

SIDEREAL TIMES

*The Official Publication of the
Amateur Astronomers Association of Princeton*

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Volume 40

February 2011

Number 2

From the Director

Snow! And more snow! And very cold! I used to never mind it, but this year it's bugging me. It's stopping or delaying many things. Our last meeting cancelled (a rarity!), very cold observing nights, very cold Outreach nights. But you know what's coming? SPRING! March and April bring chances at Messier Marathons. Maybe we could do one, maybe it won't snow, or rain, or sleet, or hail. Who am I kidding, this is New Jersey, and it's going to do all of that.

Our last meeting was cancelled, as you all know, because of snow. If ever there is a doubt in your mind if a meeting will be cancelled or not, go to the website, it will be posted prominently on the home page. We also Twitter the announcement for those of you who link to Twitter. Ken Kremer's lecture will be rescheduled to our May meeting. Please join us for our next meeting on February 8th at 8 PM. Let's hope for no precipitation.

Very soon, as it gets warmer again, we'll be making plans for activities in the Spring and Summer. We will have a club picnic sometime in the Spring. We open the observatory to the public

again starting in April. We'll be doing some equipment upgrading from another generous donation to the club. Also, there will be Super Science day at the State Planetarium coming up soon.

Also, we will soon be looking for another round of nominations for the next Board of Trustees of the club. This needs to be done by the May meeting. We need a volunteer to lead a nomination committee by our March meeting. We will be taking nominations for Director, Assistant Director, Program Chair, Secretary, and Treasurer. And we still are in need of a membership chair/committee. More help with public outreach, and needing more keyholders. If you are interested in helping your club's management and growth, please be generous with your interest and time. Drop me an email if you have questions.

See you all on February 8th!

Ludovico D'Angelo, Director

**The deadline for the March Sidereal Times is
Wednesday, February 23, 2011
Please submit articles to:**

editors@princetonastronomy.org

From the Program Chair

Our January 11th regular meeting was unfortunately snowed out. Dr. Ken Kremer's talk on "What's Beyond For NASA," which was to have taken place at that meeting, is now scheduled for our May 10th meeting. We shall just have to wait a few months for what is sure to be a fine presentation from Ken.



Hoping this time for better weather, we will be having Dr. Fronefield (Froney) Crawford speaking to us on **February 8th at 8:00 pm.** His subject will be "New Searches for Old Pulsars." Dr. Crawford is an assistant professor at Franklin and Marshall College in Lancaster, PA, where he teaches astronomy and physics and con-

ducts research with students on a variety of radio pulsar projects. Prior to coming to F&M, he taught at Haverford College and worked at Lockheed Martin Corporation. He received his B.A. from Williams College and his Ph.D. from MIT. He and his wife, two children and pet chickens live in Chester County, PA.

Dr. Crawford's subject will be radio pulsars, which have long been established as excellent laboratories for the exploration and study of a wide range of fundamental questions in physics. Of particular interest is the class of very old "millisecond pulsars" (MSPs): pulsars that have spun down over time through magnetic braking but which have subsequently been spun up through mass accretion from a binary companion to very fast (millisecond) spin periods. These objects can then be observed in some cases after the accretion phase as highly stable, pulsed radio sources. Although MSPs are important to study, they have traditionally been difficult to find in large-scale pulsar surveys owing to several important selection effects which hinder their detection. Advances in both observing and computational technology reduce these selection effects and are major drivers for surveys for new pulsars, millisecond or otherwise. He will discuss some of his recent efforts to find and study new radio pulsars (including old MSPs), some results from these searches, and some of the goals and challenges that he and his students will face with future surveys.

There will be a "Meet the Speaker" dinner at 6:00 pm before the meeting. Please email johnchurch@princeton.edu by noon on Tuesday, Feb. 8th for a reservation. I will respond with the dinner location, which has yet to be determined; it will be at either the Sports Bar (old Sotto) or the Triumph Brewing Company, close to one another on Nassau Street in Princeton. To insure a place or places at the table, it will be very important to make all reservations by noon on the 8th.

Concerning future programs, on March 8th we will be having Tim Brandt, a graduate student in Princeton's Department of Astrophysics, to speak on Type Ia supernovae and the search for their progenitors. Tim has recently been using the 8.2-meter Subaru telescope on Mauna Kea in Hawaii. On April 12th we will have Michael Molnar speaking on "The Star of Bethlehem," a topic he has extensively researched. Michael will be signing copies of his book on this subject during the intermission. As mentioned above, we will be hearing Ken Kremer's talk on May 10th. To round out our current session, on June 14th we will be treated to another presentation by Bill Murray in the New Jersey State Museum Planetarium in Trenton.

John Church, Program Chair

Treasurer's Report

Membership has increased by one to 65 members, and a successful outreach effort with the Lawrenceville Elementary School yielded a \$100 donation in January. After the payment of our annual insurance premium – the AAAP's single largest expense – our fiscal year to date surplus is just over \$2,000.

On a cumulative basis, our surplus is about \$20,400.

Michael Mitrano, Treasurer

From the Outreach Chair

Friday, January 21st was a cold and windy night (with apologies to Edward Bulwer-Lytton, Washington Irving, Charles M. Schulz, Alexandre Dumas, George Sand, and many others who have used similar kitsch phrases.)

Many thanks to Jeff Bernardis, John Giles, and me for volunteering to give our Star Party at the Lawrenceville Elementary School's "Science and Discovery Night" on January 21st.

While the children and their parents spent most of their time indoors eating good snacks and experimenting with many science projects, we three outdoor astronomers showed Jupiter, the Great Nebula in Orion, and, later in the evening, the Moon, when they came out to see us.

Not bad considering we were observing from a sidewalk position near the school directly underneath what has to be the brightest parking lot light I ever saw. Night vision was only a figment of our imagination!

But all in all, we did have fun and we did receive a generous donation of \$100.00 for our Association. Long underwear anyone?

As of this writing, I am not aware of any impending Star Party requests but I'll let everyone know if any come in. In the meantime we can look forward to a new season of open house nights starting in April.

David Lechter, Outreach Chair

Mars Rovers Celebrate 7th Anniversary on the Red Planet

NASA's twin Mars rovers Spirit and Opportunity surely rank as one of the greatest triumphs in the history of space exploration. Seven years ago this month the dynamic duo landed on opposite sides of the Red Planet on Jan. 3 and Jan. 24, 2004. They were originally designed to operate for just 90 Martian days, or sols, with an outside possibility they might last a few months longer.

In actuality - during the extended mission phase - they have endured light years beyond the mere 3 month "warranty" proclaimed by NASA as the mission began with high hopes following the nail biting "6 minutes of terror" as the twins plunged through the Martian atmosphere and with no certainty as to the outcome of the landing.

Since 2004, the rovers' longevity has far exceeded all expectations and no one on the science and engineering teams that built and operate the twins can believe they lasted so long and produced so much.

Spirit and Opportunity have accomplished a remarkable series of scientific breakthroughs, far surpassing the wildest dreams of all the researchers and NASA officials. Indeed both rovers are currently positioned at scientific goldmines on the Red Planet's surface.

Opportunity is still alive and trekking across the Martian plains, now 84 months into the 3 month mission. By the time of her last dispatch from Gusev crater, Spirit had lasted for nearly six years of bonus mission time.

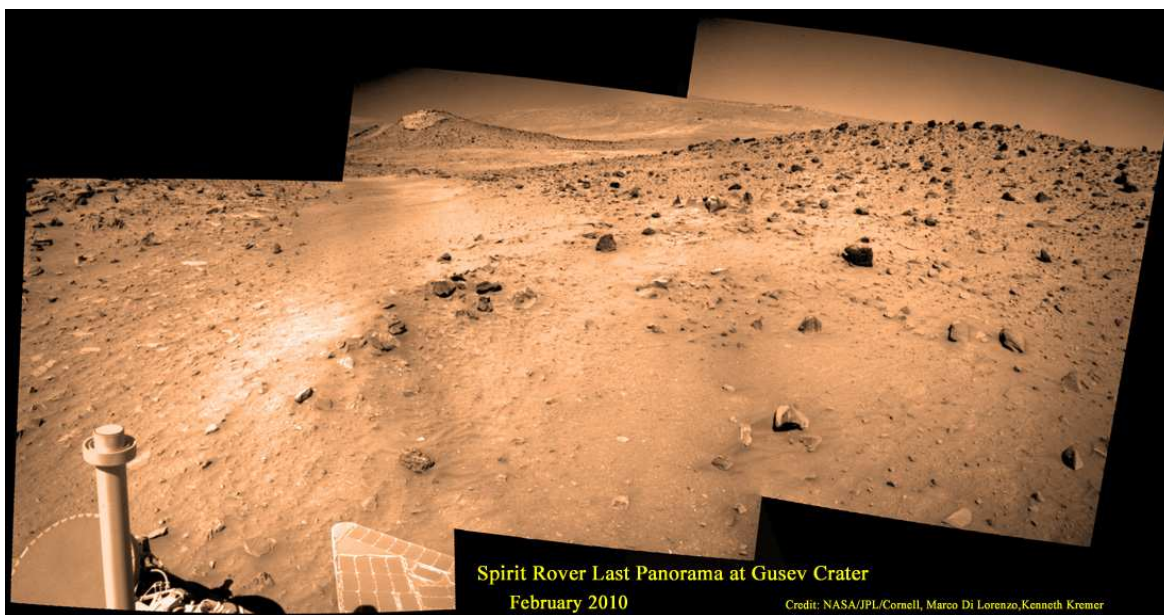


Photo 1: Spirit's Last Picture Show - for now. Spirit's final panoramic mosaic was taken on Sol 2175 in February 2010, a few weeks before entering hibernation mode in March 2010. Credit: NASA/JPL/Cornell, Marco Di Lorenzo, Kenneth Kremer

Spirit last communicated with mission controllers back on Earth on March 22, 2010. The rover had entered hibernation mode as the autumn sunlight available to power her life giving solar arrays was diminishing.

NASA hopes to reawaken Spirit from a long slumber and reignite her illustrious campaign of exploration and discovery.

No one is giving up hope for Spirit and NASA is stepping up operational efforts to contact the plucky rover since the amount of Springtime Martian sunlight is now increasing over the next few months.

Although Spirit has been stalled at a place called ‘Troy’ since April 2009, she made a significant science discovery at that exact spot. Spirit examined the soil in great detail and found key evidence that water, perhaps as snow melt, trickled into the subsurface fairly recently and on a continuing basis. Our photomosaic herein shows the very last panoramic view taken by Spirit at ‘Troy’.

While driving on the western edge of an eroded over volcanic feature named ‘Home Plate’, she broke through a hard surface crust (perhaps 1 cm thick) and sank into hidden soft sand beneath. At ‘Troy’, Spirit discovered that the crust was comprised of water related sulfate materials and therefore found further evidence for the past flow of liquid water on the surface of Mars – a great science discovery!



Photo 2: The Long Journey of Opportunity: This collage of two maps and a new close up panorama of Santa Maria crater (bottom right) shows the route traversed by the Opportunity Mars rover during her 7 year long overland expedition across the Meridiani Planum region of Mars. Opportunity arrived at the rim of Santa Maria Crater on Dec. 16, 2010 on Sol 2451. The mosaic of Santa Maria at bottom right was taken by Opportunity about 5 meters from rim on Sol 2451. Credit: NASA/JPL/Cornell, Marco Di Lorenzo, Kenneth Kremer. This map mosaic published in the Jan. 17, 2011 issue of *Aviation Week & Space Technology* magazine, p. 45.

Meanwhile, Opportunity is blazing a trail of discovery in the Meridiani Planum region of Mars. She is currently exploring the stadium sized Santa Maria Carter which holds deposits of water bearing minerals that will further elucidate the potential for habitability on the Red Planet.

The rover arrived at the western edge of the relatively fresh impact crater on Dec. 16, 2010 (Sol 2451). This intermediate stop on the rover’s 19 km long journey from Victoria Crater to giant 14 km wide Endeavour Crater will provide important ground truth observations to compare with the orbital detection of exposures of hydrated sulfate minerals.

Opportunity is driving to different vantage points around the steep walled crater and snapping a series of gorgeous Martian vistas. The rock-strewn crater is a Martian geologists dream. The robot was imaged on New Years Eve in exquisite high resolution from Mars orbit while parked at the sharp edge as she was simultaneously snapping a multitude of awesome views peering inside the stunning and scientifically interesting crater.

Santa Maria is just 6 km from the western rim of Endeavour which shows spectral signatures of phyllosilicates, or clay bearing minerals, which formed in water about 4 billion years ago and have never before been directly analyzed on the Martian surface.

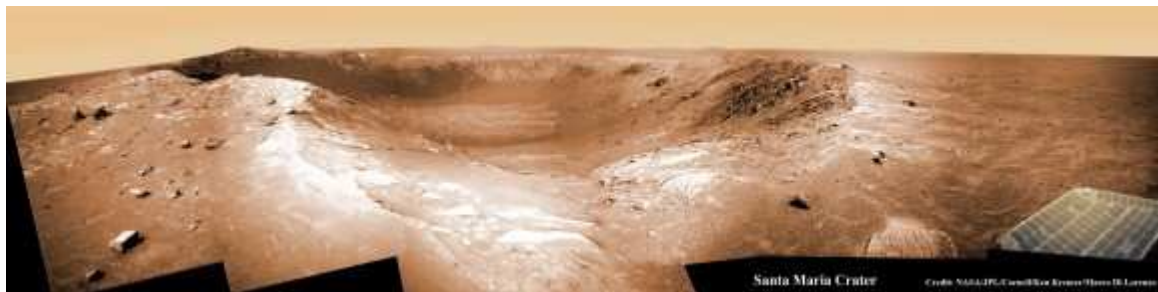


Photo 3: Opportunity's surface view of Santa Maria on New Years Eve Dec 31 while being photographed overhead from Mars Orbit. Opportunity took this panoramic mosaic just meters from the crater rim on Dec. 29, 2010 (Sol 2464). Note rover tracks near rim at left, relatively clean solar panel at right and numerous ejecta rocks. Credit: NASA/JPL/Cornell, Kenneth Kremer, Marco Di Lorenzo.

Phyllosilicates form in neutral aqueous conditions that could have been more habitable and conducive to the formation of life than the later Martian episodes of more harshly acidic conditions in which the sulfates formed, that Opportunity has already been exploring during her 7 year long overland expedition.

Opportunity remains healthy and has abundant solar power for the final leg of the long eastward march to Endeavour which will resume in mid-February and should arrive at later in 2011.

Read more in my new 7 Year Anniversary stories online at Universe Today:

<http://www.universetoday.com/82784/7-years-of-opportunity-on-mars-and-a-science-bonanza/>

<http://www.universetoday.com/82293/nasa-redoubling-efforts-to-contact-spirit/>

Read my cover story about the Mars Rovers and Robonaut R2 in the Feb 2011 issue of Spaceflight magazine: <http://www.bis-spaceflight.com/sitesia.aspx/page/184/id/2318/1/en-gb,en-gb,en-us>

Please contact me for more info or science outreach presentations:

Email:

website: www.kenkremer.com

Ken Kremer: Spaceflight magazine & The Planetary Society

Editors Note: Ken and Marco's panoramic photomosaic entitled "[Opportunity at Santa Maria Crater](#)" was featured on [Astronomy Picture of the Day](#) on January 29, 2011. Congratulations guys!

Snippets

NASA's LRO Creating Unprecedented Topographic Map of Moon

Published: Friday, December 17, 2010 - 17:21 in
[Astronomy & Space](#)

NASA's Lunar Reconnaissance Orbiter is allowing researchers to create the most precise and complete map to date of the moon's complex, heavily cratered landscape. "This dataset is being used to make digital elevation and terrain maps that will be a fundamental reference for future scientific and human exploration missions to the moon," said Dr. Gregory Neumann of NASA's Goddard Space Flight Center in Greenbelt, Md. "After about one year taking data, we already have nearly 3 billion data points from the Lunar Orbiter Laser Altimeter on board the LRO spacecraft, with near-uniform longitudinal coverage. We expect to continue to make measurements at this rate through the next two years of the science phase of the mission and beyond. Near the poles, we expect to provide near-GPS-like navigational capability as coverage is denser due to the spacecraft's polar orbit.

Article link:

http://esciencenews.com/articles/2010/12/17/nasas_lro.creating.unprecedented.topographic.map.moon

Black Holes and Warped Space: New UK Telescope Shows Off First

Published: Thursday, December 9, 2010 - 19:33 in
[Astronomy & Space](#)

Spearheaded by the University of Manchester's Jodrell Bank Observatory and funded by the Science and Technology Facilities Council, the e-MERLIN telescope will allow astronomers to address key questions relating to the origin and evolution of galaxies, stars and planets. To demonstrate its capabilities, University of

Manchester astronomers turned the new telescope array toward the "Double Quasar". This enigmatic object, first discovered by Jodrell Bank, is a famous example of Einstein's theory of gravity in action.

The new image shows how the light from a quasar billions of light years away is bent around a foreground galaxy by the curvature of space. This light has been travelling for 9 billion years before it reached the Earth. The quasar is a galaxy powered by a super-massive black hole, leading to the ejection of jets of matter moving at almost the speed of light – one of which can be seen arcing to the left in this new e-MERLIN image.

Article link:

http://esciencenews.com/articles/2010/12/09/black_holes.and.warped.space.new.uk.telescope.shows.first

ESA's Mercury Mapper Feels The Heat

Published: Tuesday, January 18, 2011 - 11:05 in
[Astronomy & Space](#)

Key components of the ESA-led Mercury mapper BepiColombo have been tested in a specially upgraded European space simulator. ESA's Large Space Simulator is now the most powerful in the world and the only facility capable of reproducing Mercury's hellish environment for a full-scale spacecraft. The Mercury Magnetospheric Orbiter (MMO) has survived a simulated voyage to the innermost planet. The octagonal spacecraft, which is Japan's contribution to BepiColombo, and its ESA sunshield withstood temperatures higher than 350°C.

Article link:

http://esciencenews.com/articles/2011/01/18/esas_mercury.mapper.feels.heat

NASA Prepares To Launch Next Earth-Observing Satellite Mission

Published: Thursday, January 20, 2011 - 17:02 in [Astronomy & Space](#)

NASA's newest Earth-observing research mission is nearing launch. The Glory mission will improve our understanding of how the sun and tiny atmospheric particles called aerosols affect Earth's climate. Glory also will extend a legacy of long-term solar measurements needed to address key uncertainties about climate change. Glory is scheduled to launch from Vandenberg Air Force Base in California on Feb. 23 at 5:09 a.m. EST. It will join a fleet called the Afternoon Constellation or "A-train" of satellites. This group of other Earth-observing satellites, including NASA's Aqua and Aura spacecraft, flies in tight formation.

Article link:

<http://esciencenews.com/articles/2011/01/20/nasa.pre-pares.launch.next.earth.observing.satellite.mission>

Swift Survey Finds 'Missing' Active Galaxies

Published: Thursday, January 20, 2011 - 17:34 in [Astronomy & Space](#)

(This is a very interesting article and well worth reading – Bryan)

Seen in X-rays, the entire sky is aglow. Even far away from bright sources, X-rays originating from beyond our galaxy provide a steady glow in every direction. Astronomers have long suspected that the chief contributors to this cosmic X-ray background were dust-swaddled black holes at the centers of active galaxies. The trouble was, too few of them were detected to do the job.

Since 2004, Swift's Burst Alert Telescope (BAT), developed and operated at NASA Goddard, has been mapping the entire sky in hard X-rays with energies between 15,000 and 200,000 electron volts -- thousands of times the energy of visible light. Gradually building up its exposure year after year, the survey is now the largest, most sensitive and most complete census at these energies. It includes hundreds of active galaxies out to a distance of 650 million light-years.

Astronomers assumed that there were many active galaxies oriented edgewise to us, but they just couldn't be detected because the disk of gas attenuates emissions too strongly.

Article link:

<http://esciencenews.com/articles/2011/01/20/swift.survey.finds.missing.active.galaxies>

Editor's Note: There are no meeting minutes in the issue because the regular January AAAP meeting was cancelled due to snow.

Twenty Years Ago in Sidereal Times

FEBRUARY PRE-MEETING NOTES

The February 12 meeting of the AAAP---with our guest speaker---place at Peyton Hall at Princeton University, and will begin at 8:00 P.M. Our guest speaker is Charles Gammie, who is a PhD candidate and a student of world-renowned astrophysicist J. Richard Gott III. Mr. Gammie received his BSc degree from Yale---cum laude---in 1987 and since that time has accumulated an impressive list of honors and publications for his research work. His lecture---"The Fate of the Earth"---will delve into the astronomical events that will affect life on Earth in both the near and distant futures, such as celestial impacts and evolution of the Earth-Moon system. As usual, Mr. Gammie's talk will be followed by our business meeting.

Mr. Gammie's BSc degree was in mathematics, and his PhD should be awarded in July of this year. In addition to his various publications, Mr. Gammie has received the following honors: the Princeton-Von Neumann Supercomputing Award (1987-88); the DeForest Prize for excellence in Mathematics (1987); the Beckwith Prize for excellence in astronomy (1987); and the Lewis Prize for excellence in mathematics.

EXCELLENT credentials, wouldn't you say? DON'T MISS what is certain to be another entertaining AAAP talk!

-Vic Belanger

NOTES FROM THE OBSERVATORY CHAIRMAN

On Friday February 8 (there will be no Saturday rain date for this event) there will be a star-hop at the Observatory starting at 8:00 P.M. The Spring galaxies in Leo, Virgo, and Ursa Major are starting to rise and I will be attempting to pick out some of the brighter ones to examine. There will also be a keyholder training session for people who desire to become Observatory keyholders after the star-hop has concluded (at about 9:00 P.M.).

Sometime during the week prior to the February 12 meeting I will be replacing the door locks on the Observatory. If you wish to use the Observatory at this time, call me prior to going out to find out whether the locks have been changed yet. I will hand out new keys to all keyholders who attend the February 12 meeting and mail keys to all other keyholders.

-Bill Murray

SIDEREAL TIMES
Amateur Astronomers Association of Princeton
Director: Larry Smith
Editor: JWHS

FEBRUARY 1991

FROM THE DIRECTOR

On January 23, we had our first Jersey Starquest planning meeting. The convention is scheduled for the weekend of June 14-16, 1991 at Beemerville, NJ and Greg Mauro is the Chairman for the event. The preliminary work is going very smoothly. Greg has prepared the announcement letter and registration materials; I have hired the cook who will prepare a pig roast and beef barbecue with all the trimmings for Saturday night plus five other meals; and Louisa is working on the publicity. We still need a few members to step up to the plate and help out on some of the Committees. Greg will ask for additional support at the February meeting.

The Board of Directors also met on January 23. The financial situation was reviewed and was deemed to be adequate for 1991. We discussed at length searching for a new observatory site and the conditions for the possible donation to the club of a 17 1/2" reflector. Greg Mauro and Bill Murray will continue to search for a possible site and make a report to the members within 6 months. Ads have been placed in various magazines as part of the new members recruitment drive. Also, the fliers placed on local company bulletin boards is helping to generate interest in the AAAP and has resulted in several new members. Thanks to Greg, Vic, John and Louisa for working on this project.

Our exhibit at Super Science Weekend at the New Jersey State Museum was a big success. We earned approximately \$100.00 from selling magazines. Many thanks to Ron and all the other members who helped by staffing the booth. We had excellent support by the members for this project.

At the end of this issue of the Sidereal Times is the Winter 1991 United Astronomy Clubs of New Jersey Newsletter and calendar of events.

-Larry Smith

919 Brian Court,
St. Cloud, MN 56303

November 8

Dear Stargazers,

I promised to send a letter after moving to Minnesota, to let you know what happens west of the Mississippi (we are a couple of miles west).

We took 3 days to drive out here in our Dodge Colt and found the house overgrown with trees, both regular ones and those grown from seed not weeded out at birth. We had not sold the house, so had it rented out for 6 years and luckily the inside had been well kept, so a small amount of painting was all that was needed. The garden however was another matter. We took out 27 trees with their roots (on a half acre lot) ranging from 1/2 inch to 4 inch trunks. The furniture truck arrived while carpets were being cleaned so all but the heavy pieces were placed in the garage and that meant weeks of moving boxes.

We were getting along reasonably well when around midnight on June 17 my wife had a stroke. We are lucky in that St. Cloud has a major hospital, which is a trauma center for the area, and she was in emergency within 1 hour - they say you have to get help within 2 hours.

Later on I heard that my youngest daughter had crashed her car on the Delaware Memorial Bridge on the same day, breaking her neck and both ankles, and giving her boy friend a broken pelvis, jaw and ankle. Quite a day for our family.

Time has passed and my wife has recovered almost completely. My daughter and boy friend are also back in operation, but we drove back East for a month to take them back to hospital and settle them back into their apartments because the boy friend's parents looked after them at the beginning while I was busy here.

We have another daughter in Japan for a year, and because we stopped her returning when the stroke happened we are going to meet her in Hawaii for 2 weeks in January, so that will be our main vacation.

I was concerned about how to fill my time during retirement, but so far that has not been a problem - I haven't done a lot of stargazing, some sunset watching, and last night a try at the Auriga star hop from Sky & Tel. This house is more awkward as I have to take out my tripod first then my 3" refractor, to get through the doors. Although we are further north, my horizon is a bit lower so I can see Sagittarius a bit more above the horizon.

You are having some good meetings this year and I wish I could be there.

Sincerely,

Dennis

Dennis Hicks.

*traveled in a couple of states you can know for
a little more bit of your trip*

SCHEDULE FOR OBSERVATORY DUTY (WINTER-SPRING 1991)

2/1/91: Dick Sivel & Larry Smith
2/8/91: Chip Yuill & Vic Belanger
2/15/91: Ron Mittelstaedt & George Walker
2/22/91: Kevin Mooney & Bob Slusher
3/1/91: John Ewald & Bob Harmon
3/8/91: Al Zampirri & John Zysk
3/15/91: Art Esposito & Greg Mauro
3/22/91: John Church & Don Monticello
3/29/91: Bill Murray & John Simpson
4/5/91: Doug Wurzel & Helen Harotte
4/12/91: Louisa Lockette & Ron Shulte
4/19/91: Al & Dan Vallus
4/26/91: Ed Petry & Ted Williams

If any changes are desired call me (890-7446) AT LEAST 2 WEEKS IN ADVANCE of your assigned date. [Note: Helen Marotte is excused until her back is better.]

-Bill Murray

FROM THE TREASURER

The Treasury now stands at \$1,228.09. Super Science Weekend brought in \$81.00 in magazine sales. Kalmbach Publishing Company, publishers of Astronomy magazine, sent Model Railroad Magazine to me by mistake [SOME MISTAKE, RON...Ed.], along with the other astronomy-related magazines. Surprisingly it sold just as well as Astronomy Magazine! There wasn't such a turn out for this year's event as in previous years; blame it on the bad weather of the previous day and less publicity because of the news from the Middle East.

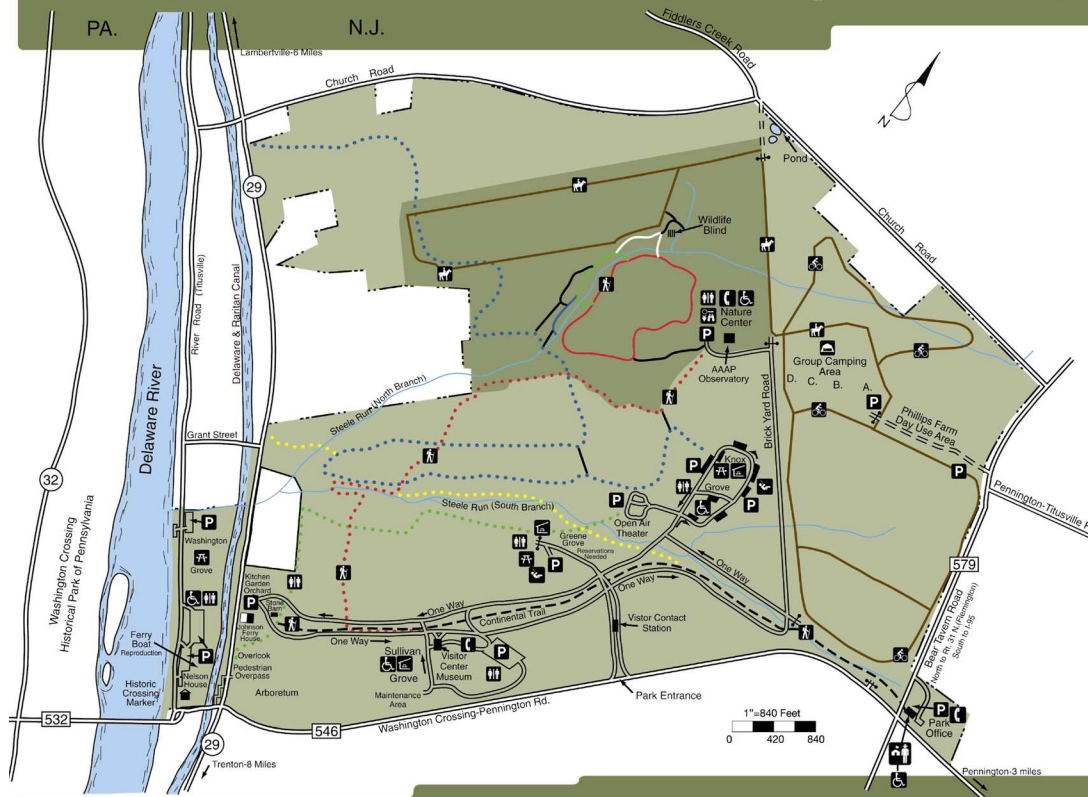
-Ron Mittelstaedt

NOT NECESSARILY AAAP NEWS

Winter is upon us, the warm, muggy-buggy nights of summer are gone. The atmosphere has less haze which makes the sky much clearer to sight constellations. You say it's too cold to venture out with your telescope? You can observe as

[Dennis Hicks' letter is on page 4; NNAAPN goes on on 5. Ed.]

Amateur Astronomers Association of Princeton - Simpson Observatory



AAAP



Directions:
From Interstate 95,
take Route 29 north.
Follow signs
to the park.

The Observatory is open to the public every clear Friday 8 to 11 PM from April to October.

Enter the park via the Philips Farm Day Use Area on Route 579, not the main park entrance. Drive past the soccer fields on the right to the soccer parking lot and look for a dirt road on left. Drive down the dirt road. Turn right on to the blacktop road and follow it to the observatory, which is on the right after the first bend.

Parking is permitted along one side of the paved road in front of the observatory. Keep vehicle wheels off the grass.

Members and guests must be accompanied by a Keyholder except on public nights.

Observatory phone: 609-737-2575

Park police: 609-737-0623

GPS:
Lat: 40° 18' 51" or 40.314°
Long: -74° 51' 42" or -74.862°

www.princetonastronomy.org

See us on the Web: www.princetonastronomy.org