

# *Inside Orbit*

A Publication of the  
Grand Rapids Amateur  
Astronomical Association

## **In This Issue:**

### **Calendar of Events & News Notes**

*Happenings in the GRAAA and the astronomical community*

### **The Solar System - January 2007** .....by Jeff Kozarski

*What's that bright object in the evening sky? Want to know where the moon is on a certain day?  
This is the article for you*

### **My Examined Astronomical Life** .....by G.M. Ross

### **NASA's Space Place**

*The wonders of the world of science and technology, brought to you by  
the Jet Propulsion Laboratory*

### **Roger B. Chaffee Planetarium**

**Note:** Any views and opinions expressed by the authors in this publication are not necessarily those of the GRAAA or its members.

#### **Inside Orbit Staff**

Editor-In-Chief	Kevin Jung
Editing, Layout & Graphics	Kevin Jung, Jeff Kozarski
Contributing Authors	Jeff Kozarski
Contributing Authors <i>(this edition)</i>	G.M. Ross
Production Staff	Kevin Jung

#### **GRAAA Website**

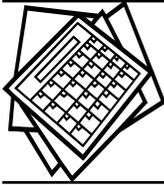
[www.graaa.org](http://www.graaa.org)

#### **Mailing Address:**

Inside Orbit  
3308 Kissing Rock Ave SE  
Lowell, MI 49331

#### **Images Credits:**

December 14 Aurora over Veen Observatory by  
James Ashley (who is standing in the door).



## News and Events

(Latest News and Events always online  
at [www.graaa.org](http://www.graaa.org))



**THERE WILL BE NO GENERAL MEETING IN JANUARY**, as the Board of Directors will be meeting early in the month to discuss the results of the Membership Survey and decide on how to implement any changes that will be mandated by the survey results. As a result, the website's calendar will not list any upcoming meetings for next year until after the board meeting.

**THE SHINDIG/EVENT FOR BRUCE SIDELL** has been postponed until sometime in the spring. Plans are being finalized, and more information will be posted (online, via email, and in upcoming publications) once everything's been worked out.

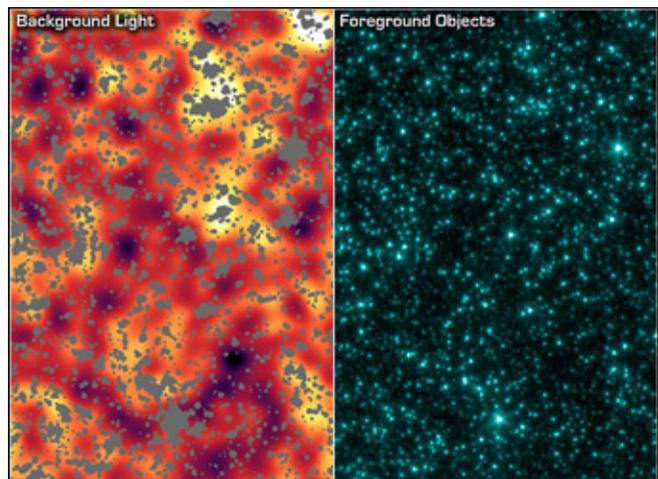
**THE FRONT COVER QUOTE WAS INSPIRED BY** James Ashley, who used it in a presentation to the Jane Austen Society of North America at their annual conference in Tucson in October 2006.

**GRAAA ONLINE FORUM:** Just a reminder of the forum for club members. It's a great place to get the latest scoop on club (and general astronomy) news, observing tips & tricks, and a whole bunch of other fun and informative things for all members to share in. You can find a link to the Forum in the Members' Section of the website.

**NASA AND GOOGLE TO BRING SPACE EXPLORATION DOWN TO EARTH:** NASA Ames Research Center and Google have signed a Space Act Agreement that formally establishes a relationship to work together on a variety of challenging technical problems ranging from large-scale data management and massively distributed computing, to human-computer interfaces.

As the first in a series of joint collaborations, Google and Ames will focus on making the most useful of NASA's information available on the Internet. Real-time weather visualization and forecasting, high-resolution 3-D maps of the moon and Mars, real-time tracking of the *International Space Station* and the space shuttle will be explored in the future.

**NASA TELESCOPE PICKS UP GLOW OF UNIVERSE'S FIRST OBJECTS:** New observations from NASA's *Spitzer Space Telescope* strongly suggest that infrared light detected in a prior study originated from clumps of the very first objects of the universe. The recent data indicate this patchy light is splattered across the entire sky and comes from clusters of bright, monstrous objects more than 13 billion light-years away.



The right panel is an image from NASA's *Spitzer Space Telescope* of stars and galaxies in the *Ursa Major* constellation. The left panel is the same image after stars, galaxies and other sources were masked out. Image credit: NASA/JPL-Caltech/GSFC

*"We are pushing our telescopes to the limit and are tantalizingly close to getting a clear picture of the very first collections of objects,"* said Dr. Alexander Kashlinsky of NASA's Goddard Space Flight Center, Greenbelt, Md., lead author on two reports to appear in the *Astrophysical Journal Letters*. *"Whatever these objects are, they are intrinsically incredibly bright and very different from anything in existence today."*

**STARDUST FINDINGS SUGGEST COMETS MORE COMPLEX THAN THOUGHT:** Comets may be more than just simple conglomerations of ice, dust and gases. Some may be important windows on the early solar system. Others may have contributed materials necessary to the development of life

on our own planet. Scientists have found a wide range of compositions and structures for the comet Wild 2 particles that were captured and returned to Earth by NASA's *Stardust* spacecraft. Their findings indicate the formation of at least some comets may have included materials ejected from the inner solar system to the far and cold outer edge of the solar nebula.

**NASA STUDY FINDS NEW KIND OF ORGANICS IN STARDUST MISSION:** A team of scientists found a new class of organics in comet dust captured from comet Wild 2 in 2004 by NASA's *Stardust* spacecraft.

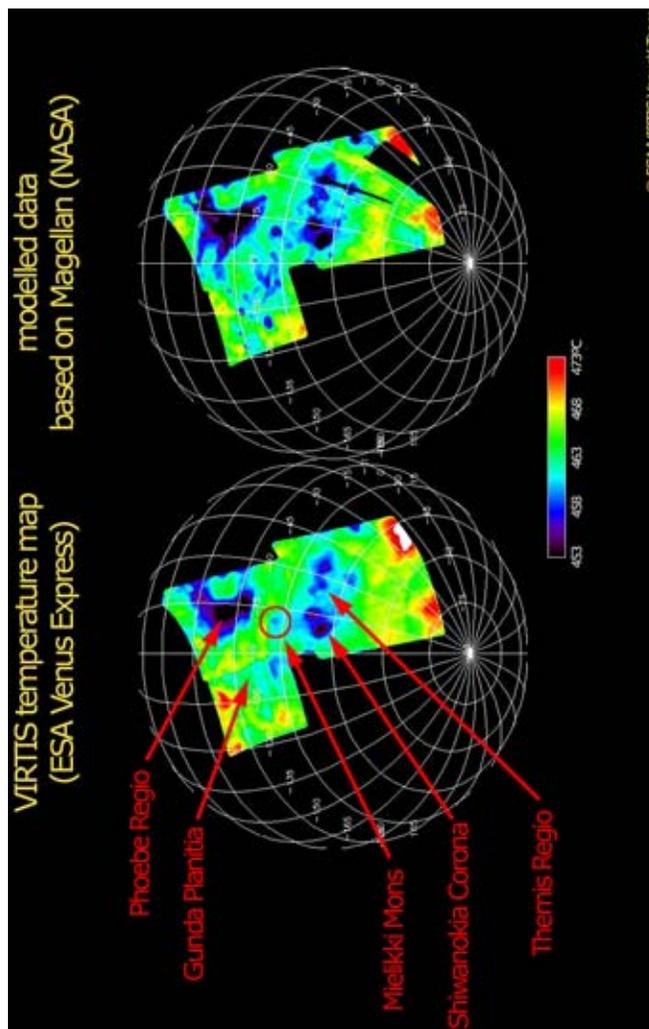


Special 'needles' mounted on micro-manipulators controlled by computer to carefully and precisely cut out sections of aerogel that contain cometary samples.

The discovery is described in a technical paper, "Organics Captured from Comet Wild 2 by the *Stardust* Spacecraft," in the Dec. 15 issue of *Science Express*, the online edition of the journal *Science*.

**HOT STUFF ON VENUS! VENUS EXPRESS SEES RIGHT DOWN TO THE HELL-HOT SURFACE:** Thanks to ESA's *Venus Express* data, scientists obtained

the first large-area temperature maps of the southern hemisphere of the inhospitable, lead-melting surface of Venus.



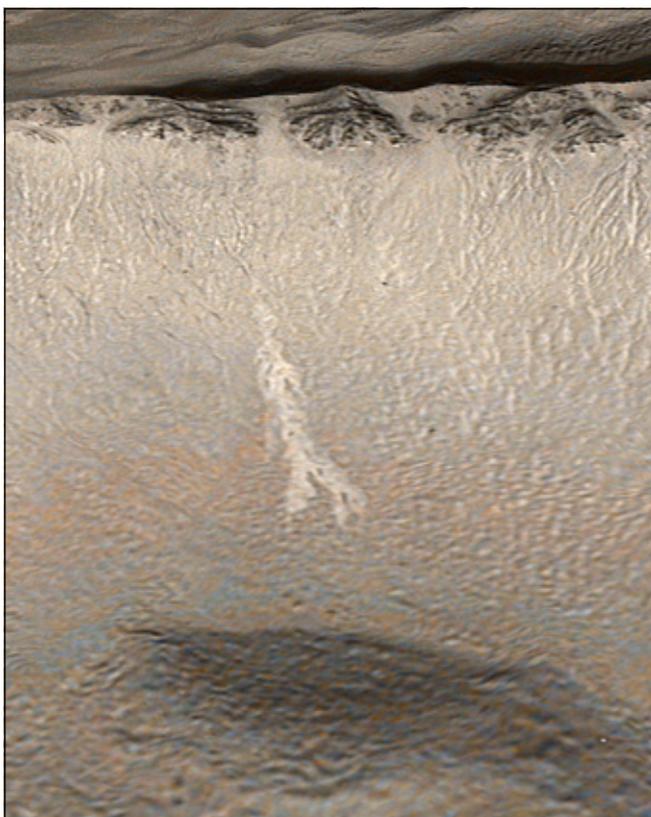
The temperature maps of the Venusian surface shown in this image were built thanks to direct measurements obtained by *Venus Express*' VIRTIS instruments (left), compared with surface temperature predictions based on the *Magellan* topographic data obtained in the early 1990s (right).

The new data may help with searching and identifying 'hot spots' on the surface, considered to be possible signs of active volcanism on the planet.

**MASSIVE MOUNTAIN RANGE IMAGED ON SATURN'S MOON TITAN:** The tallest mountains ever seen on Titan -- coated with layers of organic material and blanketed by clouds -- have been imaged on Saturn's moon Titan by NASA's *Cassini* spacecraft.

"We see a massive mountain range that kind of reminds me of the Sierra Nevada mountains in the western United States. This mountain range is continuous and is nearly 100 miles long," said Dr. Bob Brown, team leader of the *Cassini* visual and infrared mapping spectrometer at the University of Arizona, Tucson.

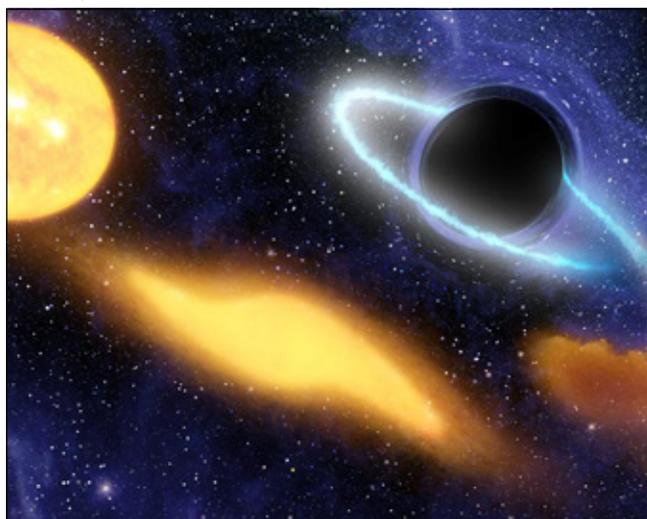
**NASA IMAGES SUGGEST WATER STILL FLOWS IN BRIEF SPURTS ON MARS:** NASA photographs have revealed bright new deposits seen in two gullies on Mars that suggest water carried sediment through them sometime during the past seven years.



"These observations give the strongest evidence to date that water still flows occasionally on the surface of Mars," said Dr. Michael Meyer, lead scientist for NASA's Mars Exploration Program, Washington.

**NASA TELESCOPE SEES BLACK HOLE MUNCH ON A STAR:** A giant black hole has been caught red-handed dipping into a cosmic cookie jar of stars by NASA's *Galaxy Evolution Explorer*. This is the first time astronomers have seen the whole proc-

ess of a black hole eating a star, from its first to nearly final bites.



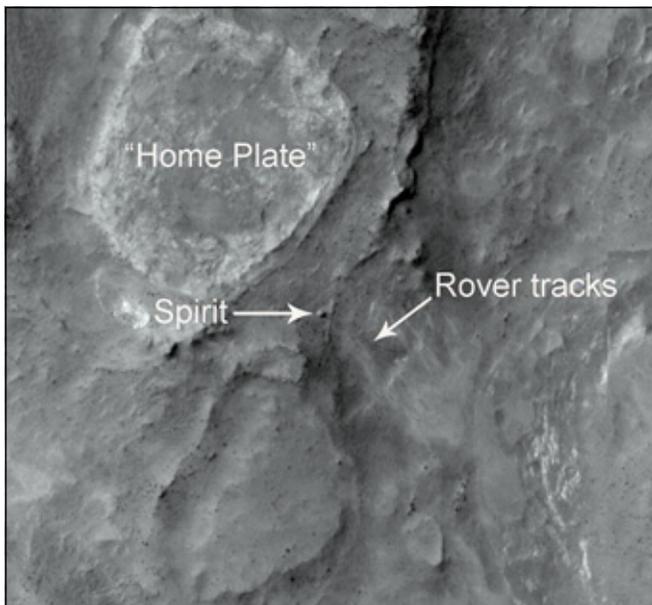
*This artist's concept shows a supermassive black hole at the center of a remote galaxy digesting the remnants of a star. Image credit: NASA/JPL-Caltech*

"This type of event is very rare, so we are lucky to study the entire process from beginning to end," said Dr. Suvi Gezari of the California Institute of Technology, Pasadena, Calif. Gezari is lead author of a new paper appearing in the Dec. 10 issue of *Astrophysical Journal Letters*.

**NASA UNVEILS GLOBAL EXPLORATION STRATEGY AND LUNAR ARCHITECTURE:** NASA on Monday unveiled the initial elements of the Global Exploration Strategy and a proposed U.S. lunar architecture, two critical tools for achieving the nation's vision of returning humans to the moon. NASA Deputy Administrator Shana Dale, who is guiding the long-term strategy development effort among 14 of the world's space agencies, said, "This strategy will enable interested nations to leverage their capabilities and financial and technical contributions, making optimum use of globally available knowledge and resources to help energize a coordinated effort that will propel us into this new age of discovery and exploration."

**NASA MARS ORBITER PHOTOGRAPHS SPIRIT AND VIKINGS ON THE GROUND:** New images from NASA's *Mars Reconnaissance Orbiter* show three additional NASA spacecraft that have landed on Mars: the *Spirit* rover active on the surface since January 2004 and the two *Viking*

landers that successfully reached the surface in 1976. The orbiter's high-resolution camera took a dramatic photograph of *Spirit's* twin rover, *Opportunity*, at the edge of a Martian crater two months ago.



*Spirit rover at Gusev Crater. Image credit: NASA/JPL-Caltech/Univ. of Arizona*

Besides providing new portraits of these robotic emissaries, the images provide scientists valuable high-resolution information about the surrounding terrain at each site. This aids both in interpreting other orbital data and in planning activities for surface missions.

**INTERNATIONAL LUNAR DECADE:** The International Lunar Decade, which was championed and proposed by *The Planetary Society*, begins in 2007 and continues through the first manned return to the moon, sometime in the next decade. The International Lunar Decade take inspiration from several sources, the best being the International Geophysical Year (1957-58). After a considerable slow down in Antarctic exploration, the International Geophysical Year (IGY) vigorously renewed exploration of that forbidding landscape, and, in fact, triggered the Space Age, when the Soviet Union launched *Sputnik 1* as part of their IGY program. It is hoped an International Lunar Decade might spur a similar reinvigoration of lunar exploration and perhaps lead to the next great -- and maybe even unforeseen -- step in space exploration.

**NASA MARS TEAM TEACHES OLD ROVERS NEW TRICKS TO KICK OFF YEAR FOUR:** NASA's twin Mars rovers, nearing the third anniversary of their landings, are getting smarter as they get older.

The unexpected longevity of *Spirit* and *Opportunity* is giving the space agency a chance to field-test on Mars some new capabilities useful both to these missions and future rovers. *Spirit* will begin its fourth year on Mars on Jan. 3 (PST); *Opportunity* on Jan. 24. In addition to their continuing scientific observations, they are now testing four new skills included in revised flight software uploaded to their onboard computers.

**NASA SEEKS WAYS TO BOOST YOUTH APPEAL:** Young Americans have high levels of apathy about NASA's new vision of sending astronauts back to the moon by 2017 and eventually on to Mars, recent surveys show. Concerned about this lack of interest, NASA's image-makers are taking a hard look at how to win over the young generation— media-saturated teens and 20-somethings growing up on YouTube and Google and largely indifferent to manned space flight.

*"If you're going to do a space exploration program that lasts 40 years, if you just do the math, those are the guys that are going to carry the tax burden,"* said Mary Lynne Dittmar, president of a Houston company that surveyed young people about the space program. The 2004 and 2006 surveys by Dittmar Associates Inc. revealed high levels of indifference among 18- to 25-year-olds toward manned trips to the moon and Mars.

**INFORMATION SPOT:** Effective Temperature is the temperature of a star's outermost layer, the photosphere. Temperatures vary throughout a star, from millions of degrees in the core to thousands of degrees in the outer stellar atmosphere. Astronomers measure the temperature of the photosphere, and combine that with other information to calculate the core temperature.

Ω Ω Ω Ω Ω Ω Ω Ω

*...news to be continued next month (where there will be some of the biggest club-related news in years, affecting the GRAAA in ways we do not yet know, nor comprehend).*



# The Solar System: January, 2007

By Jeff Kozarski

*The start of the New Year brings most of the planets huddled close to the Sun in either the morning or evening sky. Only Saturn is highly prominent in the evening sky well after dark.*

**Mercury** is in superior conjunction with the Sun on the 7th. For most of the month it is too close to the solar glare. By the end of January Mercury rebounds back into the evening sky at less than  $10^\circ$  a half-hour after sunset. Greatest elongation occurs early next month where it looms just to the lower right of brilliant Venus, but will never quite be in conjunction.

**Venus** is gaining elevation in the evening sky towards the WSW this month after sunset. It is about  $10^\circ$  high a half-hour after sunset on the 15th. Venus is bright at  $-3.9$  magnitude but is still quite small and nearly full phased through a telescope ( $11''$  of arc and 94% on the 20th).



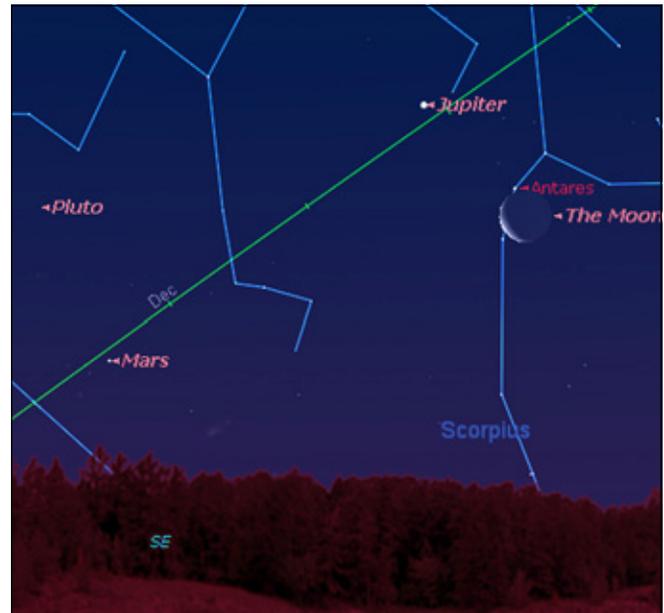
On the evening of January 20th, a half-hour after sunset, a 5% waxing crescent moon joins Venus in the twilight sky.

## January 2007 Lunar Data:

- ☆ Full Moon on the 3rd at 8.57 am EST
- ☆ Last Quarter on the 11th at 7.44 am EST
- ☆ New Moon on the 18th at 11.00 pm EST
- ☆ First Quarter on the 25th at 6.01 pm EST

**The Earth is at Perihelion** on January 3 at 3.00pm EST (20.00UT). We will be 0.983 AU from the Sun, and beginning our swing back out to aphelion in July.

**Mars** is in the morning sky in Sagittarius at mid month and glows dimly at  $+1.4$  magnitude and only  $4''$  of arc across. A good opportunity to find it is on the morning of the 15th when the moon, Jupiter and Antares are all gathered together nearby.



Pluto, Mars, Jupiter, the moon & Antares on the morning of January 15th.

**Jupiter** is much higher in the morning sky than Mars in Scorpius. It is much brighter shining at  $-1.8$  magnitude and increases to  $33''$  across

*(Continued on page 10)*



# My Examined Astronomical Life

## (And How Others May Learn From It)

by GM Ross

It was late in the night of 2 January 2005. Raimondo and I had been drinking all day, but it was beyond last call. Mom was long asleep. The flat of Raymond A. "Raimondo" Rea, M.S., J.D., Esq. was aglow by reflected light from the three storey building across 25th Street, the best of 1920s architecture gleaming with patterned white tile. Cleveland, and more particularly "Ohio City," on the last of the Holiday nights.

I met Raimondo at the Detroit Astronomical Society in the summer of 1964. His fire of amateur astronomy still smoldered, however, only requiring my inspirational company. I deployed my 1970s era Kodak Carousel slide projector and started to show old and new astronomy slides on a white wall, some going back to the 1960s. Half asleep, Raimondo made an unforgettable remark, but first some digressions...

EXHIBIT A. On the very early morning of 3 July 2006 I arrived at my venue in the Veen Observatory, otherwise known as the West Dome. Joseph P. "Handsome Joe" McBride was already at his post in the East Dome. His recent work with the Marron Telescope has made him the second or third most *puissant* astrophotographer in the Middle West, exceeded by Phil "Doc" Martin of the Warren Astronomical Society, a/k/a "Gypsy Martin." My first variable star on deck that morning was to be 192028 V1114 Cygni, a U Geminorum star near Beta Cygni which I have been observing, in a manner of speaking, for fifteen years. V1114 is listed on the "provisional" photographic A.AVSO chart -- 1988 -- as an eruptive star which peaks at 14.9 from a resting state of below 17th magnitude. It has been part of the A.A.V.S.O. stable since 1976 but very few of the worldwide observers' corps monitor the variable; for instance, in 2005-06 only a half-dozen observers have done so. One is Michael "Fast Mike" Simonsen operating out of St. Clair County, the most accomplished observer in mid-continent. In all the years I had been looking at (or for) V1114, I had *never* seen it. That morning I turned the mighty Borr Telescope on the tiny portion of the sky represented by the

A.A.V.S.O. "e" chart... and there it was! *After all these years*. Please do not think it knocked the eye out: I put it down at 15.2 with not the greatest seeing, so this was unlike a celestial Moby Dick breaching the waves. The star faded in and out of visibility, and averted vision was a necessity. Handsome Joe was in the dome for the great event, and I asked him to e-mail others with the news to get some kind of confirmation. Clouds intervened the following night, so when I made the next attempt, V1114 was beyond the reach of even the 16", and I may never see the star again.

Moral: Keep at it. If something is merrily waiting to appear, just do your reasonable best until you are the only one in the whole world at the right place and right time.

EXHIBIT B. Arriving at his house near Mt. Clemens in the wee hours of 21 November 2006, John Francis "Big Jack" Szymanski greeted me at the front door in his beddy-bye duds and sleepy-time socks. I was not pleased. I thought we had made careful arrangements, but this is not the place to explore the declaration of my former friend Samuel Cornel Ursu: "Why are all my friends flakes?"

Getting to the point, we observed, rather failed to observe, an outbreak of the Alpha Monocerotid Meteors. The night of the 20th was very dodgy in the clouds department and the Weather Underground gave a mixed review for the morning of the 21st. We had to journey to the mouth of the Clinton River, "Sunshine Point" at Anchor Bay, the large sub-set of Lake St. Clair, to get somewhat beyond the fetid sky of the north-east Detroit suburbs. Everything was lousy. Even as we walked out to the point, gummy cirri-form clouds made the heart sink. Essentially out in the lake the wind was merciless, bending the tall pampa grass. One thing though about Szymanski: he certainly has heart. How many other blokes would be out on that godforsaken spit at such a godforsaken hour on a *November* morning?

With the exception of a fine bolide in Bootes

at 05.43 E.S.T. we observed two shower meteors in one standard counting hour, so the possible outburst Guy Ottewell discussed in his magnificent annual tome did not materialise, at least for central North America. What observers saw in the eastern hemisphere is unknown at this writing.

Moral: Even with a tattered sleeping bag, site and night leaving much to be desired, someone who is willing to set an alarm and motor half-asleep into the deserted hours can make a contribution. Good negative findings are much better than nothing at all. No advanced degree or endless equipment "upgrades" need apply.

EXHIBIT C: Going back to the January night, *supra*, which began this essay. Raimondo is no stranger to astrophotography, no slouch in the 1960s, the first of the Boys to experiment with infra-red film, the first -- and only -- to make direct positives. Just because he has lost the Tao from moving amongst Men of Consequence, and his ten inch mirror to a bad marriage, does not mean he retains none of the old spirit.

He observed many projected astro-pictures, mine both old and new, inter-mingled with the awe inspiring work of Mark John "Merk" Christensen, most of those taken in southern California with portable instruments. Christensen is the second or third greatest astrophotographer in the Middle West, after the above-mentioned "Doc" Martin. Raimondo, groggy with fatigue, quietly dropped the bomb: he liked my simple, almost primitive astrophotography better than Christensen's, and without waiting I told him why. My pictures were more of a human scale, the heavens as experienced by ordinary folk. They try to convey why we take up the romance of the heavens. The *tours de force* of Christensen, McBride, and Martin make demands with a heavy technical/ intellectual component, but what they depict with high magnifications and very deep reach is not why we first look up and keep looking after forty or fifty years. No one can go out at night to see what their pictures reveal.

Moral: George S. Kaufman and Moss Hart say it best, and astronomers should take heed: if you have a song, sing it; if you have a dream, dream it. If you lack the knowledge, it will come; if you cannot get the big gear, maybe you do not really need it. Mr. Whiteside, the loud and tyrannical title character in *The Man Who Came to*

*Dinner* (1939), is immortal in stage comedy. This colloquy from Act II:

WHITESIDE: [...] Well, Dickie, would you like a candid camera shot of my left nostril this evening?

RICHARD: I'm all stocked up on those. Have you got a minute to look at some new ones I've taken?

WHITESIDE: I certainly have... why these are splendid, Richard. There's real artistry in them -- they're as good as anything by Margaret Bourke White. I like all the things you've shown me. This is the essence of photographic journalism.

RICHARD: Say, I didn't know they were as good as that. I just like to take pictures, that's all.

WHITESIDE: Richard, I've been meaning to talk to you about this. You're not just a kid fooling with a camera anymore. These are good. This is what you ought to do. You ought to get out of here and do some of the things you were telling me about. Just get on a boat and get off wherever it stops. Galveston, Mexico, Singapore -- work your way through and just take pictures -- millions of them, terrible pictures, wonderful pictures -- everything.

RICHARD: Say, wouldn't I like to, though! It's what I've been dreaming of for years. If I could do that I'd be the happiest guy in the world.

Further the deponent sayeth not. Clear skies!

---

\*\*\*\*\*  
\*  
\*  
\* "The usual approach of science of  
\* constructing a mathematical model  
\* cannot answer the questions of why  
\* there should be a universe for the  
\* model to describe. Why does the  
\* universe go to all the bother of exist-  
\* ing?"  
\*  
\*  
\* — Stephen Hawking  
\*  
\*  
\*\*\*\*\*

Note: These articles are courtesy NASA Space Place Program at the Jet Propulsion Laboratory.

## Space Weather for Air Travelers

By Dr. Tony Phillips

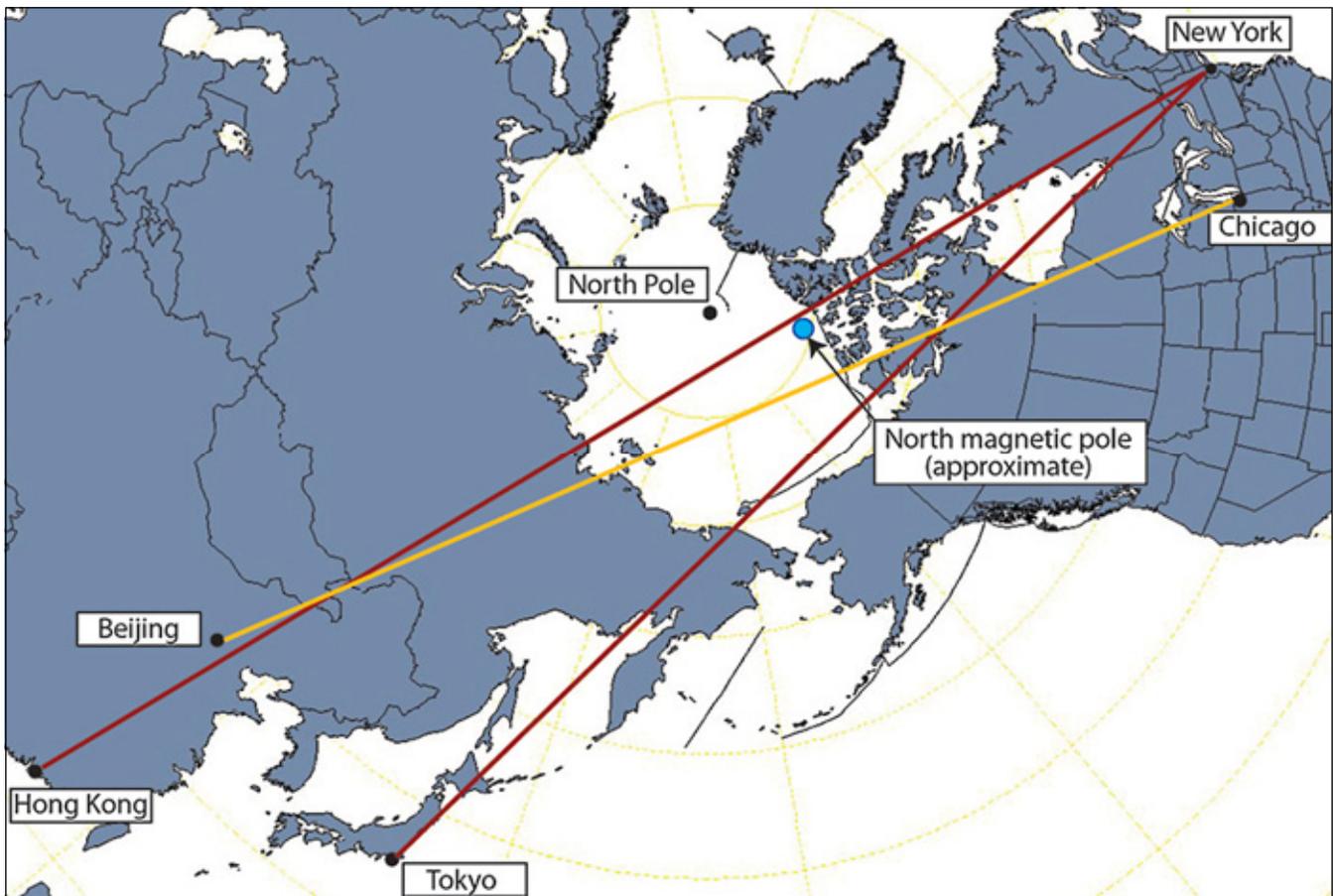
At a time when much of the airline industry is struggling, one type of air travel is doing remarkably well: polar flights. In 1999, United Airlines made just twelve trips over the Arctic. By 2005, the number of flights had grown to 1,402. Other airlines report similar growth.

The reason for the increase is commerce. Business is booming along Asia's Pacific Rim, and business travel is booming with it. On our spherical Earth, the shortest distance from Chi-

cago to Beijing or New York to Tokyo is over the North Pole. Suddenly, business travelers are spending a lot of time in the Arctic.

With these new routes, however, comes a new concern: space weather.

"Solar storms have a big effect on polar regions of our planet," explains Steve Hill of NOAA's Space Weather Prediction Center in Boulder, Colorado. Everyone knows about the Northern Lights, but there's more to it than that: "When airplanes fly over the poles during solar storms, they can experience radio blackouts, navigation errors and computer reboots—all caused by space radiation."



The shortest airline routes from the Eastern U.S. to popular destinations in Asia go very near the magnetic North Pole, where space weather is of greatest concern.

In 2005, United Airlines reported dozens of flights diverted from polar routes by nasty space weather. Delays ranged from 8 minutes to nearly 4 hours, and each unplanned detour burned expensive fuel. Money isn't the only concern: Pilots and flight attendants who fly too often over the poles could absorb more radiation than is healthy. "This is an area of active research—figuring out how much exposure is safe for flight crews," says Hill. "Clearly, less is better."

To help airlines avoid bad space weather, NOAA has begun equipping its GOES weather satellites with improved instruments to monitor the Sun. Recent additions to the fleet, GOES 12 and 13, carry X-ray telescopes that take spectacular pictures of sunspots, solar flares, and coronal holes spewing streams of solar wind in our direction. Other GOES sensors detect solar protons swarming around our planet, raising alarms when radiation levels become dangerous.

"Our next-generation satellite will be even

better," says Hill. Slated for launch in 2014, GOES-R will be able to photograph the Sun through several different X-ray and ultra-violet filters. Each filter reveals a somewhat different layer of the Sun's explosive atmosphere—a boon to forecasters. Also, advanced sensors will alert ground controllers to a variety of dangerous particles near Earth, including solar protons, heavy ions and galactic cosmic rays.

"GOES-R should substantially improve our space weather forecasts," says Hill. That means friendlier skies on your future trips to Tokyo.

For the latest space weather report, visit the website of the Space Weather Prediction Center at <http://www.sec.noaa.gov>. For more about the GOES-R series spacecraft, see [http://goespoes.gsfc.nasa.gov/goes/spacecraft/r\\_spacecraft.html](http://goespoes.gsfc.nasa.gov/goes/spacecraft/r_spacecraft.html). For help in explaining geostationary orbits to kids—or anyone else—visit The Space Place at [http://spaceplace.nasa.gov/en/kids/goes/goes\\_poes\\_orbits.shtml](http://spaceplace.nasa.gov/en/kids/goes/goes_poes_orbits.shtml).

---

#### Consumer Items Named for Scientists

- 9> The Ein-Stein beer mug
  - 8> Jenner's Parenting for Idiots
  - 7> Alexander Graham Crackers and Watson Peanut Butter
  - 6> The Triple Cheese Heisenburger: Exactly one hour after eating it, you probably won't feel guilty.
  - 5> Crick's Back Massager
  - 4> Avogadro's Guaca-Mole
  - 3> Lord Bacon Bits
  - 2> Lavoisier Courvoisier
- and the Number 1 Consumer Item Named for a Scientist...
- 1> Curie adhesive bandages with anti-bacterial radium.

[ Copyright 2006 by Chris White ]  
[ <http://www.topfive.com> ]



**Grand Rapids Amateur Astronomical Association  
Membership Application or Renewal Form**

DATE: \_\_\_\_\_

- New Membership**       **Renewal**

Please fill out the information below as completely as possible.  
For Family memberships, please include all persons for whom membership is desired.

**Please Print**

Name: \_\_\_\_\_ Birthdate: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Home Phone: \_\_\_\_\_ Cell Phone: \_\_\_\_\_

E-Mail: \_\_\_\_\_

(Note: For Family members, if more than one e-mail address, please list others on back of application)

**Adult** (18 or older, a Minimum of \$35.00) . . . . . \$ \_\_\_\_\_

**Student** (through 17 yrs old, a Minimum of \$20.00) . . . . . \$ \_\_\_\_\_

**Family** (all members of one family, a Minimum of \$45.00) . . . . . \$ \_\_\_\_\_

*(Note: Contributions greater than the minimum dues are considered a donation and are tax-deductible)*

**Observatory Endowment Fund** . . . . . \$ \_\_\_\_\_

**Miscellaneous Donations** . . . . . \$ \_\_\_\_\_

*(Note: Contributions to these funds are tax-deductible. Indicate amount of donation)*

**OBSERVATORY USER FEE:** (a Minimum of \$20.00 per user) . . . . . \$ \_\_\_\_\_

*(Contributions of more than \$20 will help meet repairs and upgrade of equipment costs.)*

If you are a qualified user of the Veen Observatory, and wish to remain so, check  
the box for **“User Fee.”**

**TOTAL ENCLOSED** (From all categories above) . . . . . \$ \_\_\_\_\_

Make Check or Money Order to:  
**GRAND RAPIDS AMATEUR ASTRONOMICAL ASSOCIATION (or GRAAA)**

Mail to: Jerry Persha, GRAAA Treasurer  
199 Smith St.  
Lowell, MI 49331

**Grand Rapids Amateur Astronomical Association  
3308 Kissing Rock Ave. SE  
Lowell, MI 49331-8918**