# CONSTELLATION

**The Official Publication of the Bucks-Mont Astronomical Association, Inc**

**VOL XVIII, NO 1/2** **JANUARY/FEBRUARY 2003** **Scott Petersen, Editor**



## *President's View*

## A New Year

Well Folks, it's time to make things happen! Your executive committee has a lot of exciting plans for BMAA. But we will need some help to bring those plans to life.

A few years ago, we had some nice, warm, hooded sweatshirts made. They were a big hit, so we're going to do it again. But we need someone to devote a few hours making this happen. There's a logo, but it may need a little updating. And we have a couple sources to choose from. Assistance is available from members that were involved last time, so this should just be a matter of a few phone calls. If you've done this kind of thing before, then your expertise may be helpful. And if you haven't, then this is an opportunity to learn something new.

One aspect of the club that we would like to improve is the 'New Member Experience'. We have been lacking a Welcoming committee for quite a while now, and I think new members have had a hard time getting involved as a result. So I'm looking for two people (perhaps one long time member and one not-so-long time) to revive the Welcoming committee, assemble a new member packet, and take charge of, well, making new members feel welcome. Again, there's history to draw from. So there's nothing to really be afraid of.

And then there's club promotion. We keep talking about keeping a stock of BMAA flyers in local camera stores, but we've only done it sporadically. All we really need is someone to compile and maintain a list of stores and members who can stop by with a pile of flyers. Stores need to be called occasionally, and arrangements need to be made with the members to obtain copies of the paper. Sounds pretty easy.

And let's not forget SDV. Our annual star party, which was a huge success last year, is in jeopardy! The executive committee decided that SDV would only be held this year if the man (woman) power can be guaranteed. Alan P has done a wonderful job delegating jobs for the weekend of SDV (each of which is typically a two-hour commitment or less). But a lot goes on in the months proceeding. There are brochures to create, copy and mail, and vendors, magazines, other club and web sites to contact. Oh, yeah, and food to order and pickup. The good thing is that all this work can be broken down into quite manageable chunks. So let's get a bunch of people to do one chunk each. A few people doing it all is not an option this year.

Ok, I could go on, but I think I've made my point. There's plenty to do, and the more of it we can do, the more fun this club will be. So let's see whom I hear from first.

Clear Skies

Antoine Pharamond
President, BMAA

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## Bucks-Mont Astronomical Association, Inc remembers the crew of Columbia

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**Wednesday, February 5 at 8:00p - BMAA General Meeting at Peace Valley**
**Wednesday, February 19 at 8:00p - BMAA Business Meeting at Peace Valley**
**The next BMAA General Meeting is scheduled for Wednesday, March 5 at 8:00p**

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**BMAA MESSAGELINE - 215/579-9973**
**website - http://bmaa.freeyellow.com**
***email – bmaa[at]bma2[dot]freeyellow[dot]com***

**Bucks-Mont Astronomical Association, Inc**
**2003 Calendar Of Events**
**StarWatch Chairman: Antoine Pharamond - 215/796-0684, *apharamond@comcast.net***
**Information Line - 215/579-9973**

| | | | | | |
|---|---|---|---|---|---|
| Jan | **8** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 25 | Sat | 7:30p | * | StarParty - Tohickon site |
| Feb | 1 | Sat | 7:30p | * | StarParty - Tohickon site |
| | **5** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| Mar | 1 | Sat | 7:30p | * | StarParty - Ed Radomski's Cooke Observatory. Chalfont |
| | **5** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 7 | Fri | 7:30p | | StarWatch - Tamanend Park, Southampton |
| | 12 | Wed | 7:30p | | StarWatch - Peace Valley Nature Center, Doylestown |
| | 27 | Thu | 7:30p | | StarWatch - Honey Hollow Nature Center, Solebury |
| Apr | **2** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 5 | Sat | 8:00p | * | StarParty - Tohickon site |
| | 9 | Wed | 8:30p | | StarWatch - Silver Lake Park, Bristol |
| | 11 | Fri | 8:30p | | StarWatch - Gwynedd Wildlife Preserve, Upper Gwynedd |
| | 23 | Wed | 8:30p | | StarWatch - Peace Valley Nature Center, Doylestown |
| May | 1 | Thu | 8:30p | | StarWatch - Honey Hollow Nature Center, Solebury |
| | 2-4 | Fri-Sat | | * | Camping StarParty - Hickory Run State Park |
| | 6 | Tue | 8:30p | | StarWatch - Cedar Hill Park, Horsham |
| | **7** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 9 | Fri | 8:30p | | StarWatch - Lower Nike Park, Warrington |
| | 10 | Sat | | | **ASTRONOMY DAY** - tba |
| | 29 | Thu | 9:00p | | StarWatch - Willard Markey Centennial Park, Perkasie |
| Jun | **4** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 6 | Fri | 9:00p | | StarWatch - Pennypack Trust, Huntingdon Valley |
| | 26 | Thu | 9:00p | | StarWatch - Peace Valley Nature Center, Doylestown |
| | 27-29 | Fri-Sat | | * | StarParty - Cherry Springs State Park |
| | 30 | Mon | 9:00p | | StarWatch - Green Lane Nature Center, Green Lane |
| Jul | **2** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 5 | Sat | 9:00p | * | StarParty - Tohickon site |
| | 7 | Mon | 9:00p | | StarWatch - Gwynedd Wildlife Preserve, Upper Gwynedd |
| | 10 | Thu | 8:30p | | StarWatch - Goodnoe's Restaurant, Newtown |
| | 24 | Thu | 9:00p | | StarWatch - Honey Hollow Nature Center, Solebury |
| | 30 | Wed | 9:00p | | StarWatch - Peace Valley Nature Center, Doylestown |
| Aug | 2 | Sat | 9:00p | * | StarParty - Tohickon site |
| | 5 | Tue | 9:00p | | StarWatch - Lower Nike Park, Warrington |
| | **6** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 8 | Fri | 9:00p | | StarWatch - Silver Lake Park, Bristol |
| | 22 | Fri | 8:30p | | StarWatch - Cedar Hill Park, Horshem |
| | 29 | Fri | 8:30p | | StarWatch - Green Lane Nature Center, Green Lane |
| Sep | **3** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 5 | Fri | 8:30p | | StarWatch - Tamanend Park, Southampton |
| | 24 | Wed | 8:00p | | StarWatch - Peace Valley Nature Center, Doylestown |
| | 26-28 | Fri-Sat | | * | Camping StarParty - Hickory Run State Park |
| Oct | **1** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 2 | Thu | 7:30p | | StarWatch - Silver Lake Park, Bristol |
| | 21 | Tue | 7:30p | | StarWatch - Pennypack Trust, Huntingdon Valley |
| | 24-26 | Fri-Sun | | | **STELLA-DELLA-VALLEY XVII** - Camp Onas, Ottsville |
| | 30 | Thu | 7:00p | | StarWatch - Cedar Hill Park, Horsham |
| Nov | **5** | Wed | 8:00p | | **BMAA Monthly Meeting** - Peace Valley Nature Center, Doylestown |
| | 21 | Fri | 7:00p | | StarWatch - Willard Markey Centennial Park, Perkaise |
| | 22 | Sat | 7:00p | * | StarParty, Tohickon site |
| | 25 | Tue | 7:00p | | StarWatch - Peace Valley Nature Center, Doylestown |
| | 28 | Fri | 7:00p | | StarWatch - Tamanend Park, Southampton |
| Dec | **3** | Wed | 8:00p | | **BMAA Holiday Meeting** - Peace Valley Nature Center, Doylestown |
| | 20 | Sat | 7:00p | * | StarParty - Tohickon site |

* StarParties are open to members and guests only.
StarWatches are free and open to the public.

For directions, visit the BMAA website http://bmaa.freeyellow.com or contact George Reagan at 215/741-3701 or george_reagan@hotmail.com. Please call the information line at 215/579-9973 before you leave for any event.

# ULTIMATE COLLIMATION: CHEAPLY!

*- by John C Deitz*

The autocollimation eyepiece is highly regarded as a very sensitive way to achieve collimation. The end-point of this procedure is easily recognized. However, the final stages of adjustment are difficult to judge and the observer finds it difficult to know just which adjustment screw to turn, and in what direction, to achieve perfection. Most of the time the last adjustment, until the field of view "lights up", is a hit or miss process. However, a simple, inexpensive modification greatly improves the process. This method allows the observer to continuously monitor the process as the adjustment screws are turned to tack toward perfection. That is, as adjustments are made the changing position of the images can be monitored during the entire process so that as each adjustment screw is turned its' effect is seen. Importantly, it is no longer necessary to hold the light source during the process. The process preserves the sensitivity of the autocollimation procedure (and actually improves on it) while removing the hit or miss nature of the older procedure. As a side benefit readjustment during the observing session no longer requires the observers eyes be flooded with the bright light of the typical hand held light source employed in the past.

In the simplest form the method requires only removal of the reflective surface of the primary mirror of the central 1-2mm and shining a flashlight through the back of the mirror! Looking through the autocollimation eyepiece the observer sees multiple reflections of the light source . The observer is free to leisurely adjust the primary until the reflected spots are coincident.

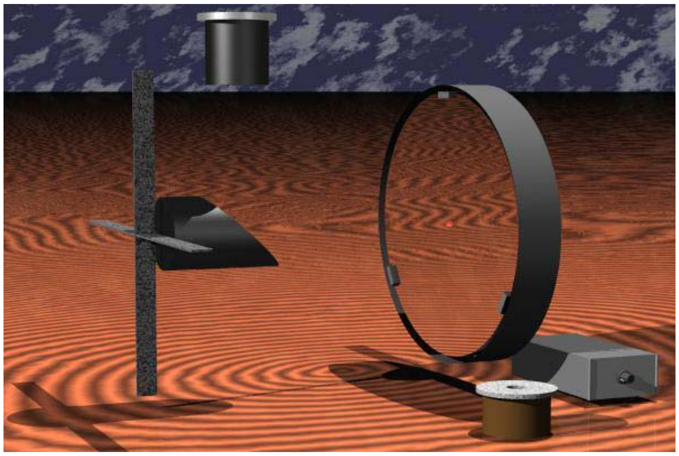

**ILLUSTRATION 1** A small diameter of a few mm of the primary's reflective coating is carefully removed from the exact center (using a pin or nail to scratch the coating).
A light source behind the primary, in this case a LED, provides an excellent source located at the center of curvature.

While the technique works well with a flashlight shining through the back of the primary, use of a light emitting diode with variable brightness control provides better contrast in a greater variety of lighting conditions. The author uses a set of two LEDs originally used for lighting setting circles and reading charts. A half-inch hole in the back of a wooden cell provides a temporary holder for one of the LEDs while the other light provides illumination to the adjustment screws.

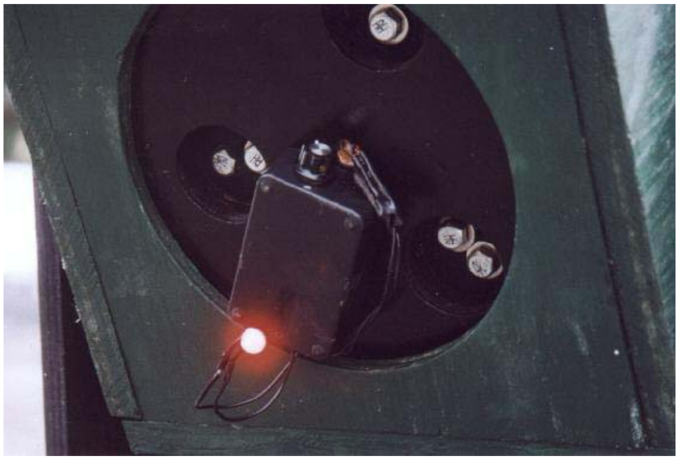

**ILLUSTRATION 2** A simple sighting eyepiece, followed by a Cheshire eyepiece can be used for initial rough collimation while a autocollimation eyepiece provides great sensitivity. The author uses a control box with two LEDs that double as general night illumination.

The process is aided by removal of any o-ring or paper reinforcer donut used to find the center as such targets hide the reflection during collimation. Initial alignment, with a simple sight-tube, is improved by this technique as well because the bright spot is much easier to see under a greater variety of lighting conditions than is possible with the donut target.

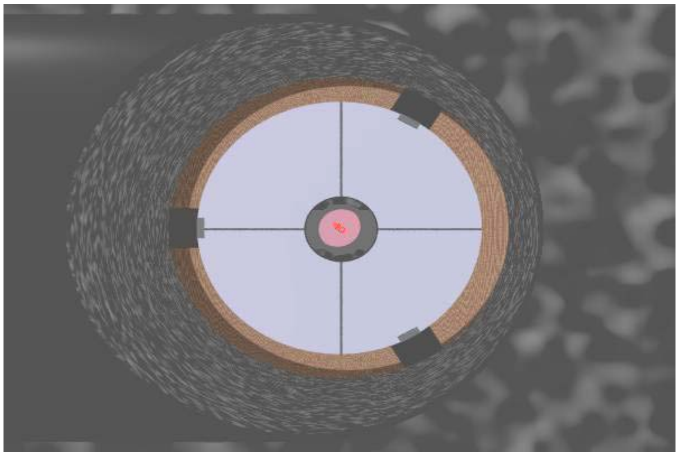

**ILLUSTRATION 3** Shown here is the view through the autocollimation when the authors' 8in F/5 is nearing collimation with an error 3 arcminutes.

- continued, next page –

So how accurate is the technique? In a word, plenty! It exceeds the conventional collimation method by a significant amount. Try this: after perfect collimation with this technique, misalign the reflections so that two spots are clearly seen. Now use the conventional penlight technique with the light held between the focuser and the secondary. You will find the second (conventional) technique to still show perfect collimation! Repeat the experiment with greater and greater error and you will discover the old fashioned method to continue to show perfection. The truth of the matter is this increased precision does NOT matter! The conventional method is plenty sensitive. The advantage to this method is not the accuracy but the ease of performing the task and being able to observe the entire process. Each change in mirror position can be seen. The observer quickly learns which adjustment screw to turn and in which direction to achieve perfection.

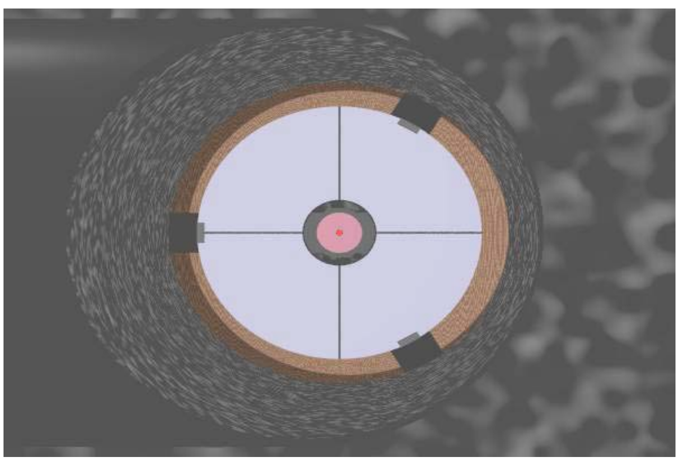

**ILLUSTRATION 4**

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*- BMAA member John Deitz provided this continuation of his series on collimation. [ -ed]*

***Observing for January***

# Some notes on seeing

***- by Bernie Kosher***

Before I start this column, let me mention a few things.

I will not be at the February meeting, as I will be in Chiefland with Brad Miller and ARod. So the answer to the puzzle will be next meeting. I imagine someone will get the correct answer before then.

I'm trying to scan some photos of the atmospherics of December 26, and will send them for posting to the web site. These are, as always, free to distribute or ignore as you please.

This month has been a spectacular one for the planets Saturn and Jupiter. They are both near opposition, thereby presenting their largest disk sizes. The rings of Saturn are almost fully opened, and the equatorial plane of Jupiter is presented to us square on. Thus the satellites are moving in straight lines and can mutually eclipse and occult each other.

Much detail can be seen on the planets. But there is always a 'however'.

Seeing this detail requires several things. We have control over some, but not all.

We have control over ....

a) the quality of our equipment, within a budget of course. This includes the scope and eyepieces.
b) our skill as observers. Do not expect to see at first look. The more you observe, the more you will see.
We have mentioned this often.
c) our location, within reason
d) the condition of our equipment, as far as cleanliness of optics, collimation, thermal equilibrium etc, within reason.
You may have troubles with temperature changes and the figure of the mirror.
e) various other physical and psychological conditions

We do not have control over the seeing other than to the extent we can relocate short distances to avoid local turbulence sources. If one is observing directly over the path of a backyard barbecue grill, which is in use to cook the steaks, then one suffers the massive effects of rising and distorted air currents. This is silly, of course, but can be instructive as we see the effect of these currents on a large scale. The same effect is seen looking over the heat waves from a chimney, an auto engine that is still hot, a driveway radiating away the heat of the day or any other local source of heat.

Sometimes we can limit the effects of this local seeing by simply moving the scope to a different place in our backyard.

Let us differentiate seeing and transparency right now. Seeing and transparency do not necessarily go hand in hand. Seeing refers only to the stability of the image, and not to the faintest stars visible. Transparency relates to the faintest limiting stars visible. However, and this is a considerable however, stable air, even if somewhat hazy, will allow faint stars to be seen as the light is all concentrated in one place and not smeared over several arcseconds of space. Faint nebulosity may be lost in slightly hazy skies, but faint stars may still be visible. This is very noticeable on Saturn's moons. I have seen Saturn's moons on hazy nights, but some of those moons may be invisible on clearer nights if the air is very turbulent.

Here's a bit of my experience with seeing.

During the current opposition of Saturn, I have looked as often as I could find time even if it was very cold. This is usually not a good time to observe fine planetary detail. Why? Simply, turbulent air.

On some nights of very clear sky, the image of Saturn is so smeared, I could not even keep the Cassini division in sight for more than a few seconds.

By removing the eyepiece and looking at the bright disk of the focal plane, one can see the turbulence of the air. The turbulence is caused by layers of air at different temperatures. Since air has a low, but measurable, refractive index, it follows that warm and cold air will bend the light differently. Since the path through the air is a maximum at low planetary elevations, it also follows that the differential refraction will be at a maximum when the planet is low in the sky. It also follows that when and if the planet is directly overhead the effect will be at a minimum; not only due to less air path, but also due to the light not being shoved in different paths. So even on nights of poor seeing the planet will give much better views when high in the sky.

Referring again to the scope used without an eyepiece....

Find a bright target, either bright star or planet. Carefully watch the flickering of the image. You will see it do several things. If the edge is noticeably rippling and the rippling is fast, the chances are the seeing is caused by distant air currents and is out of your control. If the rippling and distortion are slow, the currents are likely generated in the scope or nearby.

Place your hand in the light path and watch the fascinating and ever changing swirls of rising heat waves! Cold nights are best for this. From this, one can see that a reflector should have it's light path shrouded either by a tube or cloth, and one should not stand so as to have the body heat wafting across the mouth of the tube. The observer should arrange that exhaled breath does not waft across the tube (try it on the same test).

The rising heat waves from the area are worse nearer to the ground. Since the lower (mirror) end of a Newtonian is near the ground, it follows that the rising currents will cross the light path in an open tube scope. It may be illuminating to drape a cloth around the lower end and re-observe the image. Some scopes seem to work better with open tubes, some closed. Certainly, an open tube gets rid of its heat quicker, but may be troubled by heat waves from the ground, the mount or the observer.

I have seen some turbulence effects that were very hard to explain. IN one instance, while observing the moon, I watched two lines move across the visible area. These lines were extremely blurring, and seemed to have no relation any nearby heat source. The duration of the lines was several seconds, after which the seeing improved quickly. It turns out they were caused by jet airplane exhausts passing not far from my target.

Another source of bewilderment was "Why does my sky to the due south almost invariably have bad seeing?". that direction should be my most stable seeing, as it is over perhaps a few hundred yards of houses then a huge swamp area called Roebling Park, and then the Delaware River.

I later realized I was setting the line of sight directly over the Mercer County power generating station about 1/2 mile away.

Heat waves have a length of about 4 to 12 inches. Due to this, a small scope will have only one or part of one wave. The image will seem to move physically up and down in the field but not be too badly distorted. In a 10 inch or larger, the path is through several waves and the image position will be steady but blurred.

There is much more to this, but I'm tired or typing.

* * * * * * *

*- BMAA member Bernie Kosher provides the monthly 'Tips' column. [ -ed]*

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The *CONSTELLATION* is the official publication of the Bucks-Mont Astronomical Association, Inc, a 501(c)3 non-profit organization incorporated in the Commonwealth of Pennsylvania and exists for the exchange of ideas, news, information and publicity among the BMAA membership, as well as the amateur astronomy community at large. The views expressed are not necessarily those of BMAA, but of the contributors and are edited to fit within the format and confines of the publication. Unsolicited articles relevant to astronomy are welcomed and may be submitted to the Editor.



**Submission deadline for articles is the 15th of the month prior to publication**.

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# Frisbees in Space

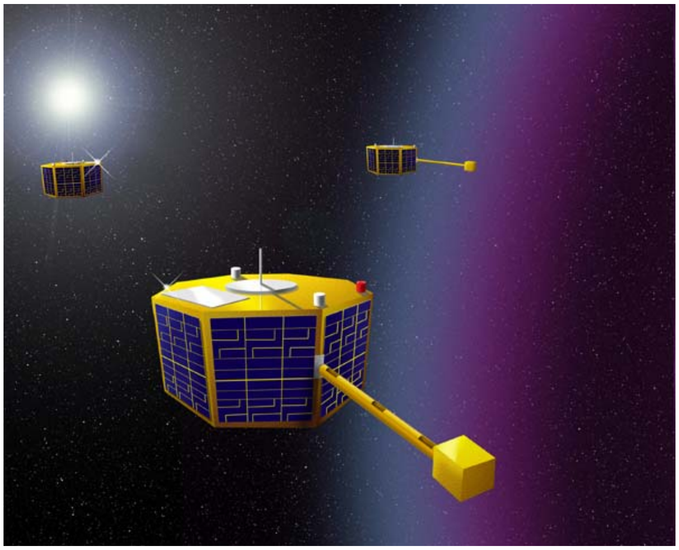
***- by Dr Tony Phillips***

When Pete Rossoni was a kid he loved to throw Frisbees. Most kids do - it's pure fun. But in Pete's case it was serious business. He didn't know it, but he was practicing for his future career in space exploration.

Grown-up Pete Rossoni is now an engineer at NASA's Goddard Space Flight Center. His main project there is figuring out how to hurl spacecraft into orbit Frisbee-style.

The spacecraft are small, about the size of birthday cakes. "This wouldn't work with big satellites or heavy space ships like the shuttle," notes Rossoni. But a cake-sized "nanosatellite" is just right.

Nanosatellites - nanosats for short - are an exciting new idea in space exploration. Ordinary satellites tend to be heavy and expensive to launch. The cost alone is a deterrent to space research. Nanosats, on the other hand, can travel on a budget. For example, a Delta 4 rocket delivering a communications satellite to orbit could also carry a few nanosats piggyback-style with little extra effort or expense.



"Once the nanosats reach space, however, they have to separate from their ride," says Rossoni. And that's where Frisbee tossing comes in.

Rossoni has designed a device that can fling a nanosat off the back of its host rocket. "It's a lot like throwing a Frisbee," he explains. "The basic mechanics are the same. You need to impart the spin and release it cleanly - all in about a tenth of a second." (The spinning motion is important because it allows the science magnetometer to measure the surrounding field and lets sunlight to play across all of the nanosat's solar panels.)

The ST5 nanosats are designed to study Earth's magnetosphere-a magnetic bubble that surrounds our planet and protects us from the solar wind. But their primary goal, notes Rossoni, is to test the technology of miniature satellites.

"We haven't done anything like this before," says Rossoni. Soon, however, the concept will be tested. A trio of nanosats is slated for launch in 2004 on the back of a rocket yet to be determined. The name of the mission, which is managed by JPL's New Millennium Program, is Space Technology 5 (ST5).

Can groups of nanosats maintain formation as they fly through space? Will their internal systems-miniaturized versions of full-sized satellite components-satisfy the demands of both the harsh space environment and critical science measurements? Is Frisbee-tossing as much fun in orbit as it is on Earth?

* * * * * * *

ST5 will provide the answers. Read about ST5 at http://nmp.nasa.gov/st5. Budding young astronomers can learn more at http://spaceplace.nasa.gov/st5/st5_tortillas1.htm

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

# Reflections.....a bit of a puzzle

***- by Bernie Kosher***

While driving home from the last meeting, I looked across the Delaware River from the NJ side toward the PA side. The river surface was fairly calm and the reflection of lights from a sports field was clearly seen in the water.

Direct vision showed three sets of lights at the same height. However, the reflection in the water showed only two sets of lights, in this case the outer two. The center set of lights did not exist in the reflection! What the hey?

Refer to the somewhat crude drawing. I was looking about due west. The time was about 10:45p. Clear sky. The only trees were out of the line of sight. The ground of the field was level (it's hard to play soccer on a field that's way out of level) and the light posts later turned out to be the same height.

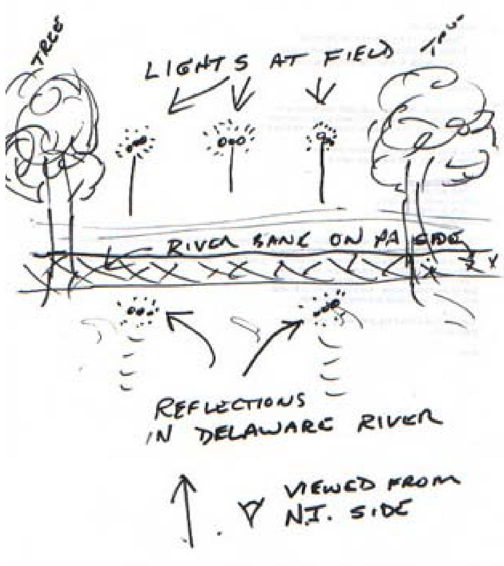
No, Virginia, the following are not the causes.....

a) the river bank at that point was flat and level, no rises or dips
b) not blocked by a tree, automobile, stage coach, low flying blimp or other obstacle
c) no ground fog or smoke from a fire....no obstruction of any kind
d) the lights were not supernatural or lycanthropic, so there
e) UFO? I don't think so.
f) not a trick question or setup, nor was I stoned

The explanation, once known, is obvious and for real.

You win absolutely nothing for the correct answer.

BK



***Observing for February***

# Atmospheric phenomena.........solar halos

***- by Bernie Kosher***

At the January meeting, I spoke about a display of atmospheric phenomena, which occurred December 26 at about 9:00a EST. In particular, the display consisted of a solar halo and the parhelic arcs.

The weather was cold and somewhat hazy, with streaky high clouds (cirrus?.....I am not sure, perhaps someone who saw the pictures is more knowledgeable and can help me out here). The sky was a medium blue between the wisps..

I was on my way between calls when I noticed the intensely bright halo, and then the rainbow hues of the parhelia. {Note: the parhelia are commonly referred to as 'sun dogs'} I found a field with a fairly clear horizon and set up my camera on a tripod. Not having any idea how long an exposure to take, I shot a roll at various speeds and f/stops, using a 50mm and 28mm lens. Fortunately, the shots came out well. I believe the best combo was 1/250th second at f/8. The sky looked too dark, but this showed the display best.

So what caused this lovely scene?

First, it's necessary to cover some basic optics and weather. We will be concerned with refraction and not reflection, and the ray path through ice crystals.

The upper atmosphere, even on warm days, is very cold. If the conditions are right, ice crystals of various sizes are formed. These are not the same thing as snow flakes, which are familiar to all from photographs as six-sided, flat, filamentary figures with the six sides actually formed by arms extending from the center. Ice crystals are also six sided but are hexagonal solids. Some are thin relative to the width of the hexagonal face and are referred to as 'plates', while others are thick and are called 'pencils.' In fact, these thicker crystals look just like a cross section of a regular lead pencil. It's the plates with which we are concerned.

These crystals are clear and colorless if pure. Some are deformed from slight melting or clumping, but herein we assume all are perfect. A bit of aerodynamics......the floating crystals tend to lie flat. Indeed, they are actually oriented all different ways, but statistically more are falling with maximum drag, in the flat face first orientation. This will be become important in our talk.

As we know from our basic optics, a ray of light striking a surface will suffer both reflection and refraction. The refracted ray bends upon entry, and also upon exit. It also suffers dispersion, or spreading, of the white light into colors. This is the familiar prismatic effect.

In our case, we are speaking of the refracted rays only. In future articles we'll talk about some reflection effects and the rainbow.

With the basics understood, here's the explanation for the halo.

Ice crystals, specifically the plate form, are falling from great heights. We are looking toward the sun, visible through the haze and wispy clouds. The sky is mostly a pale blue. Surrounding the sun is the '22 degree' halo, so called, as its radius is 22 degrees with the sun centered. We notice the inside of the ring of light is sharply defined while the outer fades insensibly into the haze. Closer inspection shows the inner part of the ring is reddish. Outside of the reddish the color is mostly whitish to gray. On the ring and about level with the sun itself are two brightenings, which also tend to show extensions away from their source and bend very slightly upward.
The sun’s altitude is about 25 degrees, and theory tells us the arcs are just slightly below the sun, and the halo is slightly flattened at the bottom. This is an effect of atmospheric refraction, and does not enter our talk. More info can be found in the literature.

Since the rays of the sun are pretty much parallel at our distance, the light rays striking the edges of the hexagonal crystal are parallel and are refracted at the same angle. Let's pick the greenish ray at about 5555 angstroms (555nm....about 22 millionths of an inch) wavelength. Knowing the refractive index for ice and air,

- continued, next page -

one can calculate that the rays striking the flat falling crystals edgewise at 22 degrees from the sun will be bent toward the observers eye. Therein the light will be increased at that distance from the sun. Since the sun is surrounded by crystals, the light is intensified FOR THE OBSERVER at these points and there will be a halo of 22 degrees radius.

The refractive index for red is somewhat less, so the rays are deviated less, giving us the inner ring of about 20 degrees radius. The other colors of the visible spectrum are more washed out and far less noticeable. This is due to randomly oriented crystals deviating light to our eye.

If all the falling crystals were oriented flat side down the halo could not exist. Due to the more random nature of the orientations, the crystals at 22 degrees from the sun refract the rays to the observer if their tilt is correct. The efficiency becomes less as one looks up or down from the sun, as one is getting less of the refracted rays.

The parhelia (sun dogs: also called false suns or mock suns) are intensification's at the apparent altitude of the sun touching the 22 degree halo. These are brightenings due to the increased number of rays thrown at the observer due to the larger number of flat side down crystals in the plane of the observer/sun. The colors are more intense for the same reason. Since they are brighter they are more easily seen against the grayish blue haze.

For accuracy's sake, the parhelia move away from the halo at greater solar altitudes.

There are many more atmospheric effects. Circumzenithal and circumhorizontal arcs; the arcs of Lowitz and Parry; antisuns and pillars, 46 degree haloes and a host of others. Many of these are rare. However, haloes and sundogs are common. One simply needs to look up, especially of the sky is streaked with high thin clouds on a cold day. Some of the persons I've talked to claim the most intense and varied phenomena occur on nearly clear days.

Sundogs also can be seen in clouds as brightenings at about 22 degrees from the sun, and frequently exhibit rainbow colors. Very common.

A point of interest.

The halo I see around the sun, just as with a rainbow, is mine alone. The one you see is from a different set of crystals. Really.

If there is interest in atmospheric phenomena, I'll ramble on about rainbows next time.

The science of astronomy covers a lot of fields, and this is related. One could argue that 'astronomy' refers to the stars alone, as 'astro' is from the Greek for 'star'. Well, then, let's also quit observing nebula, comets, meteors, the moon and planets.

Suggested readings, which are also the sources of my info: (much of the reading is mathematical in some sections, but it is not necessary to understand the cause to enjoy the beauty. The Greenler book has some fantastic photos)
Minnaert, "The Nature of Light and Color in the Open Air", Dover Publications, 1954
Greenler, "Rainbows, Halos, and Glories", Peanut Butter Publishing, 1999
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*- BMAA member Bernie Kosher provides the monthly 'Tips' column. [ -ed]*

*__NASA Space Place__*

# Invisible Tornadoes

***- by Tony Phillips***

The biggest problem with tornados-next to the swirling 300-mph winds-is that it's hard to see them coming.

But soon scientists will be able to foresee, not merely tornados, but the severe storms that spawn them, hours before there's even a cloud in the sky! Mind you, this isn't a vague "30 percent chance of rain today" type forecast. Thanks to a new satellite technology being co-developed by NASA, NOAA and the U.S. Navy, emergency personnel will actually watch the invisible beginnings of a storm unfold.

"They're going to know where the storm centers are forming before the storms are there," says James Miller, project manager for Earth Observing 3 (EO3), a satellite that will test out this new technology in 2005 or 2006.

Unlike the tiny water droplets that make up clouds, the water vapor that feeds storms is invisible to the human eye. Water vapor is easy to detect, however, at infrared (IR) wavelengths. EO3 will use an IR-sensitive device called GIFTS-short for Geosynchronous Imaging Fourier Transform Spectrometer-to make 3D movies of temperature, pressure, and water vapor in Earth's atmosphere.

Three or four hours before the storm clouds are visible, meteorologists will notice water vapor converging toward an area. This water vapor, which provides the "fuel" for the coming storm, is too close to the ground for today's weather satellites to see. Then meteorologists will check precisely how the air temperature over that area varies vertically (something else ordinary satellites can't do). This temperature variation determines whether the humid air will rise to form storm clouds. And when these conditions look ominous, the meteorologists can alert the public.

The goal of EO3 is to "test drive" this new technology and prove that it works. If successful, NOAA plans to incorporate GIFTS-style sensors into its next generation of weather satellites.

These future satellites will give meteorologists exactly what they need in order to give the people exactly what they need: an earlier warning that tornados may be on the way.

GIFTS and EO3 are managed by NASA's New Millennium Program. NASA and NOAA will operate EO3 during its first year in geosynchronous orbit above the United States. If the technology works as planned, the U.S. Navy will assume control of EO3, move the satellite to a point above the Indian Ocean, and use it to monitor weather in shipping lanes there.

This severe tornado hit south of Dimmitt, Texas, on June 2, 1995.

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For adults, the EO3 web site at http://nmp.jpl.nasa.gov/eo3 has more about the mission and the GIFTS instrument. For children, The Space Place web site at spaceplace.nasa.gov/eo3_compression.htm has a jazzy, interactive "squishy ball" demo of the data compression methods that will be used on EO3.

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