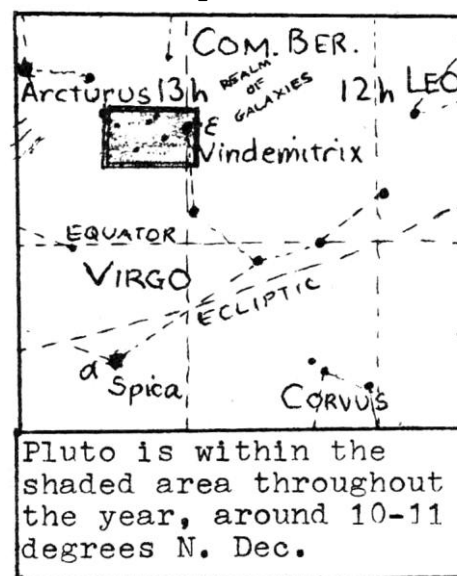
This map with Pluto's motion plotted is reproduced from Atlas Eclipticalis. Chart only shows Pluto's position relative to near-by stars.

So, the next free, clear night you have, to observe, why not add the outer planets to the agenda? Uranus and Neptune are in excellent positions for summer observing, and again in winter for morning stargazers. And Pluto would make an ideal and worthwhile photographic endeavor. The observer who succeeds in viewing or photographing these trans-Saturnian worlds is indeed an advanced amateur.

P.S.

I planned on having photographs accompanying this article, but as you can see, I failed to produce them. After several tries at photographing the planets Uranus and Neptune, I finally had the proper exposures narrowed down. My final exposures for this article went well. Clear, steady images, dark background sky; really everything went well-until I opened the camera for developing. The film never caught in the take-up spool ...

Oh well, then came Pluto's turn at the M.S.U. Observatory one Saturday night. A first, quarter moon devastated the whole area of the sky (sob). I hope to have some shots in the near future, if nothing goes wrong ...



Perseid Maxima - "77"

Lou Faix

August 11: The showers stopped about 8:30 PM and the evening sun broke through and cast the sky in gold. To the east a triple rainbow, the brightest I had ever seen, set the stage for a night of nights--- Perseid Maxima - 1977.

Sonny Elliot said "Get ready folks," Jerry Houdak said, "Tonight's the night". By 11: 00 PM the clouds were crumbling and blowing, away before the rush of a Canadian northwest cold front. By 11:30 PM the jet black sky was swept clear. A moonless sky was stilled, and the show began. Like a stage spot light, the Milky Way streaked across the heavens from northeast to southwest, visible from horizon to horizon. Vega at zenith, Arcturus setting, the Great Square bold in east.

They came. Quick darts at first. Low along the eastern horizon. Magnitude 5, short, very fast, prelude to the Tears of St. Laurence (martyred August 10, 258). By midnight the count was fifty an hour. All sizes, all colors. The smallest were very fast and nearly too quick for the eye. The largest were slower leaving smoking trails in yellow/orange glows that lingered for seconds and died all too quickly. In batches and clumps they came. Two, three or four in rapid succession in the same area. Then darkness and stillness for what seemed like minutes stretched into hours.

The handbook says a mean velocity of 37 miles per second with an average magnitude of 2.27. Remnants of Comet Swift-Tuttle last seen in 1862 and due back in 1981. Chinese astronomers were awe struck in 36 A.D. Korean and Japanese chronicles note their annual recurrence from 714 AD while European records date from 811 AD. It wasn't until 1866 that Schiaparelli made the connection between the Perseid meteors and a comet trail.

By 1:00 AM the count was 80-100/hour. If only I had more eyes. More big ones as the shower wore on. Maybe 20% were first magnitude and one in ten left a smoke trail.

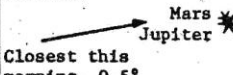
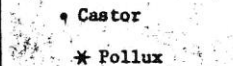
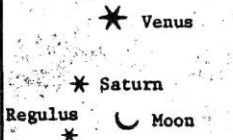
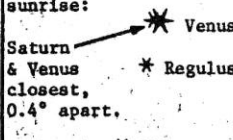
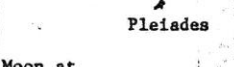
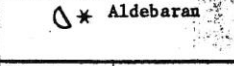
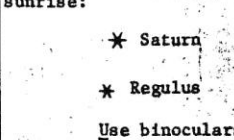
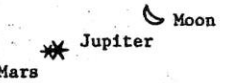
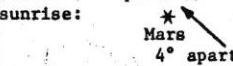
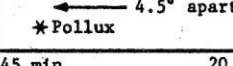
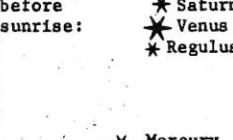
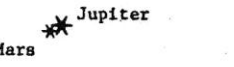
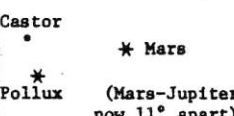
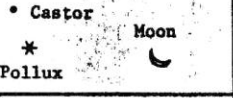

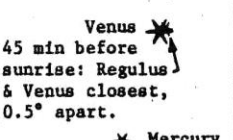
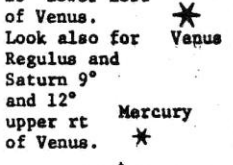

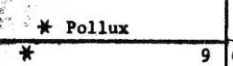
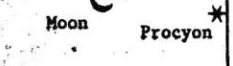
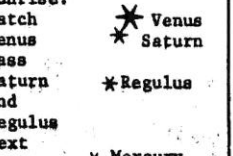
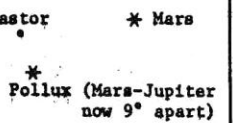
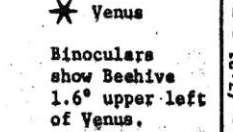


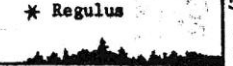
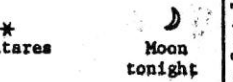
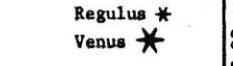
Cassiopeia was being riddled as they screamed down the corridor of the Milky Way. From Beta Andromeda and Gamma Pegasus they scorched the sky. The Great Galaxy, M31, an easy naked eye object after hours of dark adaptation was like a bull's-eye for the bullets.

Would the camera see them? Would the film be quick enough? Was the dew on the lens too thick? Yes, it will be great if we can catch just a few. But it really doesn't matter. I've seen them---

----- The Perseid maxima---

SKY CALENDAR SEPTEMBER 1977

Information for helping teachers and students observe the sky

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
<p>Planets This Month (all in morning sky): Venus rises 2 to 3 hrs before sunup. An hour before sunrise, this brightest planet is 15° to 20° up in east. Use Venus as a guide to Saturn, Mercury, and Regulus. See diagrams.</p> <p>One hour before sunrise: 4  Closest this morning, 0.5° apart. </p> <p>One hour before sunrise: 11 </p> <p>45 min before sunrise: 18 </p> <p>This week 45 min before sunup: Venus 18° up in E. Mercury 12°-14° LL of Venus. Saturn 8°-14° UR of Venus. Don't confuse Saturn with Regulus which is 3°-4° lower. Jupiter 70° up in SE. Mars 10°-12° LL of Jupiter.</p>	<p>Jupiter, next in brilliance after Venus, rises 5 1/2 to 7 1/2 hrs before sunup. An hour before sunrise, it is 33°-64° to upper right of Venus, and 50°-70° up in SE. Use Jupiter as guide to Mars, Pollux, and Castor. See diagrams.</p> <p>One hour before sunrise: 5  Moon at Last Quarter </p> <p>40 min before sunrise: 12  Use binoculars for Mercury.</p> <p>First Quarter (evening half moon). As you face setting sun tonight, note moon is 90° to left, or in the south. Binoculars show good detail on moon's terminator.</p> <p>Full Moon rises shortly before sunset. Penumbra eclipse late tonight. See Sept 27. Harvest Moon: Next few evenings, moon rises about 1/2 hr later each night, much less than the average.</p>	<p>Saturn rises 1.4 hrs before sun Sept 1, and 3.4 hrs before sun Sept 30. On Sept 1 Saturn is 18° lower left of Venus. On Sept 18 Saturn is 0.4° N of Venus. On Sept 30 Saturn is 13° upper right of Venus. Note Regulus below Saturn.</p> <p>One hour before sunrise: Planets 0.9° apart. 6  Betelgeuse</p> <p>New Moon— not visible. 13 45 min before sunrise: Jupiter 4° apart  Castor 4.5° apart </p> <p>45 min before sunrise: 20  Mercury</p> <p>Early this morning, the moon passes through the barely detectable outer portion (penumbra) of the earth shadow. Greatest darkening occurs at 4:29 a.m. EDT, with moon's southern portion getting dusky.</p>	<p>Reddish 1st magnitude Mars is very close to Jupiter in early Sept and is 12° to lower left of Jupiter by Sept 30. Mercury's best morning appearance in 1977 is last half of Sept. See Sept 14, 16, 18, 20-22, 24-25, 29.</p> <p>One hour before sunrise: Planets 1.3° apart. 7  Betelgeuse</p> <p>5 planets visible 14 45 min before sunup. First find 2 brightest, Venus 20° up in E, and Jupiter 60° up in ESE. Then find Saturn, Regulus and Mercury 4°, 9°, and 17° lower left of Venus respectively. Mars 4.5° lower left of Jupiter.</p> <p>Mercury at greatest elongation, 18° west of sun in morning sky. 45 min before sunrise, look 7°-8° above eastern horizon. From September 20-27 it is 12° lower left of Venus. Equinox tomorrow; autumn begins in N. hemisphere.</p> <p>45 min before sunrise: 28  (Mars-Jupiter now 11° apart)</p>	<p>Moon rises about 1 2 hrs after sunset tonight, allowing 1/2 hr of dark skies. Use last month's star map 3/4 hr after sunset, and this month's 2 3/4 hr after sunset. As twilight ends, look for Milky Way and Andromeda Galaxy.</p> <p>One hour before sunrise: Jupiter Planets 1.8° apart. 8  Pollux</p> <p>45 minutes after sunset: Use binoculars to locate Spica in WSW. 15  Spica</p> <p>45 min before sunrise: Regulus & Venus closest, 0.5° apart. 22  Mercury</p> <p>45 min before sunrise: Mercury 13° lower left of Venus. 29  Mercury</p>	<p>One hour before sunrise: Watch Mars pass Jupiter in next few days. They are 1.3° apart this morning. 2  Castor </p> <p>One hour before sunrise: 9  Venus</p> <p>45 min before sunrise: Watch Venus pass Saturn and Regulus next week. 16  Mercury</p> <p>45 min before sunrise: Jupiter 23  Pollux (Mars-Jupiter now 9° apart)</p> <p>Moon again rises about 2 hrs after sunset, allowing a brief interval of dark skies, as on Sept 1. This month's star map shows sky as twilight ends. Again, look for Milky Way and the Andromeda Galaxy.</p>	<p>1 hr before sunrise: 3  Binoculars show Beehive 1.6° upper left of Venus.  Saturn</p> <p>One hour before sunrise: 10  Saturn </p> <p>Moon tomorrow 17  Moon tonight (Face SW one hour after sunset.)</p> <p>Saturn 24  Venus 45 min before sunrise: Mercury</p> <p>When will planets become visible in evening sky? Jupiter rises 2 hrs after sunset in late Nov, Mars in early Jan, and Saturn in late Jan. Mercury in twilight around Dec 1, again in Mar '78. Venus is evening "star" by Mar '78.</p>

Magnitudes of the Planets: Venus -3.4; Jupiter -1.7 to -1.9; Saturn +0.7 to +0.8; Mars +1.0 to +0.8; Mercury Sept 14, +1.0; Sept 20, 0.0; Oct 1, -1.0. *Motions during September:* Venus 36°, Mars 17°, Saturn 3.5°, Jupiter 3.4° (all eastward). Venus goes from Cancer into Leo and passes Beehive, Saturn, and Regulus. Mars, in Gemini, passes Jupiter Sept 4. Jupiter passes about 1/2° N of the stars Eta and Mu Geminorum on Sept 10 and 27, respectively. Saturn, in Leo, approaches to within 3.3° of Regulus Sept 30.

Sunrise/Sunset East Lansing: Sept 1 7:03 a.m./8:12 p.m.; Sept 16 7:19 a.m./7:46 p.m.; Sept 30 7:34 a.m./7:21 p.m. (EDT)