



# NOVAC

THE NEWSLETTER OF  
THE NORTHERN VIRGINIA  
ASTRONOMY CLUB

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## Astronomy Day 2014 at Sky Meadow by Zack Panitzke



PHOTO BY ERIK HEITFIELD

See more photos on page 2.

What do you get when you combine fascinating science, engaged volunteers, and beautifully clear skies? A success the likes of this year's Astronomy Day! If you made the trip to Sky Meadows on May 31, you already know about the crowd—by official park estimates, attendance was well over 600.

The day began with presentations on a wide variety of astronomical topics, from the historical to the theoretical to the amusing; frying pan or moon? Volunteers showed the public details of the sun that many had never seen before. A member of SARA was on hand to demonstrate his radio telescope. In the meantime, kids marveled at the expanse of our solar system, built and experimented with their own astrolabes, and tested their knowledge of space to take home prizes.

As the sun set and the stars came out, the moon presented a very thin crescent, complete with a full disc well lit by Earthshine. Jupiter, Mars, and Saturn were crowd favorites, of course, but many scopes presented great views of deep sky objects. Every telescope had a line waiting to take in the view it offered. And well they should—the skies were excellent for nearly the entire night. Even through the usual eastern sky glow, the Milky Way rose and presented itself.

When I finally left the observing field at 4:15 am, two others remained, alternating between imaging and napping. Thanks to everyone who made this event a great success! ★

## Astronomy Day 2014 at Sky Meadow *Continued from p. 1*



PHOTOS BY ERIK HEITFIELD



*NOVAC Members numbered over 100 and had set up more than 50 telescope and 25 pairs of binoculars for others to look through. Thanks to Zack Panitzke, NOVAC volunteers, and Sky Meadows staff for running a smooth event for all to enjoy!*

# NOVAC

The *NOVAC Newsletter* is the official publication of the Northern Virginia Astronomy Club and is published quarterly. The *NOVAC Newsletter* is available to members of NOVAC as a regular membership benefit.

## Membership

Membership in the Northern Virginia Astronomy Club is \$35.00 per year and is open to anyone interested in astronomy or the sciences. Additional memberships at the same address are \$10.00 per person. Membership in the Astronomical League is free with NOVAC membership and includes the *Reflector* magazine plus access to their Observing Awards.

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## Submissions to the newsletter

NOVAC members are invited to submit articles for publication in the *NOVAC Newsletter*. The editor reserves the right to edit all materials submitted. Send article submissions to the Editor, Chris Lee, at newsletters@novac.com.

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## The 3rd USA Science and Engineering Festival

by Harold A. Geller

In April, I had an opportunity to participate in the 3rd USA Science and Engineering Festival. I also had participated in the first two festivals in Washington, DC. For the first Festival, which took place outdoors on the Mall in 2010, I represented George Mason University (GMU). I also represented GMU at the 2nd Festival in 2012, which found its way into the Washington Convention Center.

For the 3rd Festival, which took place on the 25th, 26th and 27th of April, I was working for the NASA/JPL planetary group which focuses on Mars. This is most appropriate as Mars was the focus of my master's degree thesis, and I still discuss Mars quite a bit as part of my outreach duties as a Solar System Ambassador.

Due to prior obligations for the weekend, I offered NASA/JPL to assist on Friday the 25th which was the day that the Festival was opened only to school groups who had made prior arrangements to visit the Festival.

I took the Virginia Rail Express that morning to L'Enfant Plaza where I hopped on MetroRail to complete my trip to the Conven-

tion Center. NASA/JPL had a number of people come to the Convention Center the day before to do most of the setup. When I arrived to the proper area, I knew I was in the correct area as I was greeted by a large panorama of the surface of Mars, and a model of the Mars Rover Curiosity.

I took a photograph of the Mars panorama, but I wasn't certain as to how it would come out in the photograph as the panorama was being displayed in the 3-D mode, where you need those funny looking glasses with one lens colored blue (for the right eye) and the other colored red (for the left eye). On the Convention Center floor the panorama is about 8 feet by 30 feet, and it does look impressive through those funny looking glasses. Anyhow, my photograph of the Mars panorama is here, and if you have those 3-D glasses, give it a try. Of course it's not

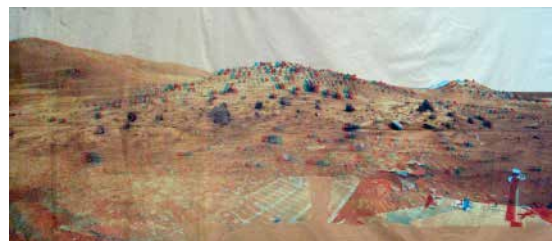


Photo of the Mars panorama

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## Upcoming NOVAC Meetings

**July 3**  
Topic &  
Speaker TBA

**Aug. 10**  
Topic &  
Speaker TBA

**Sept. 14**  
Topic &  
Speaker TBA

Monthly meetings are normally held at 7 p.m. on the second Sunday of each month (except for the month of May, when the meeting is held on the first Sunday) in Room 163 of the Research Building on the campus of George Mason University. More info at [www.NOVAC.com](http://www.NOVAC.com).



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# A Conversation With... Mary & Sarah Jimenez

*Club member David Werth interviewed sisters Sarah and Mary Jimenez*

As a regular part of the NOVAC Newsletter, we present question and answer interviews featuring some of our clubs' notable members who will share their thoughts on different aspects of our mutual interest in astronomy. Not all the stars are in the sky... There are two bright young stars within our own club.

**NOVAC:** Mary and Sarah. How did you get interested in astronomy?

**Mary:** Well, I always loved learning about it in school, and the love grew when my dad introduced me to NOVAC.

**Sarah:** I always loved astronomy ever since we learned about it in second grade!

**NOVAC:** What do you like the most about observing?

**Mary:** I like the fact that I always have something new to see, and I love it when I find what I'm looking for. That or just learning new things!

**Sarah:** I love looking at all the nebulae, galaxies, and generally everything in outer space. I like to be able to look up to the sky and gaze upon its beauty.

**NOVAC:** Do you see this as a hobby that will stay with you as you grow older?

**Mary:** Yes! Currently I hope to pursue a career somewhere in the astronomy field.

**Sarah:** I think it will definitely stay with me as I get older because I am fascinated about what goes on in space.

**NOVAC:** With busy school schedules and other activities how do you



Mary 1 Jimenez



Sarah Jimenez

manage your time to include observing and working on certifications?

**Mary:** Weather permitting, I try to observe every weekend on Fridays and Saturdays. When I get out there and once it gets dark, I start to knock out my list of what I need to find!

**Sarah:** We normally head out on Fridays or over weekends; so then other activities don't get in the way. If something is happening during the evening, we may go star gazing another night.

**NOVAC:** Have you been able to share your interest in astronomy with your friends?

**Mary:** No, not really, I have mentioned it before, but I don't think that they share the same level of interest as I do.

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The 3rd USA Science and Engineering Festival *Continued from p. 2*



Model of the Mars Curiosity Rover



8-wheeled rover—developmental model for final Curiosity Rover



Harold Geller in NASA space suit



NASA/JPL engineer, Preston Dyches (Left) talks to NASA administrator Dr. Charles Bolden about power generators

as impressive as the full panoramic image, but it appears to work for me.

Another picture I had to take was that of the model of the Mars Curiosity Rover. Although it is only a model, it still sparks the imagination to consider what it is like for that rover to quietly inch across the Mars terrain with no living creature watching it.

As I was especially early, and my NASA/JPL contacts were nowhere in sight, I had ample time to wander about the NASA display at the Festival in the Convention Center. I could not resist stepping into the space-suit that NASA had on display. I managed to get a NASA employee from Marshall Space Flight Center to take a picture of me in the spacesuit. You can see from the picture that I was dwarfed by the launch vehicle nearby and the overall dimensions of the NASA display. Hey, I was just having some fun before the schoolchildren crowds hit the floor.

Joey Williams of NASA/JPL was my contact at the Festival, and when he came to the floor, he instructed me on how I would be demonstrating the 8-wheeled rover, which actually was a developmental model used in the design for the final Curiosity Rover design. You can see from this picture of the rover I was controlling, that it was a very simplified version of the Curiosity Rover.

As NASA/JPL engineers had learned, the feature of the model rover which the public loved was that you could control its motion to roll over human children lying on their tummies. I can tell you that it was

a very big hit that Friday at the Festival.

However, before the Festival floor doors were opened, the NASA exhibit area had a surprise visit from the NASA Administrator, Dr. Charles Bolden. Bolden had been a general in the military, but I found that he was very approachable. He first spoke to NASA/JPL engineer Preston Dyches, who was there to highlight the radioisotope power generators which had to be used on all interplanetary probes. After all, solar power decreases as the square of the distance from the Sun, and so for a spacecraft at the limits of our Solar System, you can't rely on solar panels for spacecraft power. I took this picture

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# New Facts Change Theories about Star Clusters

By C.C. Petersen

One of the things I like about science is that the story is never finished. It's a story of continual change and learning. Ongoing research in any realm of science brings new answers to old questions and raises new questions as we refine our methods and techniques. This is why we often hear that scientists have changed their views on some topic. It's almost always because new data are available, or new instruments allow them to probe their topics of study more deeply. In true and honest scientific research, the changes in data aren't arbitrary or made to fit some political or business agenda. They're always because we found a better way to learn about our topics.

Take star clusters, for example. These are groupings of stars that formed about the same time in a massive cloud of gas and dust. Astronomers could tell that the stars were of similar ages when they measured their temperatures, brightnesses, metallicities (essentially, their chemical makeup), and velocities through space. However, the sequence of starbirth in a cluster wasn't really well understood.

For a long time, astronomers assumed that stars formed in clusters in giant clouds and that as more material got pulled into the central region of the star-birth crèche, more stars would form in that region. Those stars were assumed to be the oldest and the stars elsewhere would be younger. It sounds logical, but it turns out that it's not what happened.

Astronomers using the Chandra X-Ray telescope orbiting Earth looked at two clusters where sun-like stars are in the process of forming. One cluster is in the center of the Flame Nebula and the other is in the Orion Nebula (both in Orion). By looking at them in x-ray wavelengths,



*A new study of NGC 2024 and the Orion Nebula Cluster show stars on the outskirts of these clusters are older than those in the middle.*

IMAGE CREDIT: X-RAY: NASA/CXC/PSU/K.GETMAN, E.FEIGELSON, M.KUHN & THE MYSTIX TEAM; INFRARED: NASA/JPL-CALTECH

astronomers were able to calculate the ages of the stars in the clusters. It turns out the youngest stars are in the center and the older ones are in the outskirts. This has some implications for cluster development, but also means that astronomers will need to work some more on refining the models of how stars like the Sun form

The astronomers in the Chandra study, led by Konstantin Getman of Penn State University, used the Chandra data to look at the brightness of the stars in x-rays, which helped them determine the masses of those stars. They also used observations of the same stars in infrared light conducted by ground-based telescopes and also from data collected by the infrared-sensitive Spitzer Space Telescope. All that data combined helped them pinpoint the ages of the stars quite accurately.

So, stars in clusters are older in the suburbs of the cluster, and younger in the "downtown" regions. How might that happen? The astronomers have several ideas. It could be that star formation continues to occur in the inner, material-rich regions of a starforming cloud, but stops in the outer regions when material runs out. That means that no new stars form in the outer suburbs, and the older stars are the only ones left there. It's also possible that old stars drift away from the action at the core of a cluster, and settle out in the suburbs, where star formation has stopped or slowed down drastically. Finally, there's a possibility that stars form in massive filaments of gas that fall toward the center of a cluster, and the stars continue along the original path of the filaments.

To see if this old-stars on the outskirts, young stars in the cores trend occurs

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## New Facts Change Theories about Star Clusters *Continued from p.6*

elsewhere, astronomers will need to do the same measurements in other clusters. If it does, then that gives us more data points about star formation and clusters that we can use to understand the same events elsewhere in our galaxy, and in other galaxies.

Speaking of clusters, there's a star cluster you can find with the naked eye (if you have a good dark sky spot) or binoculars. It's called Melotte 111, in the constellation Coma Berenices. Want to learn how

to find it? Check out the May edition of "Our Night Sky" at Astrocast.TV. \*★

*C.C. Petersen is a science writer, voice-over artist, and video producer. Find out more at her website, [www.thespacewriter.com](http://www.thespacewriter.com).*

*This content distributed by the AAVSO Writer's Bureau*

## The 3rd USA Science and Engineering Festival *Continued from p. 5*

of Preston talking to Bolden. Then I positioned myself to listen in to their conversation. It should be noted that Bolden was accompanied by something of an entourage

As I was listening in on Preston talking to Bolden about the power generators, I found it amusing that when Preston addressed Bolden as Dr. Bolden, the former general interrupted Preston and said that he was to call him Charlie. After listening to Preston about, Charlie turned to me and asked what I was doing at the NASA display area. I told Bolden that I was a NASA/JPL Solar System Ambassador, and before I could say a few words about the Solar System Ambassador program at JPL, Preston jumped in and was lauding the program and all that it does. Bolden next asked what made me competent to be a Solar System Ambassador. I told him that I was an astronomy professor at George Mason University and had previously worked for NASA as a contractor at both NASA Goddard Space Flight Center and NASA Headquarters.

Bolden then asked about what I did for public outreach under the Solar System Ambassador program, and I told him about my appearances at schools and events. I mentioned that I had done research on Mars with the Viking Lander data for my master's degree. He then asked what schools I had visited in the area, and I noted that just earlier in the month I had spoken at an elementary

school in Fairfax City. Unfortunately, I had at that time forgotten the name of the elementary school, which was Daniels Run Elementary School. Bolden then asked if I had been to elementary schools near Falls Church, Virginia. You see, Bolden has three granddaughters I believe, and they all go schools near Falls Church. Unfortunately, I had not been to those elementary schools he had named. We were then interrupted by one of the members of his entourage, who told him that he had to make an appointment and had to go now. So NASA Administrator Charles Bolden, moved on, and I took my place at the Mars panoramic display.

There were probably a few hundred children in school groups that came by the Mars display. For a number of them, I was able to control the 8-wheeled rover, and have the rover crawl across the bodies of the students as they lay on the floor of the Convention Center. I also had an oppor-

tunity to display some very neat software which allowed you to take a picture and add to the picture in real time, a virtual Mars Curiosity Rover.

All in all, I think the children, and their parents, who came that day, enjoyed the exhibits, and being run over by an engineering model of a Mars Rover.

The 4th USA Science and Engineering Festival will take place in April 2016 (22-24). Maybe you can join us at the festival as a volunteer then, or bring the family and enjoy the event yourself. \*★

*Dr. Geller has over 30 years of work experience in industry, government and academia. He first taught astronomy as an adjunct, and is currently in his ninth year as a full-time faculty in physics and astronomy at George Mason University. He also now serves as the Associate Chair of the department. He was Principal Investigator on a research grant from the Office of Naval Research (ONR). Dr. Geller also developed multimedia CD-ROM education and public outreach products for ONR.*

### 2014 Astronomy Events

**June 26 – 29, 2014**

Cherry Springs Star Party

**July 25th – 28th, 2014**

Green Bank Starquest

**August 22 – 26, 2014**

Almost Heaven Star Party

**Sept. 27, 2014**

NOVAC Star Gaze

**October 20 – 26, 2014**

Staunton River Star Party

Find more info at [www.NOVAC.com](http://www.NOVAC.com)



# A Glorious Gravitational Lens

By Dr. Ethan Siegel



*Abel 2218.*

IMAGE CREDIT: NASA, ESA, AND JOHAN RICHARD (CALTECH). ACKNOWLEDGEMENT: DAVIDE DE MARTIN & JAMES LONG (ESA/HUBBLE).

As we look at the universe on larger and larger scales, from stars to galaxies to groups to the largest galaxy clusters, we become able to perceive objects that are significantly farther away. But as we consider these larger classes of objects, they don't merely emit increased amounts of light, but they also contain increased amounts of mass. Under the best of circumstances, these gravitational clumps can open up a window to the distant universe well beyond what any astronomer could hope to see otherwise.

The oldest style of telescope is the refractor, where light from an arbitrarily distant source is passed through a converging lens. The incoming light rays—initially spread over a large area—are brought together at a point on the opposite side of the lens, with light rays from

significantly closer sources bent in characteristic ways as well. While the universe doesn't consist of large optical lenses, mass itself is capable of bending light in accord with Einstein's theory of General Relativity, and acts as a gravitational lens!

The first prediction that real-life galaxy clusters would behave as such lenses came from Fritz Zwicky in 1937. These foreground masses would lead to multiple images and distorted arcs of the same lensed background object, all of which would be magnified as well. It wasn't until

1979, however, that this process was confirmed with the observation of the Twin Quasar: QSO 0957+561. Gravitational lensing requires a serendipitous alignment of a massive foreground galaxy cluster with a background galaxy (or cluster) in the right location to be seen by an observer at our location, but the universe is kind enough to provide us with many such exam-

ples of this good fortune, including one accessible to astrophotographers with 11" scopes and larger: Abell 2218.

Located in the Constellation of Draco at position (J2000): R.A. 16h 35m 54s, Dec. +66° 13' 00" (about 2° North of the star 18 Draconis), Abell 2218 is an extremely massive cluster of about 10,000 galaxies located 2 billion light years away, but it's also located quite close to the zenith for northern hemisphere observers, making it a great target for deep-sky astrophotography. Multiple images and sweeping arcs abound between magnitudes 17 and 20, and include galaxies at a variety of redshifts ranging from  $z=0.7$  all the way up to  $z=2.5$ , with farther ones at even fainter magnitudes unveiled by Hubble. For those looking for an astronomical challenge this summer, take a shot at Abell 2218, a cluster responsible for perhaps the most glorious gravitational lens visible from Earth! ★

**Learn about current efforts to study gravitational lensing using NASA facilities:**

<http://www.nasa.gov/press/2014/january/nasas-fermi-makes-first-gamma-ray-study-of-a-gravitational-lens/>

**Kids can learn about gravity at NASA's Space Place:**

<http://spaceplace.nasa.gov/what-is-gravity/>

*Blast from the past—This article originally appeared in the July/August 1998 issue of the NOVAC Newsletter.*

# A Swan in a Milky River

By Marc DeFrancis

## For Young Astronomers ages 8 and up

Keep your fingers crossed that soon you can stay up late on a clear, moonless night—at the seashore maybe?—far from the bright lights of Washington. With mid-summer, the Great Swan Cygnus arrives, flying with spread wings and outstretched neck through the starry stream of the Milky Way. You might never see a more beautiful bird.

Even under suburban skies you can usually see the Swan's five brightest stars. These five make a simple cross, the short crossbar outlining the swan's wings, and the farthest star representing her south-facing head. The brightest star of all is named Deneb, the Arabs' word for "tail," which is just where you will find it.

Perhaps the stars love summer picnics as much as we do, for during this season, a bright triangle is laid out across the sky's middle like a three-cornered picnic blanket. Can you find it? Deneb holds down one corner. Just west of the Swan's head is the bright star Vega, which marks the sky's center in July. The third corner is held down by the bright star Altair, which you can reach by tracing a straight line from Vega through the Swan's head and continuing an equal distance. Once you've found it, you can show your friends how to spot this so-called Summer Triangle.

Hollywood has given two of the Summer Triangle's members "starring roles" in its films. Altair is featured in *Forbidden Planet*, a classic '50s sci-fi epic that your parents might recall. (It uses very little real science, but the robot is just great, and it's got one terrific monster.) And of course Vega was very important in last year's film, *Contact*.

### HOW FAR AWAY?

Looking at these summer stars, how far do you think your eyes can see? To gauge

the distance to Vega, recall that the alien civilization in *Contact*, which sent us messages from there, had grabbed the first television broadcast they received from earth and sent it back to us with a coded message. Television waves, which are another form of light, about 186,000 miles per second. That's fast enough to reach the moon in less than two seconds.

Unfortunately, one of the first TV broadcasts ever made, and therefore one of the first to ripple out of our solar system, happened to be from cameras at the Berlin Olympics of 1936, when Germany was ruled by Adolf Hitler. *Contact*, a fictional film, added the part about the aliens from a Vegan planet who spent seven years encoding their message in the Hitler broadcast after they got it and then bounced it back to us. Supposing that such a thing did happen, and that we received the message last year, try a little algebra to find out how far away Vega is:  $(1997 - 1936) \text{ years} = A \text{ years (going)} + A \text{ years (returning)} + 7 \text{ years (encoding the message)}$ . That is ...  $61 \text{ years} = 2A \text{ years} + 7 \text{ years}$ . Your answer for "A" tells you how far away Vega is in light-years, the distance light travels in a whole year. Look at Deneb now: it seems just as bright as Vega, yet it is no less than 1,600 light years away. Here's a rule about light: it gets dimmer by the "square" (number times itself) of its distance. For example, if my light bulb is 2 times farther away than yours, its light will appear 4 (that's  $2 \times 2$ ) times dimmer than yours. If 10 times farther, 100 times dimmer, and so on. Deneb is about 64 times farther away than Vega, which means, if it is the same kind of star, it should appear  $[64 \times 64]$  times dimmer. Can you multiply and get the answer? In fact, Deneb does not look any dimmer than Vega. The reason must be that Deneb is a super powerful,

super-bright star. How bright? It must be  $[64 \times 64]$  times brighter than Vega, to make up for its greater distance. That's one very big, very hot star.

### THE MILKY WAY

Moving your gaze from the Swan's tail star to her head, you can't help noticing the sparkling clouds of the Milky Way, which continue southward in broken patches that finally seem to be puffing out of the spout of the teakettle near the horizon. That teakettle is the constellation Sagittarius. This great band of glowing light awed and puzzled ancient people, and for very good reason. Here is a cloud you can only see on the darkest nights, and unlike the clouds of daytime, it always appears in the exact same shape! The ancient Chinese called it the Heavenly River, the ancient Jews called it the Bandage of the Sky, and the Algonquin and Iroquois Indians considered it the pathway that men's souls must travel after death. Only with the invention of the telescope, could people begin to see that the Milky Way is made of stars too distant to separate. Astronomers today estimate there are more than a hundred billion of them, and we in our little solar system are part of it all, part of our Milky Way galaxy.

Since many of these stars are hotter and brighter than our Sun, why, you may wonder, doesn't the galaxy glow brighter than our daytime sky? It is for the same reason that Deneb doesn't shine much, much brighter than Vega—because of the great distances. Our galaxy is known as a spiral galaxy, shaped roughly like a wagon wheel with a thick hub of dense stars at the center. Look toward the Sagittarius teapot again, in a dark night from a dark loca-

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## A Conversation With... Mary & Sarah Jimenez

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**Sarah:** Yes, my neighbors have joined us on several nights, and they have an interest in astronomy.

**NOVAC:** Do you have an astronomy club at your school?

**Mary:** No, not currently, but when I enter high school next year, I plan on starting one if there is not already an existing club.

**Sarah:** No, my school doesn't have an astronomy club, but it would be awesome if they did!

**NOVAC:** What night sky objects do you like to observe the most?

**Mary:** So far for the year 2014, we haven't gotten much personal observing done, but usually when we go observing, we start with planets and identifying constellations. While I was working for the Binocular Messier Award, everything I looked at used to be different, but I love M81 and M82.

**Sarah:** Planets! I love how they have lots of color and details.

**NOVAC:** Are there other AL observing programs that you would like to go for?

**Mary:** Yes, I have already planned to start the Binocular Double Star program.

**Sarah:** I don't know, I think that the Binocular Messier or the Binocular Deep Sky Programs would be fun!

**NOVAC:** Sarah you were just the 36th person within the Astronomical League to win the Sky Puppies Award. How did you come to pursue this certification?

**Sarah:** After joining NOVAC, my dad asked me if I'd like to do Sky Puppies. I said yes because I was eager to learn more about the sky, and was excited to complete this challenge.

**NOVAC:** What did you enjoy the most and what was the hardest part of the certification?

**Sarah:** I thought having to locate each constellation was difficult, but I loved every part of it.

**NOVAC:** Mary you recently achieved the AL Messier Binocular certification. What attracted you to this very difficult challenge and how long did it take you to complete?

**Mary:** Well, my dad first told me about the AL programs, and we looked for ones to do with our binoculars, and we found the Binocular Messier Program. I started it thinking it was a fun thing to do over the weekends, and it turned out to take almost six months to complete.

**NOVAC:** What was the hardest thing you had to do to reach this certification?

**Mary:** It wasn't the struggle of finding the objects as much as it was the cold. It was a challenge to observe during the cold because I wanted to find as many objects as I could, but the temperature was the hardest part.

**NOVAC:** Would you like to someday achieve the Messier certification using a telescope?

**Mary:** Absolutely! I had a lot of fun finding all of the objects using binoculars and it would be great to see everything again in greater detail! ★

## Blast from the Past

*Continued from p. 9*

tion. The thickest part of the Milky Way cloud you can see there rests at the hub of our galaxy, 26,000 light-years away.

### INFINITE STARS?

Is our Milky Way the only galaxy? It's certainly big enough to call a universe. When the great Isaac Newton thought about this question, he saw only two alternatives: either the stars continue infinitely, in all directions, or our Milky Way is like an "island universe" floating in a sea of empty space. An astronomer named Olber suggested that if the number of stars were infinite, no matter how far away they were, their combined light would add up to an infinite flash, and we would all be blinded even in the middle of the night. (But here's another question: What if an infinite number of stars were mingled with an infinite amount of dark dust between them? Which would win, the light or the darkness?)

Newton had discovered that gravity was a force, which pulled in all directions from any heavy object. The earth's gravity, for instance, not only holds us in place, but the Moon too, and although it gets weaker and weaker, it does extend beyond the moon forever. Here was a new puzzle: if there were an infinite number of stars, the force of gravity pulling from all of them in every direction would either tear you and me apart or keep us frozen, as if held between an infinitely strong tug-of-war ropes. (Please check and let us know if this happening in your household.)

So Newton concluded that we must be part of a island universe, a single galaxy in a sea of emptiness. After Newton's age, scientists began to think that while there were not an infinite number of stars, time was infinite, that is, the universe could not have had any "beginning." But this left us with another paradox: Why hadn't the gravity of all the stars already caused them to collapse into a heap? The answer to that question came 250 years after Newton, when Albert Einstein set in motion a whole bunch of new ideas, including the Big Bang. ★

## “To observe, and to help others observe”

NOVAC is a non-profit, all-volunteer organization chartered to advance amateur astronomy in Northern Virginia. Member benefits:

### Access to dark sky observing sites

NOVAC maintains agreements that provide club members with year-round access to observing sites away from city lights. [www.novac.com/wp/observing/](http://www.novac.com/wp/observing/)

### Monthly meetings

Monthly meetings are normally held at 7 p.m. on the second Sunday of each month [except in May when the meeting is held the first Sunday] in Room 163 of the Research Building on the campus of George Mason University. Each meeting features a lecture on an interesting topic by a local expert. See the meeting web page or future newsletters for a schedule of speakers. [www.novac.com/wp/outreach/meetings/](http://www.novac.com/wp/outreach/meetings/)

### Quarterly newsletter

The NOVAC newsletter provides information specifically for NOVAC members, as well as general interest articles on such topics as observing reports, equipment reviews, upcoming events, amateur telescope making (ATM) projects, and more.

[www.novac.com/wp/members/newsletter/](http://www.novac.com/wp/members/newsletter/)

### High-quality telescopes to borrow

NOVAC members may borrow one of the club's several loaner telescopes at no charge. Members may choose from among three 6 in. reflectors, two 10 in. f/6 reflectors, an 8 in. SCT, and a hydrogen-alpha solar scope. Binoculars are also available for loan.

[www.novac.com/wp/members/loaner-scope/](http://www.novac.com/wp/members/loaner-scope/)

### Club website

Up to date information about club events and activities is maintained on the club website at [www.novac.com](http://www.novac.com).

### Large club library

NOVAC maintains a well stocked library from which members may borrow by contacting John Deriso ([librarian@novac.com](mailto:librarian@novac.com)). A full list of titles is available on the club website.

[www.novac.com/wp/members/library](http://www.novac.com/wp/members/library)

### Private email listserv

Members keep up with current club information by subscribing to the NOVAC email list, without fear of flame wars or spam emails.

### Public outreach opportunities

Several times each year volunteers from NOVAC present astronomy programs to schools, churches, Scout troops and other public groups. Contact [outreach@novac.com](mailto:outreach@novac.com) or fill out the outreach form on the NOVAC website to request a program or help in supporting an event. [www.novac.com/wp/outreach/outreach-form/](http://www.novac.com/wp/outreach/outreach-form/)

### Membership in the Astronomical League

Through NOVAC's membership in the Astronomical League (AL), NOVAC members gain access to the AL's newsletter, services and observing programs.

[www.astroleague.org](http://www.astroleague.org)

### Discounts on astronomy magazines

Subscriptions to *Sky & Telescope* and *Astronomy* magazines are offered to club members at a considerable discount.

Contact Kent Allingham: [membership@novac.com](mailto:membership@novac.com)

### Mentor Program

Young or old, new or experienced, this program is for everybody. If you would like to meet with a mentor, think you would like to be a mentor, or have any questions about the program, contact: [mentor@novac.com](mailto:mentor@novac.com).

See your Membership Guide for more details about member benefits.

<http://www.novac.com/wp/members/>