NOVAC

THE NEWSLETTER OF THE NORTHERN VIRGINIA ASTRONOMY CLUB

Issue Number 50 **Volume 13** **November/December 1993**

UPCOMING NOVAC EVENTS

Club Observing Dates

November 5, 6, 12, 13

December 10, 11, 17, 18

Monthly Meetings

November 17

December 15

Editor's Note

by Thomas S. Parry

Although this year's NVTM was washed out and October was wetter than usual, there were a couple of sparkling clear nights in which those of us who went to Crockett Park were rewarded with some spectacular deep sky views. I saw the Veil Nebula through my 14.5 inch reflector and I could hardly believe my eyes! Adding a two-inch O-III filter (generously lent to me by one of my fellow observers) I took one look at the Veil and thought I was looking through a large observatory scope. It looked like the photographs you see in books with intricate filamentary structure clearly defined. Adding magnification brought out even more filamentary structure. It is a sight I'll never forget and want to experience again! I also found the Helix Nebula for the first time and the detail was superb! Other treats included the Omega, Lagoon, and Trifid Nebulae and a number of globulars. All were spectacularly bright and displayed intricate detail. No one observing that night came away disappointed.

While some of us were satisfying our visual hunger for photons, others were using emulsion to soak up even fainter photons. Using his eight-inch SCT, Bob Sandy photographed a number of deep sky objects, among them the North America Nebula featured in this month's *Images* section.

September and October have been banner months for observing Saturn. I've been out to observe it on numerous occasions and sketch my observations. In this issue I've included a digitized image of a Saturn sketch I did early this autumn as part of the article *Saturn 1993*. November and December will be our last chance to glimpse the ringed planet in the evening hours as it gradually edges its way toward a conjunction with the sun in early 1994.

Our feature article this month describes NOVAC member Alexander White's work on calculating planet positions using a geometric method of calculation in order to improve on Ptolemy's epicyclic models. He also proposes and describes his own model to correct for weaknesses in one of Ptolemy's models. Alexander's work should challenge the mathematically minded among us!

Jon and Kathleen Stewart-Taylor, in *The Recreational Astronomer*, share some insights on how those of us with families can get our spouses and children involved in discovering the wonders of the universe--and really enjoy it. In *Reflections in the Eyepiece*, Bob Bunge looks at the growing threat of light pollution and offers some tangible ideas of what we can do to bring the night sky back. This is particularly important given the rapid expansion of development throughout the Northern Virginia area and gradual brightening of the night sky at Crockett Park.

As Fall wanes on and Winter sets in, we

Inside This Issue

look forward to the crystal clear skies filled with bright stars and the gentle wisp of the Milky Way that are a hallmark of the season. Lets hope for clear skies and some good Winter observing!

November and December General Membership Meetings

The November General Membership Meeting will feature NOVAC member Thomas Parry who will speak on *Fundamental Considerations in Purchasing an Astronomical Telescope*. The presentation will address optics, advantages and limitations of various telescope types with emphasis on choosing the right telescope for the intended purpose. Anyone--fledgling or advanced--considering a new telescope purchase or an upgrade should attend this session.

Our speakers for the December meeting will be Colonel Simon Warden and Dr. Milan Nikolich of the Ballistic Missile Defense Organization. Col Warden is a Physicist and Astronomer and serves as Deputy for Technology. Dr. Nikolich is an Electrical Engineer and is Special Assistant to the Deputy. Their topic is *Emerging Technologies that will Change How We Do Things in Space*. The talk will focus on: 1) How we launch, 2) small satellites--satellites that have both military and environmental uses, and 3) adapting military systems to astronomical uses.

The monthly General Membership Meetings of the Northern Virginia Astronomy Club are held the third Wednesday of every month at 7:30 P.M. at the Arlington County Planetarium, 1426 N. Quincy Street, Arlington, VA. Admission is free and open to the public. Call the NOVAC hotline (703) 256-8359 for upcoming events, special announcements or to leave a message for additional information.

Highlights of September and October NOVAC General Membership Meetings

by Bob L'Hommedieu, Secretary

General Meeting September 15, 1993

Myron Wasiuta called the meeting to order at 7:30 P.M. Twenty-five members and guests attended at the Arlington County Planetarium.

New Business

1. A nominating committee was formed to propose a slate of candidates for NOVAC elections in December. Tom Parry, Steve Bodner, and Brent Archinal agreed to serve on the committee. Any member is eligible to be nominated for office. Anyone interested in serving should contact the committee or attend the upcoming monthly meetings.

2. Five members are needed to subscribe to Astronomy to establish group subscription rates for the club. For more information contact Brenda Jones at 527-7963.

Announcing the 1994 NOVAC Annual Meeting

Tuesday, January 11, 1994
at the home of Brenda Jones
883 N. Kentucky Street
Arlington, Virginia
7:30 P.M.

This is NOVAC's planning meeting for the new year. All NOVAC members are invited to attend, meet new club officers and give their ideas and input on NOVAC activities for 1994

Old Business

1. The Northern Virginia Telescope Meet is this coming Saturday (Sep. 18) with a rain date the following Saturday (Sep 25). Volunteers are needed for concessions, security, and traffic control. Please contact Doug Mistler if you are able to help.

Fred Holmes presented the observing report and John Huggins gave the program for the evening. John spoke on the theory behind optical interferometry and the current efforts under way to build operating instruments. John is an engineer who has been working on the project and presented us with a behind-the-scenes look at this exciting effort.

General Meeting October 20, 1993

Myron Wasiuta called the meeting to order at 7:30 PM. Thirty-eight members and guests attended at the Arlington County Planetarium.

Old Business

1. NVTM was rained out this year. Brenda Jones and Doug Mistler will coordinate the event for next year. Discussions are under way to move the site of NVTM '94 to a location that offers indoor facilities. Brenda has contacted the Northern Virginia 4-H Center in Front Royal and will soon visit the site to assess the sky conditions at night. Anyone interested in going should contact Brenda for more information.

New Business

1. New member Sandy Sanders is interested in forming a committee to organize events around the annular solar eclipse in 1994. The eclipse centerline is expected to pass through the northeast portion of the United States on May 10, 1994. He would also like to hold a more organized Messier Marathon in 1994.

2. The Planetary Society will hold an event at the Naval Observatory next summer to commemorate the 25th anniversary of the Apollo moon landing and to observe Comet Shoemaker-Levy 9 strike Jupiter. NOVAC has been asked to participate and provide telescopes. More information will be forthcoming.

3. Brenda Jones received the Astronomical League Binocular Messier Certificate. She is the first member of NOVAC to receive this honor for observing at leaset 50 Messier objects with binoculars.

4. The Nominating Committee has nominated a slate of officers for NOVAC elections in December. Nominations are now open and any club member is eligible for nomination. All interested in running for election are encouraged to contact an officer or come to the November meeting. At this time those nominated include: *President*- Bob L'Hommedieu; *Vice President*- Ron Ferris; *Secretary*- open; *Treasurer*- Brenda Jones; *Trustees*- Bill Jensen, Fred Holmes, Doug Mistler, Bob Sandy and Bob Bunge.

Al Boldt demonstrated the equipment and techniques for properly cleaning eyepiece lenses in a lively talk. The program for the evening featured Dr. John Wallin of George Mason University who spoke about peculiar galaxies and his research relating to their formation. He described the methods used to gather data about the structure of these systems, showed slides of the telescopes employed and the instruments used. Dr. Wallin also showed video of computer simulations depicting the collisions of galaxies.

Observer Report: NVTM '93

This year's NVTM was a double disappointment. After being postponed due to crummy weather, the rain-date lived up to it's name. A few die-hard NOVAC members were present to raise the banner and greet the crowd of *person* who showed up. We directed him to Brenda who gave him a NOVAC membership application.

The swap table (van) did a brisk business, concluding several transactions per hour for at least 30 minutes. The estimated ZTR (zenithal transaction rate) was over 500/hour, assuming a 95% obscuration of the crowd by the rain. The hit activity of the day was the 1000-yard solar-system model with nearly 50% of the attendees making the long trek to the outer reaches of the solar system. I personally gave up after walking for 5 minutes to reach Uranus, where the informative plaque cheerfully informed me that I was halfway to the edge of the solar system. It really gave one a feel for just how far away the outer-planets are.

We hung on through several brief sprinkles. Technical discussions involving what magnification to view the raindrops at and how big a flashlight would be required to incinerate the geese across the lake when shone into the eyepiece of a 13-incher kept the conversation lively. We finally gave it up when the sprinkles turned into a downpour. There was talk about resuming the meet at a restaurant, but I sloshed home to warm up and dry off.

While everybody who showed up deserves a pat on the back, special thanks should go to Jim Schaeffer for setting up the 1000-yard model and Brenda for stocking the concession stand and feeding the ravenous hordes with first-magnitude brownies. Next year we'll have to arrange for better weather. Maybe if we hold one of the weather satellites hostage, we'll finally get some clear skies!

Sky Calendar
November/December 1993

Compiled by Thomas S. Parry

Events occur on dates indicated per Eastern Standard Time

November

2	*Venus shines bright in A.M. sky 4 degrees N. of Spica.*
3	*S. Taurid meteor shower (Evening of Nov 2/3).*
6	*Mercury at inferior conjunction. Transit of Mercury across sun visible in the Pacific, Australia, Asia.*
7	*Last-quarter moon.*
8	*Venus and Jupiter less than 1/2 degree apart in A.M. sky 45 minutes before sunrise.*
12	*Venus and Jupiter within 5 degrees north of waning crescent moon in A.M.*
13	*New moon; a partial eclipse of the sun occurs over South Pacific from southern South America to Australia.*
14	*Venus below Jupiter. To upper left of Venus is Mercury. Spica to Jupiter's upper right. A beautful conjunction in A.M. sky!*
16-17	*Leonid meteor shower peaks tonight.*
17	*Neptune 3 degrees S. of crescent moon P.M.* *Uranus 4 degrees S. of crescent moon P.M.*
20	*First-quarter moon shines 7 degrees N of Saturn.*
22	*Mercury at greatest western elongation (20 degrees) and having a favorable morning apparition for N. America.*
28-29	*Full moon. Late night TOTAL ECLIPSE OF THE MOON for N. America.*

December

6	*Last-quarter moon.*
10	*Jupiter shines 4 degrees N. of crescent moon and crescent moon shines very close to spica in A.M.*
12	*Mercury 5 degrees N. of Antares in A.M.*
13	*New moon. Geminid meteor shower peaks. Should be best meteor shower of year.*
15	*Neptune 3 degrees S. of crescent moon (P.M.).* *Uranus 4 degrees S. of crescent moon (P.M.).*
17	*Saturn 7 degrees to the lower left of crescent moon (P.M.)*
20	*First-quarter moon.*
21	*Winter solstice occurs at 3:36 P.M. Eastern Standard Time. This marks the first day of winter and the shortest day of the year. The sun now begins its journey northward.*
27-28	*Mars in conjunction with the sun.*
28	*Full moon.*

Sky Sweep for November and December 1993: The Open Clusters of Auriga
by Kevin Jones

The large pentagon-shaped constellation Auriga the Charioteer sparkles high in the evening skies of early winter. The band of the Milky Way passes directly through Auriga, and is wonderfully rich with stars, star clusters, and nebulae. This area is well worth sweeping with binoculars. This column will point out a few of the brightest and most interesting clusters and nebulae of Auriga.

Begin with the sixth-magnitude open cluster M37 in the Milky Way just outside the pentagon of Auriga towards Gemini. This bright open cluster is a third of a degree in diameter and contains a couple hundred stars visible through small telescopes. M37 is *class F*, indicating a fairly rich and dense cluster. The concentration classes for open clusters range from C for very loose, scattered clusters through G for compressed, rich clusters. Despite their value for the observer, they are used in only a few catalogs and observing guides, most notably the exhaustive Burnham's Celestial Handbook.

Two and a half degrees west-northwest of M37 lies the smaller and brighter open cluster M36. It contains between fifty and one hundred stars visible through small telescopes. They are packed into about ten arcminutes, only half the diameter of M37. Like M37, M36 is a cluster of concentration class F.

A degree west of M36, the nebula NGC 1931 glows faintly. This nebula is small, only three arcminutes across, and not terribly exciting to look at. Simply locating it is a bit of a challenge.

The small open cluster NGC 1907 is found

two degrees northwest of M36. It is another fairly rich class F open cluster, containing about fifty stars visible in small telescopes, the brightest of which are tenth magnitude. Use high powers on this cluster as it is only five arcminutes in diameter.

A degree or so north of NGC 1907 is the larger and brighter open cluster M38. This cluster's diameter is roughly four times that of NGC 1907, and contains twice as many stars. M38 shines at about sixth magnitude and contains stars eighth magnitude and fainter. M38, M36, and M37 are all around five thousand light years distant.

Three degrees south-southwest of M38 is the loose (class D) open cluster NGC 1893. This cluster is twelve arcminutes in diameter and contains only a couple dozen stars, all around tenth magnitude. If skies are particularly dark and transparent, the faint nebulosity IC 410 that envelops the cluster may be glimpsed.

Two degrees northwest of NGC 1893 is the final object on this issue's celestial tour, the Flaming Star Nebula (IC 405). This object is large and faint, with a low surface brightness. As its apparent size (eighteen by thirty arcminutes) is almost that of the full moon, low powers are necessary to reveal the nebula. Interestingly, the nebula's illumination is provided by the peculiar sixth magnitude star AE Aurigae. This star is one of the *Runaway Stars*; stars moving across the sky with unusually high proper motions (a few hundredths of an arc second per year) away from the region of the Orion Nebula. The star and nebula are around two thousand light years away or roughly half the distance to the three Messier open clusters of Auriga.

That's it for this month. Enjoy the Auriga Milky Way and the rest of those wonderful winter constellations, and be sure to keep warm!

Planet Positions using Ptolemy's Epicyclic Models and Calculation Accuracy using Circular Orbits

by Alexander L. White

I am a retired research chemist and have been interested in astronomy as a hobby since 1940. Several years ago I bought four books on astronomy by Johns Hopkins University Professor Robert R. Newton who has made an extensive study of Ptolemy's work on astronomy. I then became interested in knowing how well Ptolemy's *epicyclic models* would perform if used in a *geometric method* of calculation. This is not shown in Dr. Newton's work[1]. An epicyclic model can be thought of as a small circle, the center of which moves round in the circumference of a larger circle (see Figure 1). Epicycles and deferents represent orbits or substitute orbits.

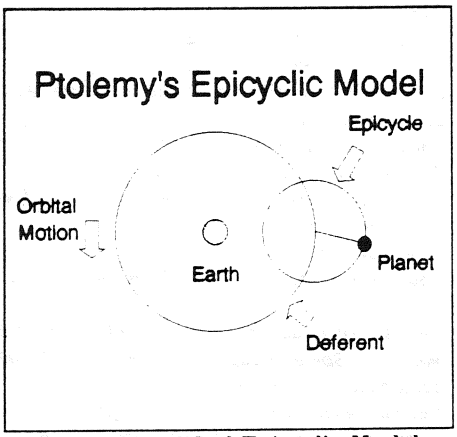


Figure 1: Simplified Epicyclic Model (Epicycle moves counterclockwise)

My purposes in this article are to demonstrate 1) how epicyclic models perform using a geometric method of calculation and 2) how accurate calculations are if circles are used instead of ellipses in a *heliocentric* (sun-centered) model. Ptolemy used a different method of calculation for planet positions that will be described near the end of this article.

In the second century A.D., the time of Claudius Ptolemy, people wanted to believe that the universe was perfect and the earth an important part. Prevailing religious and philosophical beliefs of the time placed earth at the center of the universe and the orbits of the sun and planets followed a circular path about the earth. Ptolemy made drawings called *models* to show positions of the five known planets relative to the earth. These models were described in his *Almagest*[2] and were not intended to give accurate distances between earth and the planets.

I selected two of Ptolemy's epicyclic models to test. The *Inferior Planet Model* or *Venus Model* shows the position of Venus (see Figure 2). Ptolemy used a different, more complex model for Mercury. The *Superior Planet Model* illustrates the position of Mars (see Figure 3) and could be applied to Jupiter and Saturn. I made calculations for Venus and Mars using the models illustrated here and for Mars alone with an epicyclic model of my own design (see Figure 4).

It was necessary to design this model (Figure 4) because Ptolemy's model does not keep the epicycle radius parallel to the earth-to-sun direction to prevent collisions of earth with the sun and does not show the sun's apparent orbit. Modern orbital elements and scale drawings were used to obtain *geocentric ecliptic longitudes* (GEL). GEL is the coordinate of a planet used in geocentric (earth-centered) systems that is measured from the vernal equinox eastward along the ecliptic. Geocentric longitudes calculated from the equinox position along with elapsed time are marked on a scale drawing with a line drawn from earth to the planet. The line is then measured with a protractor. This geometric method of calculation is compared with those of a sun-centered model having eccentric circular orbits. The epicyclic model longitudes were also compared with longitudes converted from modern right ascension and declination positions.

I wrote a computer program[3] and made calculations for a sun-centered model with centered, circular orbits. The purpose was to determine the accuracy of circular orbit calculations. This program allowed much quicker calculations and a more complete accuracy study. The results were also needed for comparison with the inadequately corrected results of Ptolemy's epicyclic models. I found an epicyclic model calculation for Mars where this correction made the result worse.

Ptolemy's Inferior Planet (Venus) Model uses a circle the size of earth's orbit as the *deferent* (a circle around the earth, along the circumference of which the orbit of a planet moves) with the earth near the center. The epicycle used a circle the size of Venus' orbit with the sun at the center (see Figure 2). I used the *product of the radius of an orbit* and its *eccentricity* for this offset distance when drawing all the models. Knox[4] used this method of calculation based on a heliocentric, circular orbit model for Mars. Ptolemy did not give offset distances or a method of calculation in his *Almagest*. This inadequate correction does not account for

the largest differences in planet positions due to variation in speed in elliptical orbits. Ptolemy's use of eccentric circles implies that he knew the solar system does not have centered, circular orbits.

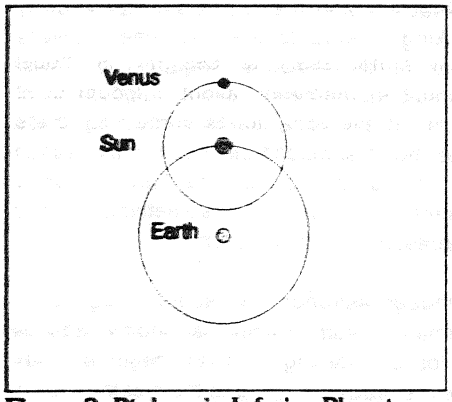


Figure 2: Ptolemy's Inferior Planet (Venus) Model

Ptolemy's Superior Planet Model (Figure 3) is composed of a circle the size of the orbit of a superior planet (one outside earth's orbit) for the deferent with the earth near the center. The epicycle used a circle the size of earth's orbit with an imaginary point at the center.

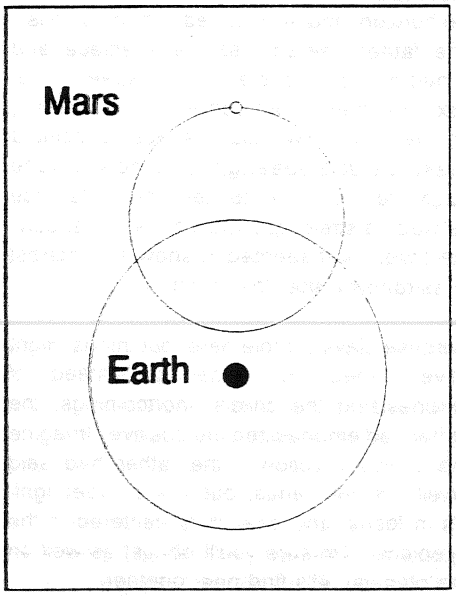


Figure 3: Ptolemy's Superior Planet (Mars) Model

As mentioned previously, the weakness of the Superior Planet Model is that it fails to keep the radius of the epicycle parallel to the earth-to-sun direction thus allowing the planet to maintain a roughly constant distance from the sun. In addition, this model fails to show the sun's apparent orbit and the planet moves about a center void of a heavenly body. I thus designed a model that gets around these disadvantages and call it the *Small Deferent Model* (Figure 4). A circle the size of the earth's orbit is the deferent with the earth at the center. The epicycle uses a circle the size of a superior planet's orbit with the sun near the center. This model shows the apparent orbit of the sun around the earth and collisions between the superior planets and the sun are not possible. The size of Mars' orbit relative to the sun's apparent orbit is correct.

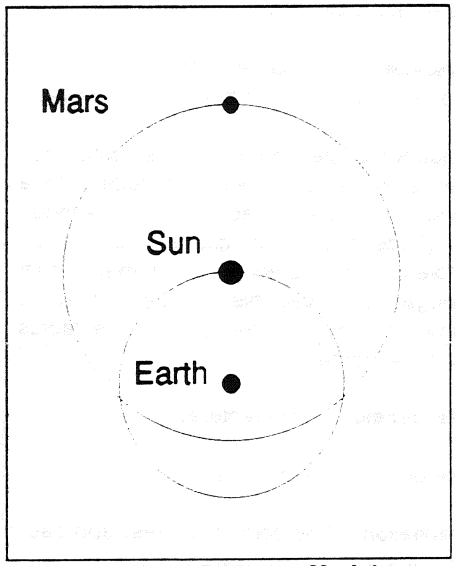


Figure 4: Small Deferent Model

A few geometric method calculations for Venus and Mars, with the three epicyclic models, gave the same geocentric longitudes obtained using a sun-centered model with eccentric circular orbits. The epicyclic-model longitudes were also compared to longitudes converted from modern right ascension and declination positions and the largest error was five degrees. Larger errors are expected from some other positions, as an inadequate correction was made for using circles instead of ellipses. Mercury's position calculations for epicyclic models using the geometric method are expected to be less accurate than those for Venus due to Mercury's larger eccentricity. Position calculations for Jupiter and Saturn are more accurate than those for Mars since their eccentricities are smaller.

I made about 25 calculations for a sun-centered model with centered circular orbits. I wrote my own computer program and used it to search for the largest errors. Errors up to seven degrees were found for Venus and 29 degrees for Mars. Mars' calculations can be greatly improved if a modern *equation-of-the-center* correction is used with an uncorrected sun-centered model. This equation-of-the- center is given in the glossary. The 29-degree error of Mar's December 1, 1990 position was reduced to 2 or 3 degrees using this equation--a very effective correction.

Ptolemy did not give an example of his calculation or the data needed to make one in his *Almagest*. Dr. Newton gave a general description of what he thinks Ptolemy did. It was necessary to determine parameters, by observation, that were somewhat like modern orbital elements. The use of the longitude of apogee, as a parameter, implies that the planets do not have centered circular orbits. This method employed a formula known to the Greeks as the *equation-of-the-center* in the calculation. It is given in the glossary and is different from the modern formula. The sum of the longitude of apogee, the Greek anomaly and the Greek equation-of- the-center gave the geocentric ecliptic longitude of the planet. There are some difficulties with this description and not all of the parameters were used.

This work gave me an intellectual puzzle to solve. It showed that epicyclic models can be used to get the same geocentric longitudes obtained with heliocentric, circular orbit models. The eccentric correction used was inadequate to compensate for not using elliptical orbits. Calculations using circular orbits give varied and generally inaccurate results unless a modern equation of the center correction is used. These corrected results are much more accurate and may be of limited use to amateur astronomers. The writing of a much longer program needed for elliptical orbits is avoided.

It is believed that Aristarchus of Samos was the first to propose a heliocentric hypothesis. About the third century B.C., he suggested that the earth revolved about the sun in a circular orbit. If Ptolemy had supported a heliocentric system, he may have had trouble because of the prevailing religious beliefs of the time as did Galileo. The people would also have found this system

harder to believe. There was no theory of gravitation and birds and clouds did not appear to move westward. The stars were believed to be much closer than they are and there was no noticeable change in the shape of constellations.

References

[1]Newton, Robert R. ***The Crime of Claudius Ptolemy***. Baltimore MD: The Johns Hopkins University Press (1978), pp. 55-57, 309.

[2]Hutchens, Robert M. ***Ptolemy, Copernicus, Kepler*** in *Great Books of the Western World*. Chicago: Enyclopedia Brittanica (1952), p. 5. Contains the *Almagest*.

[3]**Pocket computer program available to NOVAC members only upon request from Alexander White, 8610 Queen Elizabeth Blvd. Annandale VA 22003.** Written in BASIC language for use with the Tandy PC-7 pocket computer. This program has 18 statements and requires eight data entries. Results obtained should reflect correction using the equation of the center. Programmable calculators such as the Casio FX-4000P may be used for astronomical calculations if they have adequate memory.

[4]Knox, Richard. ***Experiments in Astronomy for Amateurs***. New York: St Martin's Press (1976), pp. 141-158. An excellent resource for those interested in making early planet calculations.

Other References Not Cited

Duffet-Smith, Peter. ***Practical Astronomy With Your Calculator***. New York: Cambridge University Press (1983), p. 107. Duffet-Smith gives an approximate method of calculation for planets using concentric, circular orbits.

Crowe, Michael J. ***Theories of the World from Antiquity to the Copernican Revolution***. New York: Dover Publications Inc. (1990), pp. 21, 97.

Glossary of Terms

Anomaly: In modern use the mean anomaly of a planet is the difference in longitude between perihelion and the mean longitude of the planet. Dr. Newton used the angle between apogee and the epicycle center for the Greek mean anomaly.

Apogee: The point on the orbit around the earth most distant from the earth.

Apsis (Apse): The extremity of the major axis of an orbital ellipse such as apogee or perigee.

Deferent: An imaginary earth-centered circle on which the epicycle center moves in a counter-clockwise direction.

Eccentricity: The degree of elongation of an ellipse. The ratio of the distance of a focus from the center to the length of the semi-major axis.

Ecliptic longitude: The longitude of a planet or apse, measured from the vernal equinox eastward along the ecliptic.

Epicycle: An imaginary circle on which the planet moves around the epicycle center.

Equation-of-the-Center: The difference between true and mean longitude, 115 e sin(L-w), where e = eccentricity, L = mean longitude and w = longitude of perihelion. Ptolemy measured the anomaly from apogee and used this formula, arc tan (-r sinV/(1+r cosV)), where r=epicycle radius and V=anomaly.

Geocentric: Earth-centered

Heliocentric: Sun-centered

Perihelion: The point of closest approach to the sun in an orbit about the sun.

The Recreational Astronomer: Family Astronomy

by Jon and Kathleen Stewart-Taylor

Welcome back to the Recreational Astronomer. This column will address Family Astronomy: how to include all members of the family in astronomy. The emphasis is *family* rather than Astronomy. Most of this applies to friends as well as family, but for convenience we'll use "family" throughout, so substitute as appropriate for your case.

We're assuming that you'll be introducing beginners to astronomy. If you're a family of expert observers, you can probably manage without advice. On the other hand, if your observing sessions aren't as tranquil as you'd like, perhaps you can derive something of benefit.

What is Family Astronomy?

In Family Astronomy, the whole party should enjoy themselves, have a good time interacting with the family and come away looking forward to the next time. Unless your family regularly engages in Trivial Pursuit tournaments, avoid outpourings of facts. If everyone learns something, that's fine, but it shouldn't be the primary reason for being out under the sky. Family Astronomy is for sharing something you find interesting and having fun.

Although Astronomy is usually thought of as primarily visual, Family Astronomy requires a lot of listening. When beginners say they're ready to quit, take them at their word. If you suspect they're saying they are cold or tired due to boredom, you can try a different activity. Usually it's better to call it a night. Astronomy is normally interesting enough that beginners won't say they've had enough, unless they've really had enough.

Beginners need positive reinforcement when approaching new things. One father was initiating his 11-year-old into the wonders of the universe. The child took control of the telescope, quickly found a bright object near the horizon, and announced "I found Venus!" The father peered into the eyepiece and ruined his dark adaptation on a streetlight at 45x. He then spent some time impressing on the child how stupid it was to point a telescope at a streetlight, and how anyone ought to be able to tell the difference between a streetlight and Venus. Strangely, the child never seemed to show any interest in astronomy after that night.

Surprise played a role here, but things might have turned out better if, instead of emphasizing the child's shortcomings, the father had emphasized the positive. Imagine the child's reaction if the father had said "Well, it's not Venus, but it is a street light. It's in focus, and beautifully centered in the eyepiece. I'm sure you'll do just as well on the planets- let's find one together."

How to Get Started

One good way to start beginners is to make Family Astronomy part of other activities. Walks are particularly good for this. During walks at dusk or in the evening, look at the moon. Pick out the bright stars, and the constellations if they're visible. If you take

walks most evenings, watch the changing positions of the planets, particularly during conjunctions. Vacations are also good times for family astronomy. Trips to the beach or camping offer many opportunities for combining astronomy with other family activities.

Mythology forms a good basis for introducing astronomy to children (and some adults!). You can tell the stories, then go out and find the constellations. There are many Greek myths and legends concerning the heavens and they can be told during the seasons when the appropriate constellations are visible. Describe the labors of Hercules during the summer and the story of Orion during the winter. There are also myths and legends about the sky from other cultures as well. Most libraries have books describing American Indian legends, many of which deal with the sky. Your own family's heritage may include myths about the constellations. If you aren't familiar with them, it can be doubly interesting to look them up.

Activities for Family Astronomy

Following is a list of activities that can be good for Family Astronomy: watching moon phases, meteor showers, planetary conjunctions, lunar and solar eclipses; putting up glow-in-the-dark constellations in a bedroom; visiting museums, planetariums, and observatories. Also, making a telescope, calendars, attending star parties and the study of Paleoastronomy (learning about astronomy in ancient times) can be fulfilling. There are many more, but these will give you a place to start, and some ideas of where to go next.

Equipment for Beginners

If someone in your family shows an interest in Astronomy, but you don't already have lots of equipment, don't worry about it. Most beginners start with naked eye astronomy. Experienced observers may provide occasional access to equipment such as telescopes, charts, and so on. As new astronomers become more knowledgeable, they may acquire more equipment such as star charts and binoculars or telescopes. Be sure it's good equipment. Little will dampen one's enthusiasm more than working with inadequate charts or flimsy department-store telescopes with inferior optics.

If you're the expert providing the equipment and are worried about damage, treat it like a car. You wouldn't give your car to someone without a driver's license, or who knows only an automatic transmission if your car has a manual transmission. Always give beginners driving lessons and make sure they understand the do's and don'ts. Don't assume that anything is obvious: it may not be to someone else.

It's Not Like The Pictures!

One of the biggest sources of disappointment for beginning astronomers is color astrophotography. It's not that the photos are disappointing, but that there's so little available through most visual telescopes that can come anywhere near matching the intense colors and vivid details. There are two basic approaches to dealing with this, and they'll probably work best if they're combined.

The first thing is simply to describe ahead of time what they can expect to see. If that galaxy is going to look like an eraser smudge, tell them so, and describe why it does and the photos don't. Emphasize what is there to be seen: patterns and textures, stars that can and can't be resolved. Describe what the visible things mean. For example, explain how that bright blur is the unresolved core of M13, thousands of stars too close together to separate with the telescope.

The other remedy is to view objects which, although perhaps not as overwhelming as the photos, are sure crowd pleasers. Saturn is one sight that almost always wins *oohs*, even through small telescopes. Others include the moon's terminator, Jupiter and the Galilean moons, and the Ring nebula. There are many others, depending on what you are observing with, and who your audience is.

Concerning Children...

While adults may be able to postpone needs such as using the facilities or a snack, children (particularly the younger ones) usually can't. Children need to be kept warm and comfortable, to have food and drink available when they need it, and to have ready access to a bathroom (or potty for younger children). When children get sleepy, they need to have some place to sleep. Trying to keep them awake will lead to grumpy, over-tired children making constant demands on grumpy, over-tired adults.

Children tend to have shorter attention spans than adults do, so alternate activities need to be available. If the location and situation allow, activities such as firefly chasing, tag, or just running and jumping are good. Quiet activities such as simple toys, telling stories, and finger-games are always appropriate. Except with older children, an adult devoting full time to looking after the children is essential. If you don't have an "extra" adult willing to spend the entire outing supervising, another option is to designate (ahead of time!) shifts for looking after the children.

In Summary...

You can't really go wrong in Family Astronomy as long as you remember that Family comes first. Listen to what everyone is saying. Keep expectations reasonable (yours and theirs) and remember that sharing and being together are the most important things. The heavens have fascinated people for thousands of years, and, given a proper chance, they can do the same for your family.

References

Faber and Mazlish. ***How to Talk so Children Will Listen***. An excellent source for learning new ways to interact with family members.

Guy Ottewell. ***Astronomical Calendar***. For information about current astronomical events. Refer also to ***Sky Calendar*** in the ***NOVAC Newsletter***.

H.A. Rey. ***The Stars***. Excellent introduction to the constellations. Includes recognizable star patterns, brief discussions of mythology, and more.

For more mythology, ***Burnham's Celestial Handbook*** covers all the constellations, although briefly. ***Mythology***, by Edith Hamilton and Bulfinch's ***Mythology*** give more detail.

There are many sources of activities for Family Astronomy. Libraries have nature activity books. Teacher supply stores (e.g. Hammetts) have a larger selection. You can also check children's bookstores such as Imagination Station in Arlington or The Cheshire Cat in Chevy Chase.

Planetary Observing: Saturn 1993

by Thomas S. Parry

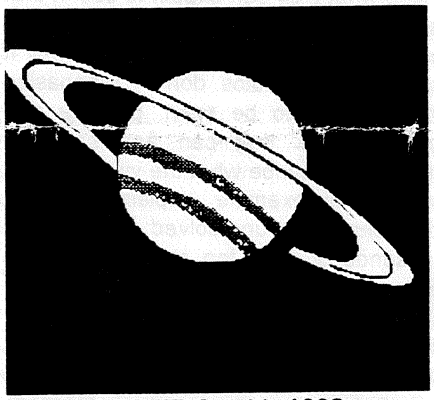
On several occasions this year, I've had the opportunity to show first-time viewers Saturn through my 14.5-inch reflector. On each occasion, the resulting exclamations of wonder reminded me of my first view of the ringed planet and my reactions. Even though my first look was through a 60mm refractor, I was spellbound by the majesty of the intricate ring system and my excitement is renewed each year as Saturn reaches opposition and puts on its best show as seen from earth.

You don't need a large-aperture telescope to see good detail on Saturn. A two-inch telescope will clearly reveal the ring system and hints of atmospheric belts and zones on Saturn's disk. A high-quality four-inch or larger instrument will resolve even greater detail in the ring structure and cloud belts.

Atmospheric seeing is a prime consideration in resolving any kind of planetary detail regardless of aperture or optical quality. This is why for so many observers Saturn is a visual challenge and may appear down right disappointing. On nights of poor seeing, small-aperture telescopes have an advantage over large-aperture instruments because they see through a narrower column of earth's atmosphere. Being patient and waiting for those nights of clear, steady seeing do pay big dividends and are worth waiting for particularly if you have a large-aperture scope.

Such was the case late last July while observing at Crockett Park. Still over a month from opposition, Saturn shone with a particularly steady brightness high in the southeastern sky. There was a fair amount of humidity in the air and the horizons were hazy. The zenith was clear and relatively transparent as was the area of sky around Saturn. I aimed the scope, put in my 22mm Panoptic at 75x and the planet appeared razor sharp! I decided to put in the 9mm Nagler yielding 200x and focused until the image snapped tack sharp. It was breathtaking! I could clearly see the Cassini Division (the gap between the A and B rings) as well as some shading within the rings. The A ring appeared noticeably dimmer than the inner B ring. Clearly defined dark belts and bright zones were visible on the planet's disk.

After a good amount of time just studying the details, I put in the 2x barlow with the 9mm Nagler to yield 400x. At first, the image seemed a little unsteady (suggesting that the atmosphere was not going to allow such high magnification) but I gave it some time and as the night wore on, pockets of steady air enveloped the region. Saturn was a spectacle to behold razor sharp at 400x! I have never seen it so steady with such incredible detail. At this point I could see the C ring (the crepe ring) traverse the front of the disk. It appeared unusually dusky and after several minutes I realized I was seeing the shadow cast by the rings on Saturn's disk *through* the crepe ring! Such an alignment of the crepe ring and shadow angle can create an optical illusion making it difficult to distinguish between the ring and the shadow. Details in the belts and zones were more apparent at 400x. There was even a hint of color within the divisions between darker belts and lighter zones.



Saturn 2:05 UT Oct 11, 1993
Sketched at 230x

Saturn's moons were also prominent on this occasion. The largest moon, Titan, is visible in a two-inch scope. It appeared very bright through the 14.5 inch. Also visible were the smaller, fainter moons of Dione, Rhea, Iapetus, Tethys and Enceladus. These smaller moons are very difficult to detect in telescopes of less than ten inches aperture. They can appear very close to the planet and are easily washed out by the glare from Saturn's disk. Exact placement of the moons relative to Saturn on any given night may be found in monthly issues of *Sky and Telescope* Magazine.

More recently, I set up in the backyard and did more observations of Saturn. This time I sketched the planet freehand at the eyepiece (see accompanying illustration). The seeing was not as good as it was that night in July so high magnifications were out of the question. The image included here was hand-drawn at 115x through the 14.5-inch telescope. Because the sketch was digitally scanned, much of the subtle contrast in the cloud belts and on the rings themselves was lost. The image is, however, true to form and shows the current tilt (about 13 degrees) of the rings.

Saturn reached opposition for 1993 last August and has been shining prominently high in the southern sky after sunset throughout the autumn season. Because Saturn reaches east quadrature November 13th, now is the best time to get out and observe it. When an outer planet is at quadrature, it is at a point in the sky 90 degrees from the sun from our vantage point on earth. When this happens with Saturn, the planet's shadow is cast starkly on the rings to the rear of the disk at an angle we can observe from earth (see sketch) and the rings passing in front of Saturn also cast a shadow across the planet's disk. These two shadow phenomena give Saturn a three-dimensional appearance through a telescope.

Another reason to get out and observe Saturn now is that the rings are tilted toward their maximum of 13 degrees for the year. Next year at this time, the rings will have closed to nearly five degrees and by 1995 will be *edge on* from our view on earth and for a period of time appear to disappear. The rings will not be visible at the present 13 degree angle or wider again until 1997!

As 1993 draws to a close, Saturn gradually edges its way toward a conjunction with the sun in early 1994. Take time now to enjoy the wonders of the ringed planet while it is conveniently visible in the early evening sky.

Reflections in the Eyepiece - Fade to White: The Loss of the Night Sky

by Robert Bunge

In today's economy it's hard to imagine a restaurant employee turning all of the water facets on before closing up for the night. Over the course of each night thousands of gallons of expensive, treated water would gush down the drain -- wasted.

It's hard to imagine a homeowner opening all the windows on cold January mornings before going to work. The natural gas furnace would run all day, burning cubic yards of an expensive irreplaceable natural resource – wasted.

It's not hard to imagine the builder of a new office building spending thousands of dollars installing a lighting system to protect the building's parking lot. The lights are lit every night until morning, even without an automobile to be seen. Lighting the parking lot is accepted without question even though it costs hundreds or thousands of dollars per year.

It's not hard to imagine a homeowner, worried about rising crime rates, going to a local hardware or discount store and buying an all night *security* light for $29.95. From dusk till dawn, the faithful light *protects* their property for about $70 per year. It makes the homeowner feel more secure, even though it produces glare and is uncomfortable to be around.

While the first two scenarios sound outrageous, the last two stories are accepted practice. Hundreds of thousands of office buildings are lit at night, and millions of homes have security lights hanging above the garage. But in reality, the differences are not so great. The vast majority of security lighting used in the United States is incredibly wasteful. David Crawford, the executive director of the International Dark Sky Association (IDA), says *It's easy to estimate – and one of our handouts does it – we spend way more than $1 billion a year in the United States alone, doing nothing except lighting the bottoms of birds*. One billion dollars a year wasted on inefficient lighting, and staggering amounts of fossil fuels burned, for no use.

What we are talking about here is light pollution – the unnecessary use of light. The root cause of light pollution is years of cheap electrical power combined with the natural human need to feel safe at night. The effect is the destruction of the night sky and the loss of an important part of our folklore, the historical sense of who we are in this universe, and an incredible waste of money and natural resources.

While light pollution has been around since before the turn of the century, today's climate of rising crime and aggressive sales by electric companies and lighting manufacturers have made light pollution worse than ever. For all practical purposes, there is nowhere east of the Mississippi river unaffected. On satellite photographs it is possible to trace the Interstate Freeway system across the country.

There are many different types of light pollution. It may come from a downtown building lit to attract attention, or a $29.95 175-watt mercury- vapor security light that is sold at almost any hardware store. Anytime light is allowed to escape into the night sky, light pollution is the result. The escaped light travels upwards in the atmosphere until it is reflected back toward the ground by tiny particles of dust floating in the air. We see this as a brightening of the sky, which astronomers call *skyglow*.

People living in cities are prevented from seeing any but the brightest stars and planets. Children may spend their entire lives deprived of a part of nature, unaware of the universe around them. They loose a part of their own culture as well as a looking glass into the future. More and more of our youngsters never learn even the basics about the sky. It's hard to get interested in astronomy when all you can see are the Moon and a few bright stars and planets. Star gazing is more often than not a child's first introduction to science.

While most children don't grow up to become professional astronomers, some children do become scientists, and it is often star gazing that first triggers their interest.

From the country, the skyglow of brightly lit cities can be seen from 30 miles away. Telescopes at observatories perform at only a fraction of their capability. For years, astronomers have located their telescopes on increasingly more isolated mountain tops to avoid the lights of humankind. But what happens when you run out of mountains, or can no longer afford to build new observatories? The hundreds of thousands of amateur astronomers are already running out of places to go to escape skyglow.

Light pollution is a true threat to astronomy. Professional telescopes cannot collect data as well as in the past. Multi-billion dollar facilities such as the National Optical Astronomy Observatory located on Kitt Peak in Arizona are becoming increasingly impaired as the sky brightens. At the Mt. Wilson Observatory near Los Angeles, the historic 100-inch Hooker telescope -- used by Edwin Hubble to discover the expansion of the universe -- has been mothballed, useless for many types of research because of light pollution.

There is a dark spot at the end of the tunnel, and things are slowly turning around. The IDA, under the direction of Crawford and amateur astronomer Tim Hunter, is organizing communities involved in the fight against light pollution into a force with which to be reckoned. It isn't too surprising that these communities include more than just the astronomers. *Professional lighting engineers know that there is a lot of bad lighting out there*, says Crawford about IDA members who light for a living. *We also have lighting companies, universities, observatories, astronomy clubs, people from the general public.* Others include environmentalists, naturalists who see overzealous nighttime lighting affecting insect populations, and community planners who are interested in attracting people to their communities with good lighting.

The primary focus of IDA's efforts is to encourage good lighting. *We don't want to turn the lights off*, Crawford says. *We advocate the use of better fixtures that put the light were it's needed. That helps save the sky, saves money and makes for a better nighttime environment.* If you own or rent a security light, take a minute to look at it. Does the lamp -- the part that actually produces the light -- stick down below the cover over the light? If it does, then you may be wasting light -- and money.

Better lighting can be accomplished by any one or combinations of several approaches.

Shielding: Perhaps the easiest and most effective use of good lighting, and rooted in basic common sense, shielding puts the light were you need it. Fixtures that don't allow light to escape upward are called *full cutoff fixtures*. By reflecting all of the light toward the ground, a lower wattage lamp can be used, saving the user money. Perhaps the most common type of street light fixture is called the cobra head. These lights, shaped like the head of their namesake snake, allow up to 20 percent of their light to escape and produce a lot of glare. *Shoebox* fixtures (normally dark brown, and becoming more numerous) direct almost all of the light

downward, but still provide a coverage pattern that allows them to be used along city streets.

The right type of lamp: The most efficient outdoor lights are Low Pressure Sodium lamps (LPS). LPS lamps shine with a deep yellow or dark orange color, whereas their more common but less efficient cousins, High Pressure Sodium (HPS) tends to look pink or light orange to most people. Unlike HPS, LPS lamps are monochromatic (emitting only yellow light) making it harder to see different colors under them. Therefore, it makes sense to use LPS in situations like all-night security lighting along a campus or city walkway, where color vision isn't as important.

Effective use of lighting: All too often home and even municipal lighting is poorly designed and installed, without much thought given to its desired effect. The results are glare, even dangerous, roads and highways on rainy nights, and often too-brightly lit suburban roads where the glare from poorly shielded cobra head fixtures makes the environment unattractive. The main point is simple: put the light were you need it!

The remedies are simple: Use glare-free full-cutoff fixtures, pick the best, most efficient light source for the job, and hire a high-quality light designer or consultant who is knowledgeable about light pollution and cares about good lighting -- not a fast buck and $29.95 light fixtures.

While both professional and amateur astronomers are interested in seeing more people and cities use low pressure sodium lighting (because they can filter out the yellow light without affecting the data they collect) Crawford and IDA suggest that a good solution is to push for full-cutoff fixtures and better education. Nonetheless, LPS should be attractive to homeowners and cities alike because it is affordable. A large city -- one with around 30,000 street lights -- will save more than $3 million a year after changing from HPS to LPS. In addition, an aggressive updating of street lighting will result in more savings as old mercury vapor lights are exchanged, and unshielded lights are replaced by full cutoff fixtures.

A typical street is lit with 200 watt HPS lamps. The HPS lamps, which each produce an average of 19,800 lumens (a measure of the amount of light) can be replaced with 135-watt LPS lamps that produce an average of 22,500 lumens. For each new LPS lamp installed, an average of 271 kilowatt-hours of electricity is saved and more light is put on the ground.

A homeowner switching their 150-watt incandescent porch light to an 18 watt LPS light will save close to $40 per year. The $100 cost of changing the light will be paid back in under three years. Perhaps the biggest drawback to LPS is that it is hard to find. Unless you live in an area where it is already used (mostly on the west coast and in Arizona) it may not be in local lighting stores. The best route may be to mail order lamps from lighting stores in Tucson, Arizona, where LPS is required by law.

If LPS is rejected due to its monochromatic light, full cutoff fixtures represent a major improvement, and are readily available across the nation. Even some hardware stores are starting to carry full cutoff security lights. If you have an old-fashioned (many were designed in the 1930s) 175-watt mercury-vapor lamp in your backyard, replace it with a full cutoff HPS fixture.

Even with the choices on the market today it is still a matter of educating the people who light streets, shopping malls, office complexes and houses. Education may well be the most important key to bringing back the night sky. The primary reason to light the night is for security. Though there is little if any direct evidence to link a decrease in crime with an increase in lighting, we feel safer when the area around our house, or the streets that we walk on are lit. No one is asking that the light be turned off, only that light is used properly.

Good lighting makes good sense. Aside from the efforts of groups like IDA, one of the best means for educating people is -- you. Talk to your neighbor with the bad light. Pass a copy of this article to people involved in lighting your street. Give a short presentation to your local officials. It is certainly among the best ways of educating the public in the *American* tradition.

Robert Bunge is an amateur astronomer who has been involved in educating the public about light pollution for the past several years.

NOVAC Notices

Discounts on Sky & Telescope Magazine

As a member of NOVAC you can get a subscription to Sky & Telescope for $20.00 instead of the regular $27.00 rate. To start a new subscription or renew an established subscription, make your check out to SKY & TELESCOPE for $20. Note on the check if this is a new subscription or a renewal. Send your check to Brenda Jones, 883 N. Kentucky St., Arlington, VA. 22205.

You can also order any publication directly from Sky Publishing at a 10% discount. Just mention the Club Discount Plan and that you are a member of NOVAC.

Discounts on Astronomy Magazine

Your NOVAC membership now entitles you to subscribe to Astronomy Magazine at the annual rate of $16.00. That is a significant discount over the usual $24.00 rate. A two-year subcription costs $32.00. To start a new subscription or renew an established subscription, make your check payable to KALMBACH PUBLISHING COMPANY for $16 (one-year subscription) or $32 (two-year subscription). Note on the check if this is a new subscription or a renewal. Send your check to Brenda Jones, 883 N. Kentucky St., Arlington, VA 22205. NOTE: There are no special 10% discounts offered on publications through Kalmbach Publishing.

Club Telescopes Available for Use

NOVAC makes available two six-inch (f-5) Newtonian reflectors for club members to check out free of charge and use for a limited time.

The first scope is a *Celestron model SP-C6* on a Super Polaris German equatorial mount and wood tripod. It will readily fit disassembled in any car and is easily transported and setup at remote observing sites. The scope comes with an *Orion Ultrascopic* 10mm and *Meade* MA 25mm eyepieces with 1.25-inch barrel sizes. If you are interested in borrowing this scope, contact Steve Bodner at (703) 243-1722 (until 10:00 P.M.) or leave a message on his answering machine. He will schedule a time for you to pick the scope up at his home. Steve resides at 1557 N. Danville Street, Arlington, VA 22201. You will need to show your NOVAC observing pass and leave a $500.00 security deposit to take the scope out.

The second scope is a home-made six-inch reflector on a dobsonian mount and comes with a 25mm Kellner eyepiece. It is easy to transport to dark sky sites and easy to use. If you are interested in borrowing this scope, contact Bob L'Hommedieu at (703) 978-0946. He will schedule a time for you to pick the scope up at his home. Bob resides at 4415 Eastwood, Fairfax, VA 22032.

You will need to take your NOVAC observing pass and leave a $250.00 security deposit to take the scope out.

NOTE: Checks must be made payable to NOVAC. Checks used for security deposits on telescopes ARE NOT deposited and will be returned to the originator when the scope is turned in. The scope may be checked out for two to four weeks at a time depending on demand.

1994 NOVAC Meeting & Observing Schedule

The schedule below lists the NOVAC General Membership Meeting and NOVAC Observing Schedule for 1994. The General Membership Meetings are held at the Arlington Planetarium on the third Wednesday of every month. Trustee Meetings are held on an *as needed* basis the second Tuesday each month. Non-Trustees interested in attending should contact a Club Officer or Board Member for further information. NOVAC Observing Sessions are held at C.M. Crockett Park in Midland, VA.

1994 NOVAC Monthly Membership Meeting and Observing Schedule

	Mtgs	Observations
January	19	7, 8, 14, 15
February	16	4, 5, 11, 12
March	16	4, 5, 11, 12
April	20	8, 9, 15, 16
May	18	6, 7, 13, 14
June	15	3, 4, 10, 11
July	20	1, 2, 8, 9, 29, 30
August	17	5, 6, 26, 27
September	21	2, 3, 9, 10, 30
October	19	1, 7, 8, 28, 29
November	16	4, 5, 25, 26
December	21	2, 3, 30

Crockett Park Site Rules

NOVAC members may use Crockett Park for observing on nights other than those scheduled for club observing; However, YOU MUST HAVE PRIOR APPROVAL FROM PARK MANAGER GARY KWOLEK. Call (703)-788-4867 early in the day on which you wish to observe. If you reach the answering machine, leave a message saying that you are a NOVAC member and you wish to observe that night. Also, leave a telephone number where someone can reach you. If you do not receive a return call, you MAY NOT use the park. THERE ARE NO EXCEPTIONS! Use of the park is limited to NOVAC members only. Park management locks the entrance gate at sunset and you may use the combination shown on your Observing Pass to gain access. Do not reveal it to anyone. You must lock the gate behind you after entering and please remember to lock it after you leave. During EDT, you must set up on the large field to the left of the park entrance. During EST, you must set up on the paved cul-de-sac 200 yds. past the gate.

No loud radios, alcoholic beverages or loose pets. Do not leave trash or debris behind. We are guests of the park and park management may revoke our observing privileges any time due to the carelessness of one person.

Directions to Crockett Park

From the Washington DC/Northern Virginia area, go west on I-66 to the 47-a exit. This is 234 South to Manassas. Continue on 234 for 2.8 miles then turn right on Godwin Drive at the "Po Folks" restaurant. Follow Godwin Dr. for 1.8 miles to where it merges with Rt. 28 West. Once on Route 28 continue driving for another 13.7 miles through the towns of Nokesville, Catlett and Calverton until you turn right on Rt. 643 toward Warrenton. There is a small country store (Mayhugh's) on the corner of the intersection. Go on about a mile up Rt. 643 to the Park Entrance road. Look for a small sign for C.M. Crockett Park on your right directing you to turn left. Once on the park entrance road, go one-half mile to the park gate.

Internet News

Hubble Servicing Mission Planned for December

The WFPC II optics were tested, and found to be properly aligned. In addition to replacing the WFPC II, astronauts are scheduled to replace faulty gyroscopes, jittery solar panels, COSTAR, a magnetometer, and the solar array drive electronics.

HRMS Cancelled

The official NASA SETI program HRMS was cancelled by congress for budgetary reasons. Famous science fiction writer Arthur C. Clarke is lobbying for its reinstatement.

Comet 1993a Brightens Slowly:

Comet Mueller (1993a) is scheduled to exceed 9th magnitude around November 5th.

NOVAC Newsletter is the official publication of the *Northern Virginia Astronomy Club* and is published six times per year at 12000 Vale Road, Oakton, Virginia 22124-2321, telephone (703) 758-8224, Thomas S. Parry, Editor. NOVAC Newsletter is sent to members of NOVAC as a regular membership benefit.

Membership in the Northern Virginia Astronomy Club is $18.00 per year and is open to anyone interested in astronomy or the sciences. Contact Brenda Jones, Treasurer, 883 North Kentucky Street, Arlington, Virginia 22205, telephone (703) 527-7963. All notices of change of address should be sent to Brenda Jones. Please include both old and new addresses.

While NOVAC does not knowingly accept advertising for products of inferior quality, neither does it accept the responsibility for the quality of such products.

NOVAC members are invited (and ENCOURAGED!) to contribute materials of interest for publication consideration in the NOVAC Newsletter. The editors, however, reserve the right to edit all materials submitted. Ideally, materials submitted for publication consideration should be sent on 3.5" or 5.25" floppy disks in ASCII text format. Other electronic formats are acceptable as well as double-spaced typed and letter-quality manuscripts. Contact the editors for details and/or possible electronic file transfer.

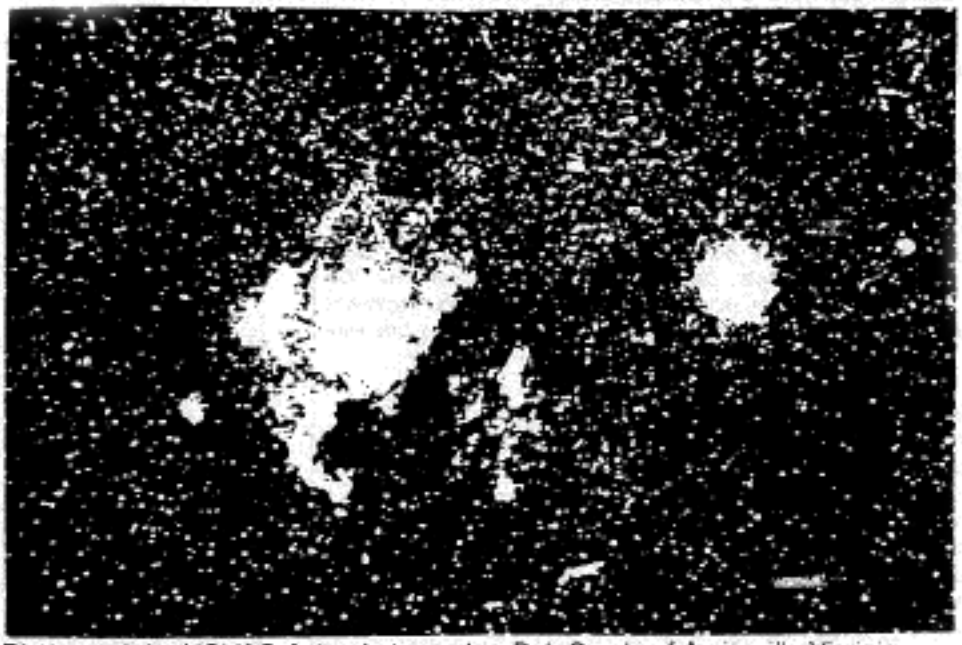
SPECIAL Note

Andre Bormanis moved to LA, and is now working as scientific consultant to *Star Trek: The Next Generation* and *Star Trek: Deep Space Nine*. He says we should be seeing his name in the credits starting with the new season in late September. He would be glad to stay in touch with anyone from NOVAC. His address is:

Andre Bormanis
1446 Butler Avenue, #6
Los Angeles, CA 90025

Images

The North America Nebula - NGC 7000



Photograph by NOVAC Astrophotographer Bob Sandy of Amissville Virginia

"Of all the duplications in nature, there is nothing more rare than seeing our continent adrift in a sea of stars."
Anonymous

NOVAC

The Northern Virginia Astronomy Club
c/o Brenda Jones
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Arlington, Virginia 22205