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Journal of the Association of Lunar & Planetary Observers

Founded in 1947

The Strolling Astronomer

Volume 53, Number 3, Summer 2011

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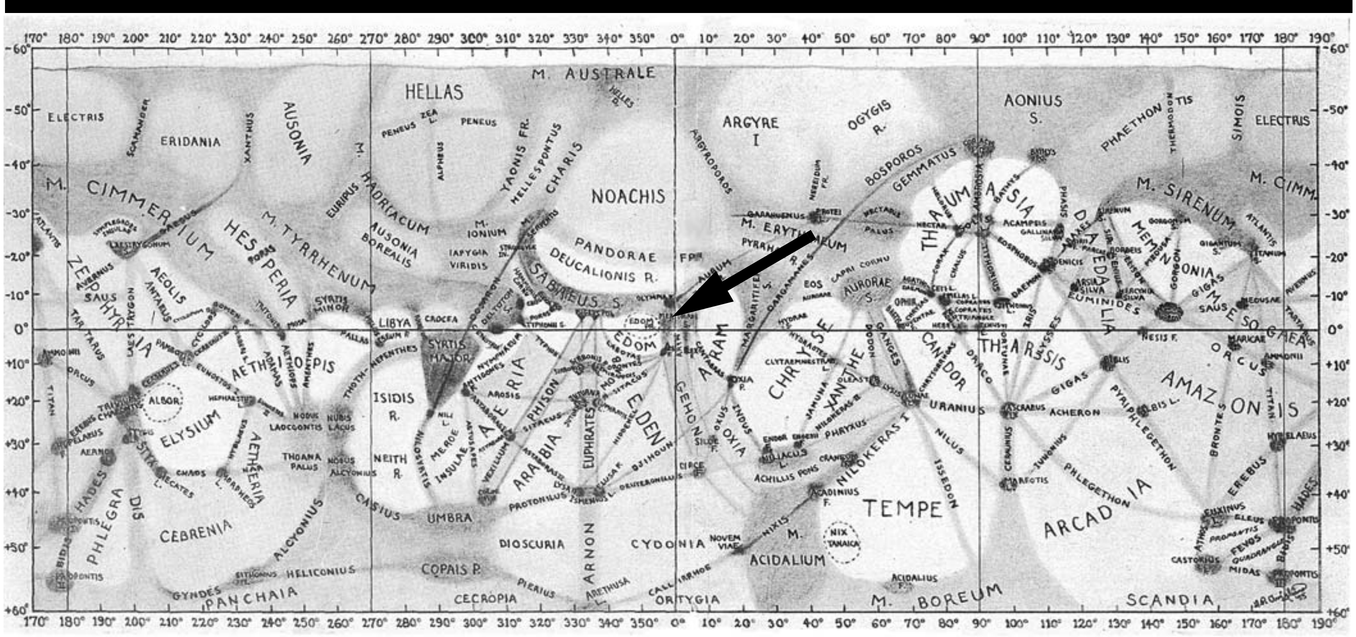
Inside this issue . . .

- *Final reminder on ALPO 2011 at Las Cruces*
- *Retrospective on the "Mars Flashes" expedition of 2001*
- *All you need to know about the current (2011-2012) Mars apparition*
- *Index to Volume 52 (2010) of The Strolling Astronomer*
- *Lunar feature spotlight: Montes Harbinger . . . plus reports about your ALPO section activities and much, much more!*



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Journal of the Association of Lunar & Planetary Observers
The Strolling Astronomer

Volume 53, No. 3, Summer 2011
This issue published in June 2011 for distribution in both portable document format (pdf) and also hardcopy format.

This publication is the official journal of the Association of Lunar & Planetary Observers (ALPO).

The purpose of this journal is to share observation reports, opinions, and other news from ALPO members with other members and the professional astronomical community.

For membership or general information about the ALPO, contact:

Matthew Will
ALPO Membership Secretary/Treasurer
P.O. Box 13456
Springfield, Illinois 62791-3456

E-mail to: matt.will@alpo-astronomy.org

Visit the ALPO online at:
http://www.alpo-astronomy.org

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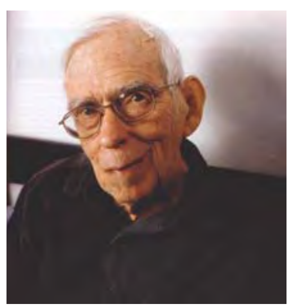
ALPO 2011 Conference
Las Cruces, New Mexico
July 21- 23



Join your ALPO colleagues for a weekend of observational solar system astronomy and planetary science at the prestigous New Mexico State University:

• Meet with Walter Haas, founder and director emeritus of our fine organization, the Assn of Lunar & Planetary observers
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• Special tours to the Very Large Array radio observatory, National Solar Observatory, Apache Point Observatories, New Mexico Museum of Space History, and White Sands Missile Range
• Awards banquet Saturday night

For more information, go to http://www.morning-twilight.com/alpo
e-mail alpoconference@morning-twilight.com

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Member, section and activity news

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Point of View
The Moon and Mars – What A Pair This Month

By Ken Poshedly, editor & publisher, *The Strolling Astronomer*

As we wrap up this issue of your latest JALPO, it's mid-June and plans are just about finalized for our annual get-together in late July, this time in Las Cruces, New Mexico. Why there? Well, besides being another opportunity to meet and talk astronomy and visit some really neat astro-locations, it's also an opportunity to meet our dear founder and still spry Walter Haas.

Now in his 90s, Walter enjoys his independence but must still be extra careful. He's now back home after a nasty fall there some weeks ago and recuperation at an area hospital. But yep, his mind is still sharp as a tack and he's almost back in form.

We can't wait to see you, Walter!!

Three big highlights in this JALPO are:

- A nicely detailed look back by Tom Dobbins and Bill Sheehan at the hubbub over observations of perceived flares on the surface of Mars and an expedition in 2001 by a mixed bag of professional and amateur astronomers to the Florida Keys to hopefully see a repeat occurrence of said flares. What they saw should reinforce our arguments that Earth-based observations are still very valid and very important tools for all of astronomy.

- A great report by our Mars Section coordinator Roger Venable on the Mars apparition currently in progress. Included is a Calendar of Selected Events which lists highlights of various Martian features for observers all the way until Mars is unavailable in April 2013.

- A study by ALPO Lunar Topographic Studies Program Coordinator Wayne Bailey of the often overlooked lunar region Montes Harbinger. One interesting characteristic about Montes Harbinger is that several types of features occur within this relatively small area that reward the observer at all lunar phases - especially when the terminator is near.

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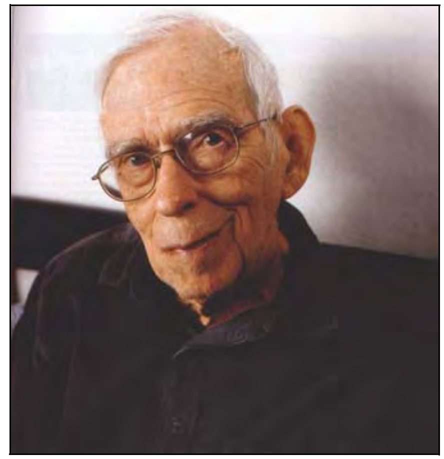
ALPO Founder on the Mend

ALPO founder and Director Emeritus Walter H. Haas has returned to his home after suffering a fall there and spending some weeks recovering at a local hospital and a rehabilitation facility.

Cards and other get-well wishes can be sent to him at his home, 2225 Thomas Drive, Las Cruces, NM 88001.



News of General Interest

ALPO 2011 Updates

Arrangements for the 2011 annual conference of the Assn of Lunar & Planetary Observers are nearly complete as this issue of your Journal goes to press (mid-June).

The event will be held Thursday through Saturday, July 21 - 23, on the campus of New Mexico State University at Las Cruces.

Registration - Individual (includes Friday night dinner

- Before July 1: $65
- After July 1: $80

Registration - Individual plus family member (includes Friday night dinner)

- Before July 1: $75
- After July 1: $95

Check payable to:

- “ASLC ALPO Conference”

Meeting/presentation venue:

- Room 201, Guthrie Hall, New Mexico State University

Banquet:

- $30 per person (location to be determined - check website for updates and speaker)

Lodging:

- Dorm rooms at NMSU -- check website for additional information
- Sleep Inn-University, 2121 South Triviz, Las Cruces, NM 88001; phone 575-522-1700; two queen-size beds per room $70+tax per night, reservation phone number, 1-877-424-6423.

Special tours (July 21 and July 22; see website for latest details:

- National Radio Astronomy Observatory's Very Large Array
- National Solar Observatory/White Sands Missile Range

Conference website:

- http://www.morning-twilight.com/alpo

Registration/questions e-mail:

alpoconference@morning-twilight.com

ALPO 2011 conference registrar:

- Robert Williams
  308 N. Mesquite St. #3
  Las Cruces, NM 88001

Registration packets will be sent out shortly.

Final Call for Papers: ALPO 2011

Participants are encouraged to submit research papers, presentations, and experience reports concerning Earth-based observational astronomy of our solar system for presentation at the event.

Topics

Suggested topics for papers and presentations include the following:

- New or ongoing observing programs and studies of solar system bodies, specifically, how those programs were designed, implemented and continue to function.
- Results of personal or ALPO group studies of solar system bodies possibly including (but not limited to) Venus cloud albedo events, dust storms and the polar caps of Mars, the various belts and Great Red Spot of Jupiter, the various belts and ring system of Saturn, variances in activity of periodic meteor showers and comets, etc.
- New or ongoing activities involving astronomical instrumentation, construction or improvement.
- Challenges faced by Earth-based observers including increased or lack of interest, deteriorating observing conditions brought about by possible global warming, etc.

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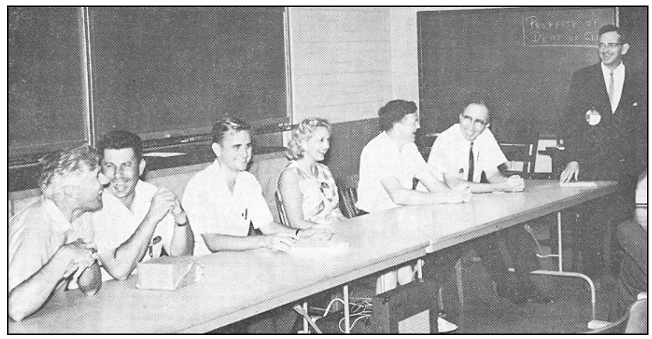
In Memoriam: Thomas A. Cragg, 1927 - 2011

(*The following is drawn from an extensive write-up by Elizabeth O. Waagen, senior technical assistant for the AAVSO, with additional notes by Geoff Gaherty, ALPO member and former Mercury Section Recorder for the ALPO and by Mary Cragg, wife of the late Mr. Cragg.*)

Thomas A. Cragg, longtime ALPO member and former ALPO Saturn Section Recorder, passed away at 1 p.m. (New South Wales, Australia, time), Friday, May 6, 2011. He was 83 and had been ill for about a year following a series of strokes. The funeral was in Coonabarabran on Tuesday, May 10, and burial in the Native Grove Cemetery there.

Mr. Cragg was the ALPO Saturn Section Recorder from April 1952 to June 1971 – a span of 19 years. It was during that time that he co-chaired the ALPO's first annual meeting, a joint gathering with the Western Amateur Astronomers, at Flagstaff, Arizona, in 1956. In 2009, he was the recipient of the Walter H. Haas Observers Award.



Tom Cragg (second from left) on a “Stump the Experts” panel at the 1966 Tuscon, Arizona, ALPO convention. Also shown are (left to right) Ewen Whitaker, Mr. Cragg, Dale Cruikshank, Winifred Cameron, Rev. Kenneth Delano, Prof. Paul Engle, and master-of-ceremonies Walter Haas. (Photo by Dennis Milon)

Says Geoff Gaherty, “I met Tommy at my first ALPO convention in San Jose in 1960, and had the pleasure of his wit and southern drawl as he drove me up Mount Hamilton to visit Lick observatory. At that time I had just become the ALPO's Mercury Recorder, but he was already one of the greats of lunar and planetary observing, mainly known for his stunningly detailed drawings of Saturn.”

Mr. Cragg was also extremely active with the American Assn of Variable Star Observers (AAVSO), serving three terms on the AAVSO Council: 1951-1953, 1962-1964, and 1964-1966. He had a strong interest for many years in Cepheid variables, and served as chair of the AAVSO Cepheid Committee from the years when Cepheids were of great interest to the professional community until the committee's dissolution in the late 1980s, its goals achieved.

Tom was the recipient of numerous AAVSO awards, including the 25th Merit Award, the Director's Award, a Solar Honor Award, Observer Awards for visual observations through the 150,000 observations level, and a Supernova Award (for assisting Robert O. Evans in his discovery of SN 1995V in NGC 1087).

Among Tom's other honors is the Astronomical League's Leslie C. Peltier Award for his work in variable stars and lunar and planetary astronomy. Minor planet (5068) Cragg is named in Tom's honor.

In his professional career, Tom's astronomical work included being an observer at Mount Wilson Observatory near Los Angeles, California, for many years, then, starting in the 1970s, serving for many more years as an observer at Siding Spring Observatory near Coonabarabran, New South Wales, Australia.

From Mr. Cragg’s wife Mary, we learn that he was a man for all seasons: “Tom was born in St. Louis, Missouri on Nov. 2, 1927. He moved to California when he was around 7 or 8 years old and don't know of the grade school attended but he received the Bausch & Lomb Honorary Science Award from John T. Francis Polytechnic High in Los Angeles. He was an accomplished chess player and won awards in local chess competitions. He also was an avid postal chess player.

“Another love was history about the Second World War and loved the strategy and tactics deployed by the leaders from both sides. Tom also got heavily into wargaming and has a formidable collection of board games. He also did wargaming by correspondence with several avid players. Tom loved music and played flute and clarinet, participating in our local band which played for various events around town, especially on Anzac Day here in Coonabarabran. In his later years he began playing Bridge. Another love was trains. He enjoyed watching videos and DVDs of trains and even when he was in the nursing home and already blind, I would put on the train DVDs for him. He didn't have to see the trains, but just hearing the sound and listening to the narration was enough for him.”

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Submission Format

Please observe and follow these guidelines:

- Presentations — The preferred format is Microsoft PowerPoint, though 35mm slides or overhead projector slides are also acceptable. The final presentation should not exceed 45 minutes in length, to be followed by no more than five (5) minutes of questions (if any) from the audience.
- Research Papers — Full and final research papers not being presented as described above should not exceed 5,000 words (approximately 8 pages), including figures and references. ***Important: The results described must not be under consideration for publication elsewhere.***
- Posters — 1,000 word maximum. Posters provide an opportunity to present late-breaking results and new ideas in an informal, visual and interactive format. Accepted poster submissions will receive a one-page description in the conference proceedings. The submission abstract must be no longer than one page.

Acceptance for presentation is contingent on registration for the conference. In the case of multiple authors, at least one must register.

Important Dates

- June 15, 2011 - Deadline for four- or five-sentence abstracts / proposals for papers, workshops, and posters.
- March 30, 2011 - Registration opens.
- July 1, 2011 - Late registration fee begins (late registration via mail accepted up to July 15; then in person at conference afterwards).
- July 21 - 23, 2011 - ALPO Con 2011.

Contact

Dr. Richard Schmude
Professor of Chemistry, Gordon College
Barnesville, Georgia 30204
770-358-0728
schmude@gdn.edu

Venus Volcano Watch

By Michael F. Mattei
micmattei@comcast.net

The Venus Volcano Watch continues. See the accompanying table for a list of times to be watching Venus for cloud activity both on the terminator and on the bright sun lit side.

Watch for a bulge on the terminator where the uplifted sunlit clouds would show on the dark side of the terminator, and on the sunlit side, watch for bulges of circular cloud formation like the tops of cumulus clouds.

There are three volcanoes that are believed to be active; Maat Mons, Ozza Mons and Sapas Mons. All are near the equator centered near CM 165°. From research of cloud formations and lit clouds on the dark side and circular sunlit side clouds, it may be possible to determine if a volcano has erupted. A correlation of these observations can be made to locate volcanoes on the surface of Venus.

Observations should be made at all times because there may be many more volcanoes that could be active. I would be happy to receive observations, drawings, sketches, CCD images. Please be sure of the time in UT and location of observer.

Date	Location from Terminator
14 Aug 2011	Superior conjunction; Venus enters eastern sky (morning).
13 Oct 2011	Volcanoes on 45° from bright limb.
28 Oct 2011	Volcanoes near CM.
7 Nov 2011	Volcanoes midway from CM to terminator.
17 Nov 2011	Volcanoes at the terminator.
5 Feb 2012	Volcanoes at the bright limb.

See Volume 51, No. 1, page 21 this Journal for an article of the events and what they look like. You can find the article by going to *http://www.alpo-astronomy.org/djalpo/51-1/JALPO51-1%20-%20Free.pdf*

ALPO Interest Section Reports

Web Services

Larry Owens,
Section Coordinator
Larry.Owens@alpo-astronomy.org

Follow us on Twitter, become our friend on FaceBook, or join us on MySpace.

Section Coordinators: If you need an ID for your section's blog, contact Larry Owens at *larry.owens@alpo-astronomy.org*

For details on all of the above, visit the ALPO home page online at *www.alpo-astronomy.org*

Computing Section

Larry Owens,
Section Coordinator,
Larry.Owens@alpo-astronomy.org

Important links:

- To subscribe to the ALPOCS yahoo e-mail list, *http://groups.yahoo.com/group/alpocs/*
- To post messages (either on the site or via your e-mail program), *alpocs@yahoogroups.com*.
- To unsubscribe to the ALPOCS yahoo e-mail list, *alpocs-unsubscribe@yahoogroups.com*

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- Visit the ALPO Computing Section online at *www.alpo-astronomy.org/computing*.

Lunar & Planetary Training Program

Tim Robertson,
Section Coordinator
cometman@cometman.net

For information on the ALPO Lunar & Planetary Training Program, go to *www.cometman.net/alpo/*; regular postal mail to Tim Robertson, 195 Tierra Rejada Rd. #148, Simi Valley CA, 93065; e-mail to *cometman@cometman.net*

ALPO Observing Section Reports

Eclipse Section

Mike Reynolds, section Coordinator
alpo-reynolds@comcast.net

Please visit the ALPO Eclipse Section online at *www.alpo-astronomy.org/eclipse*.

Meteors Section

Report by Bob Lundsford,
Section Coordinator
lunro.imo.usa@cox.net

Visit the ALPO Meteors Section online at *www.alpo-astronomy.org/meteorblog/* Be sure to click on the link to viewing meteors, meteor shower calendar and references.

Meteorites Section

Dolores Hill, Section Coordinator
dhill@lpl.arizona.edu

Visit the ALPO Meteorite Section online at *www.alpo-astronomy.org/meteorite/*

Comets Section

Gary Kronk,
acting Section Coordinator
kronk@cometography.com

Visit the ALPO Comets Section online at *www.alpo-astronomy.org/comet*.

Solar Section

Kim Hay, Section Coordinator,
kim.hay@alpo-astronomy.org

For information on solar observing – including the various observing forms and information on completing them – go to *www.alpo-astronomy.org/solar*

Mercury Section

Report by Frank J. Melillo,
Section Coordinator
frankj12@aol.com

As you read this, the MESSENGER spacecraft orbits Mercury, making it the first mission ever to do so. It has been over 35 years since Mariner 10 visited Mercury with three flybys. Now, the MESSENGER will study the innermost planet for one Earth-year in orbit. During its journey to Mercury, the spacecraft followed a path through the inner solar system for 6 ½ years, including one flyby of Earth, two flybys of Venus and three flybys of Mercury in order to conserve fuel. By the time it had reached Mercury on March 18, 2011, MESSENGER had traveled 4.9 billion miles!

Since the beginning of the year, the ALPO Mercury Section started out slowly. The number of observers had fallen within the past two years. I am hoping that many observers will be back on track while MESSENGER is in orbit. John Boudreau has a new Flea 3 camera, and it is supposed to be a slight improvement over his last camera. Already, his images of Mercury show incredible details and some of his results will appear in the 2010 Mercury apparition report.

Visit the ALPO Mercury Section online at *www.alpo-astronomy.org/mercury*.

Venus Section

Report by Julius Benton,
Section Coordinator
jlbaina@msn.com

Look for Venus low in the Eastern sky before sunrise, drawing nearer and nearer toward the Sun as the apparition progresses. For Western (Morning) apparitions, since Venus rises higher and higher in the sky as the morning hours

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progress, the planet is easily tracked into daylight for viewing when most of the glare associated with the planet against a dark sky is less. During the current 2010-11 Western (Morning) Apparition, the planet is passing through its waxing phases (a progression from crescent through gibbous phases). At the time of this report (early May), the gibbous disk of Venus is about 17.7" across and roughly 66.5% illuminated.

This apparition, observers continue to submit images, although observing activity has been poorer than in the last couple of observing seasons. Readers are reminded that high-quality digital images of the planet taken in the near-UV and near-IR, as well as other wavelengths through polarizing filters, continue to be needed by the Venus Express (VEX) mission, which started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in May 2006. This Professional-Amateur (Pro-Am) effort continues, and observers should submit images to the ALPO Venus Section as well as to the VEX website at:

http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38833&fbodylongid=1856.

Regular Venus program activities (including drawings of Venus in Integrated Light and with color filters of known transmission) are also valuable throughout the period that VEX is observing the planet, which continues into 2011. Since Venus has a high surface brightness it is potentially observable anytime it is far enough from the Sun to be safely observed.

The observation programs conducted by the ALPO Venus Saturn Section are listed on the Venus page of the ALPO website at http://www.alpo-astronomy.org/venus as well as in considerable detail in the author's ALPO Venus Handbook available from the ALPO Venus Section. Observers are urged to carry out digital imaging of Venus at the same time that others are imaging or making visual drawings of the planet (i.e., simultaneous observations).

Although regular imaging of Venus in both UV, IR and other wavelengths is extremely important and highly encouraged, far too many experienced observers have neglected making visual numerical relative intensity estimates and reporting visual or color filter impressions of features seen or suspected in the atmosphere of the planet (e.g., categorization of dusky atmospheric markings, visibility of cusp caps and cusp

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bands, measurement of cusp extensions, monitoring for the Schröter phase effect near the date of predicted dichotomy, and looking for terminator irregularities).

Routine use of the standard ALPO Venus observing forms will help observers know what needs to be reported in addition to supporting information such as telescope aperture and type, UT date and time, magnifications and filters used, seeing and transparency conditions, etc.

Venus as imaged on March 20, 2011 at 14:00UT by Michael Mattei of Littleton, MA, USA, with a 20.3 cm (8.0 in.) Schmidt-Cassegrain telescope equipped with a 742nm IR filter. Apparent diameter of Venus is 14.2", phase (k) 0.774 (77.4% illuminated) and visual magnitude 4.0. South is at top of image.

The ALPO Venus Section urges interested readers worldwide to join us in our projects and challenges ahead.

Individuals interested in participating in the programs of the ALPO Venus Section are encouraged to visit the ALPO Venus Section online http://www.alpo-astronomy.org/venusblog/.

Lunar Section:

Lunar Topographical Studies / Selected Areas Program

Report by Wayne Bailey, Program Coordinator

wayne.bailey@alpo-astronomy.org

The ALPO Lunar Topographical Studies Section (ALPO LTSS) received a total of 114 new observations from 12 observers during the January-March quarter. Four contributed articles were published, and 5 observations included extensive comments. The “Focus-On” series observation project continued with the Marius-Reiner Gamma region. Upcoming “Focus-On” subjects include Central Peaks with Craters (postponed from March due to my computer failure), Alphonsus, Plato and Posidonius.

Visit the following online web sites for more info:

- The Moon-Wiki: the-moon.wikispaces.com/Introduction
- Chandrayaan-1 M3: pds-imaging.jpl.nasa.gov/portal/chandrayaan-1_mission.html
- LROC: lroc.sese.asu.edu/EPO/LROC/lroc.php
- ALPO Lunar Topographical Studies Section moon.scopesandscapes.com/alpo-topo
- ALPO Lunar Selected Areas Program moon.scopesandscapes.com/alpo-sap.html
- ALPO Lunar Topographical Studies Smart-Impact WebPage moon.scopesandscapes.com/alpo-smartimpact
- The Lunar Observer (current issue) moon.scopesandscapes.com/tlo.pdf
- The Lunar Observer (back issues) moon.scopesandscapes.com/tlo_back.html
- Banded Craters Program: moon.scopesandscapes.com/alpo-bcp.html
- The Lunar Discussion Group: tech.groups.yahoo.com/group/Moon-ALPO/

Lunar Domes Survey

Marvin Huddleston, FRAS, Program Coordinator

kc5lei@sbcglobal.net

Visit the ALPO Lunar Domes Survey on the World Wide Web at www.geocities.com/kc5lei/lunar_dome.html

Lunar Meteoritic Impacts

Brian Cudnik, Program Coordinator

cudnik@sbcglobal.net

Please visit the ALPO Lunar Meteoritic Impact Search site online at www.alpo-astronomy.org/lunar/lunimpacts.htm.

Geocentric Phenomena of the 2010-2011 Western (Morning) Apparition of Venus in Universal Time (UT)

Inferior Conjunction	2010	Oct 19 (angular diameter = 58.3 arc-seconds)
Greatest Brilliancy	2010	Dec 04 (m_v = – 4.6)
Greatest Elongation West	2011	Jan 08 (47º west of the Sun)
Predicted Dichotomy	2011	Jan 08.28 (exactly half-phase)
Superior Conjunction	2011	Aug 16 (angular diameter = 9.6 arc-seconds)

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Lunar Transient Phenomena

Dr. Anthony Cook,
Program Coordinator
tony.cook@alpo-astronomy.org

Note that live LTP alerts are now available via Twitter at *http://twitter.com/lunarnaut*.

Please visit the ALPO Lunar Transient Phenomena site online at *http://alpo-astronomy.org/lunar/ltp.html*.

Mars Section

Roger Venable,
Section Coordinator
rjvmd@hughes.net

This issue of "The Strolling Astronomer" has two Mars-related articles that you don't want to miss -- a description of the characteristics of the apparition that has just begun (beginning on page xx) and a review of the salient features of flashes on the Red Planet (beginnion page).

Visit the ALPO Mars Section online at *www.alpo-astronomy.org/mars*.

Minor Planets Section

Frederick Pilcher,
Section Coordinator
pilcher@ic.edu

Minor Planet Bulletin Vol. 38, No. 2, 2011 April - June, contains lightcurves and rotation periods for 13 additional Trojan asteroids found by Linda French, Robert Stephens, and colleagues. A binned graph of rotation periods for 40 Trojan asteroids larger than 70 kilometers, most of those in that size range, is presented.

Their distribution of rotation periods somewhat resembles those of main belt asteroids, although some statistical uncertainty remains. Among the asteroids smaller than 1 kilometer and detectable only upon close approach to Earth, some are super fast rotators which could survive centrifugal disruption only if they were "monoliths," single unbroken rocks.

Peter Birtwhistle has observed four more of them, 2010 TG19, 2010 UJ7, 2010 VK139, and 2010 XE11, with periods between 0.019 and 0.053 hours.

Lightcurves with derived rotation periods are published for 133 other asteroids, numbers 25, 140, 149, 151, 185, 186, 301, 436, 475, 507, 549, 571, 574, 585, 596, 603, 607, 630, 635, 795, 875, 893, 912, 926, 938, 1080, 1082, 1172, 1177, 1203, 1263, 1333, 1404, 1448, 1498, 1506, 1550, 1600, 1663, 1679, 1699, 1730, 1749, 1796, 1811, 1982, 1996, 2000, 2241, 2263, 2266, 2352, 2357, 2437, 2460, 2494, 2518, 2699, 2715, 2797, 2846, 2853, 3063, 3104, 3252, 3277, 3309, 3368, 3408, 3451, 3540, 3605, 3709, 3747, 3873, 3915, 3940, 4003, 4063, 4091, 4209, 4289, 4431, 4489, 4690, 4834, 4867, 5277, 5390, 5477, 5630, 5940, 6361, 6425, 7870, 8380, 9069, 9774, 10217, 10452, 10772, 11118, 11279, 11976, 13331, 14657, 14668, 15700, 16026, 16558, 18108, 22357, 24815, 25884, 44600, 45646, 48601, 48707, 49667, 69406, 74219, 75489, 76818, 86192, 86217, 86257, 100926, 107668, 126074, 150370, 2004 GD2, 2010 WA9, 2010 XM56.

Some of these provide secure period determinations, some only tentative ones. Some are of asteroids with no previous lightcurve photometry, others are of asteroids with previous period determinations which may be consistent or inconsistent with the earlier values.

The *Minor Planet Bulletin* is a refereed publication and that it is available on line from *http://www.MinorPlanetObserver.com/astlc/default.htm.* Annual voluntary contributions of $5 or more in support of the publication are welcome.

In addition, please visit the ALPO Minor Planets Section online at *http://www.alpo-astronomy.org/minor*.

Jupiter Section

Richard W. Schmude, Jr.,
Section Coordinator
schmude@gdn.edu

I have started working on the 2010-2011 Jupiter apparition report. The images are of excellent quality and show many small features. One image by Tomoyuki Yoshida shows 25 small dark spots that lie just below the South Temperate Belt. These spots appear to follow the South Temperate Current Jet stream. A series of images taken in late August also show the Great Red Spot with a small

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We ask all who are considering an online purchase of Orion astronomical merchan-

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Lunar Calendar, Third Quarter, 2011 (All Times UT)

July 01	04:53	New Moon (Start of Lunation 1095)
July 02	23:00	Moon 4.9° SSW of Mercury
July 07	14:05	Moon at Perigee (369,565 km – 229,637 miles)
July 07	23:00	Moon 7.5° SSW of Saturn
July 08	06:29	First Quarter
July 12	16:54	Extreme South Declination
July 14	01:00	Moon 3.3° S of Pluto
July 15	06:38	Full Moon
July 18	05:00	Moon 5.4° NNW of Neptune
July 21	01:00	Moon 5.8° NNW of Uranus
July 21	22:48	Moon at Apogee (404,356 km – 251,255 miles)
July 23	05:03	Last Quarter
July 23	22:00	Moon 4.9° NNW of Jupiter
July 27	03:06	Extreme North Declination
July 27	19:00	Moon 1.0° ESE of Mars
July 30	08:00	Moon 4.2° SSW of Venus
July 30	18:39	New Moon (Start of Lunation 1096)
Aug. 01	09:00	Moon 1.5° of Mercury
Aug. 02	21:00	Moon at Perigee (365,755 km – 227,270 miles)
Aug. 04	06:00	Moon 7.2° SSW of Saturn
Aug. 06	11:08	First Quarter
Aug. 08	23:18	Extreme South Declination
Aug. 10	05:00	Moon 3.3° S of Pluto
Aug. 13	18:57	Full Moon
Aug. 14	12:00	Moon 5.2° NNW of Neptune
Aug. 17	07:00	Moon 5.7° NNW of Uranus
Aug. 18	16:24	Moon at Apogee (405,159 km – 251,754 miles)
Aug. 20	09:00	Moon 4.7° NNW of Jupiter
Aug. 21	21:56	Last Quarter
Aug. 23	12:18	Extreme North Declination
Aug. 25	13:00	Moon 2.6° S of Mars
Aug. 27	24:00	Moon 2.4° SSW of Mercury
Aug. 27	03:03	New Moon (Start of Lunation 1097)
Aug. 29	08:00	Moon 6.4° SSW of Venus
Aug. 30	17:36	Moon at Perigee (360,857 km – 224,226 miles)
Aug. 31	20:00	Moon 6.9° SSW of Saturn
Sept. 04	17:39	First Quarter
Sept. 05	05:00	Extreme South Declination
Sept. 06	11:00	Moon 3.0° S of Pluto
Sept. 10	19:00	Moon 5.3° NNW of Neptune
Sept. 12	09:26	Full Moon
Sept. 13	14:00	Moon 5.6° NNW of Uranus
Sept. 15	06:24	Moon at Apogee (406,067 km – 252,318 miles)
Sept. 16	17:00	Moon 4.6° N of Jupiter
Sept. 19	20:06	Extreme North Declination
Sept. 20	13:39	Last Quarter
Sept. 23	04:00	Moon 4.6° SSW of Mars
Sept. 27	09:00	Moon 6.3° SSW of Mercury
Sept. 27	11:08	New Moon (Start of Lunation 1098)
Sept. 28	01:02	Moon at Perigee (357,555 km – 222,174 miles)
Sept. 28	06:00	Moon 5.5° SSW of Venus
Sept. 28	09:00	Moon 6.6° SSW of Saturn

Table courtesy of William Dembowski

dark spot in it. This dark spot is only about one-third the size of Io.

Jupiter was a few percent brighter in 2010 than normal. This may have been due to the lack of the South Equatorial Belt during most of 2010.

The 2011-2012 Jupiter apparition has just begun and at least four images have already been posted on the ALPO Japan Latest website. Please remember to post your images on either the ALPO Japan Latest website or on the Arkansas Sky Website. In this way, your images will be archived.

Visit the ALPO Jupiter Section online at *http://www.alpo-astronomy.org/jupiter*

Galilean Satellite Eclipse Timing Program

John Westfall, Assistant Jupiter Section Coordinator
johnwestfall@comcast.net

A new apparition of Jupiter has begun, and by the time you read this, Jupiter and its Galilean satellites will be visible in the morning sky.

If you have not yet submitted your timings of the eclipses of the Galilean satellites for the past apparition (2010-2011), we would be happy to receive them. We have placed on the ALPO Jupiter Section webpage a schedule of satellite eclipses for the 2011-2012 Apparition of Jupiter.

Currently, three circumstances have come together to allow us to view something we see only rarely – both the beginnings and endings of the same eclipses of Europa. For the great majority of the time, we can see only disappearances of the satellite before opposition, and only reappearances after opposition (indeed, some literature incorrectly states that this is always the case).

The first condition that helps create this series of events is that Jupiter is closer than average to the Sun, having reached perihelion on 2011 March 17 (4.9494 AU from the Sun). The second situation is that the Earth is well north of Jupiter's equator (and thus the orbital planes of the Galilean satellites; 3.89° north on 2011 October 01). Finally, the Sun also is north of the Jupiter's equator (3.57° north on 2012 March 10). This allows us to peek past the planet and, before opposition see both eclipse disappearances and reappearances; the last very close to Jupiter's limb. After opposition, we have the opposite, with the

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Completely Visible Eclipses of Europa by Jupiter, 2011-2012

Series 1 (17 eclipses)			Series 2 (15 eclipses)			Series 3 (18 eclipses)		
TT Date	Begin	End	TT Date	Begin	End	TT Date	Begin	End
2011	hh mm	hh mm	2011-12	hh mm	hh mm	2012	hh mm	hh mm
Jul 05	05 07	07 39	Dec 29-30	22 25	00 52	Aug 06	07 28	09 51
Jul 08	18 24	20 56	Jan 02	11 44	14 11	Aug 09	20 45	23 08
Jul 12	07 41	10 14	Jan 06	01 04	03 31	Aug 13	10 02	12 25
Jul 15	20 59	23 31	Jan 09	14 23	16 50	Aug 16-17	23 19	01 42
Jul 19	10 16	12 48	Jan 13	03 43	06 10	Aug 20	12 36	14 59
Jul 22-23	23 33	02 05	Jan 16	17 02	19 29	Aug 24	01 53	04 16
Jul 26	12 51	15 22	Jan 20	06 23	08 49	Aug 27	15 10	17 33
Jul 30	02 08	04 40	Jan 23	19 42	22 08	Aug 31	04 27	06 50
Aug 02	15 26	17 57	Jan 27	09 02	11 28	Sep 03	17 44	20 07
Aug 06	04 43	07 14	Jan 30-31	22 21	00 47	Sep 07	07 01	09 24
Aug 09	18 01	20 32	Feb 03	11 41	14 07	Sep 10	20 18	22 41
Aug 13	07 18	09 49	Feb 07	01 00	03 26	Sep 14	09 35	11 58
Aug 16	20 36	23 07	Feb 10	14 20	16 46	Sep 17-18	22 52	01 15
Aug 20	09 53	12 24	Feb 14	03 39	06 04	Sep 21	12 09	14 32
Aug 23-24	23 11	01 42	Feb 17	16 59	19 24	Sep 25	01 26	03 49
Aug 27	12 28	14 59	-	-	-	Sep 28	14 43	17 06
Aug 31	01 46	04 17	-	-	-	Oct 02	04 00	06 24
-	-	-	-	-	-	Oct 05	17 18	19 41

disappearances next to Jupiter's limb and the reappearances well away from the planet.

There are three periods when we will be able to see these complete eclipses of Europa: 2011 July 5 - August 31; 2011 December 29/30 - 2012 February 17; and 2012 August 06 - Oct 05. These three series contain a total of 50 eclipses of Europa, all taking place well away from solar conjunction.

We hope that some of our readers will watch and time some of these events. (Normally, we must time Europa's eclipse reappearances months after we time its disappearances.) The following table gives the dates and terrestrial times (TT) of these events. (Subtract about one minute to convert TT to UT.)

There is one more unusual event, and this concerns the satellite Io. Most of the time, the visibility of Io's eclipses resembles what is the normal situation for Europa – only disappearances before opposition and only reappearances afterward. However, in 2011, *Io will be in eclipse at the moment of opposition*, on 2011 October 29, with predicted UTs as follows: Io disappearance 00h 40m, Jupiter in opposition to the Sun 01h 27m, Io reappearance 02h 51m. Thus we will be able to see disappearance and reappearance for the same eclipse of Io, although the two events will occur when the satellite is very close to the planet's limb. (This last happened in 2009 and 2006, but then not since 1996.) As with the unusual complete eclipses of Europa, we hope that some of our readers will watch and time this event.

New and potential observers are invited to participate in this worthwhile ALPO observing program.

Contact John Westfall via regular mail at P.O. Box 2447, Antioch, CA 94531-2447 USA or e-mail to johnwestfall@comcast.net to obtain an observer's kit, also available on the Jupiter Section page of the ALPO website.

Saturn Section

Julius Benton,
Section Coordinator
jlbaina@msn.com

Saturn currently appears at apparent visual magnitude +0.5, well up in the east after sunset having passed opposition on April 4th. The planet's northern hemisphere and north face of the rings are becoming increasingly visible as the ring tilt toward Earth increases throughout the next several years, with regions south of the rings becoming progressively less favorable to view. Right now, the rings are inclined about +7.9 toward Earth and will reach as much as +11.5 during the apparition,

With inclinations of the rings round +9.0°, observers can still witness and digitally image transits, shadow transits, occultations, and eclipses of satellites lying near Saturn's equatorial plane. Apertures great than about 20.3 cm (8.0 in.) will likely offer the best opportunities for observing and imaging these events, except perhaps in the case of Titan.

Those who can image and obtain precise timings (UT) to the nearest second of ingress, CM passage, and egress of a satellite or its shadow across the globe of Saturn should send their data to the ALPO Saturn Section as quickly as possible. Notes should be made of the belt or zone on the planet crossed by the shadow or satellite, and visual numerical relative intensity estimates of the satellite, its shadow, and the belt or zone it is in front of is important, as well as drawings of the immediate area at a given time during the event.

As of this writing, there have been over 750 visual observations and digital images submitted this apparition. By far, the most notable highlight this apparition has been the emergence of a massive storm in the region of Saturn's North Tropical Zone (NTrZ) that was first detected by ALPO observers in early December 2010. It has been regularly observed and imaged ever since, easily the brightest feature seen on the planet for well over a decade! This long-enduring NTrZ white "complex" has exhibited considerable brightening over time, undergoing rapid evolution and showing morphologically differentiation into bright and dusky structures along its length. The storm has progressively widened showing longitudinal growth, essentially encircling the globe of the planet at the latitude of the NTrZ. Cassini images also have documented how the storm has rapidly grown nearly ten times its original size and exhibited structural metamorphosis since last December.

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Presumably as the inclination of Saturn's northern hemisphere toward the Sun increases, with subsequently greater solar insolation affecting these regions, conditions are more favorable for activity to develop, such as the NTrZ white storm currently being monitored. Observers are encouraged to continue watching and imaging for further changes in the NTrZ storm over the coming months. Color filter techniques can be used by visual observers to determine which visual wavelengths produce the best views of the NTrZ storm, and consistent digital imaging at visual, infrared, UV, and methane (CH4) wavelength bands is particularly important.

The observation programs conducted by the ALPO Saturn Section are listed on the Saturn page of the ALPO website at *http://www.alpo-astronomy.org/* as well as in considerable detail in the author's book, ***Saturn and How to Observe It***, available from Springer, Amazon.com, etc., or by writing to the ALPO Saturn Section for further information. Observers are urged to carry out digital imaging of Saturn at the same time that others are imaging or visually watching Saturn (i.e., simultaneous observations). Although regular imaging of Saturn is extremely important and highly encouraged, far too many experienced observers have neglected making visual numerical relative intensity estimates, which are badly needed for a continuing comparative analysis of belt, zone, and ring component brightness variations over time. So, this type of visual work is strongly encouraged before or after imaging the planet.

The ALPO Saturn Section appreciates the dedicated work by so many observers who regularly submit their reports and images. *Cassini* mission scientists, as well as other professional specialists, are continuing to request drawings, digital images, and supporting data from amateur observers around the globe in an active Pro-Am cooperative effort.

Information on ALPO Saturn programs, including observing forms and instructions, can be found on the Saturn pages on the official ALPO Website at *www.alpo-astronomy.org/saturn*.

All are invited to also subscribe to the Saturn e-mail discussion group at *Saturn-ALPO@yahoogroups.com*

Awesome digital image showing the current appearance of the massive, evolving NTrZ storm taken on April 17, 2011 at 23:19UT by Damian Peach, Norfolk, UK, using a 35.6 cm (14.0 in.) SCT in visible light (RGB) in excellent seeing. Ring tilt is +8.1º. CMI = 315.0°, CMII = 173.8°, CMIII = 173.4°. S is at the top of the image.

Geocentric Phenomena for the 2010-2011 Apparition of Saturn in Universal Time (UT)

Conjunction	2010 Oct 01^d
Opposition	2011 Apr 04^d
Conjunction	2011 Oct 13^d
Opposition Data:	
Equatorial Diameter Globe	19.3 arc-seconds
Polar Diameter Globe	17.5 arc-seconds
Major Axis of Rings	43.8 arc-seconds
Minor Axis of Rings	6.6 arc-seconds
Visual Magnitude (m_v)	0.4 m_v (in Virgo)
B =	+8.6º

Remote Planets Section

Richard W. Schmude, Jr., Section Coordinator
schmude@gdn.edu

I have finished writing the 2010-2011 apparition report for Uranus and Neptune. I am planning to submit this report to the editor in June. Jim Fox contributed over a dozen high-quality brightness measurements of Uranus and Neptune during 2010. Uranus is starting to get brighter while Neptune remains about as bright as it has been for at least the past 20 years. I am hoping that people will continue to measure the brightness of these planets in 2011.

Both Uranus and Neptune will be visible in the pre-dawn sky during June and early July. Uranus will be about as bright as a magnitude 5.8 star and Neptune will be about as bright as a magnitude 7.8 star during early summer.

A reminder that the book *Uranus, Neptune and Pluto and How to Observe Them* is now available from Springer at *www.springer.com/astronomy/popular+astronomy/book/978-0-387-76601-0* or elsewhere (such as *www.amazon.ca/Uranus-Neptune-Pluto-Observe-Them/dp/0387766014*) to order a copy.

Visit the ALPO Remote Planets Section online at *http://www.alpo-astronomy.org/remote*.

Feature Story:
Index to Volume 52 (2010) of The Strolling Astronomer

By Michael Mattei
E-mail: *micmattei@comcast.net*

PUBLICATION DATA

AUTHOR INDEX

SUBJECT INDEX

Feature Story:
The Harbinger Mountains Area

By Wayne Bailey,
Program Coordinator
Lunar Topographic Studies/
Selected Areas Program
wayne.bailey@alpo-astronomy.org

Online Readers

Left-click your mouse on the e-mail address in blue text to contact the author of this article, and selected references also in blue text at the end of this paper for more information there.

Introduction

An interesting, but often overlooked, region of the Moon is the area around the Montes Harbinger (Figure 1). Aristarchus, close-by to the south-west, attracts the observer's attention with its brightness and wealth of easily observed detail. However, the Montes Harbinger area, separated from the Aristarchus plateau by a rather bland strip of Oceanus Procellarum, deserves closer examination. Several types of features occur within this relatively small area that reward the observer at all phases — especially when the terminator is near.

Overview of the Area

Aristarchus, Krieger, Angstrom and Brayley approximately bound the region under discussion, although there is no special significance to these markers except that they are easily identified craters. The area appears to be a slightly domed, elevated plateau whose most obvious features are the isolated blocks of the Montes Harbinger and the partially buried crater Prinz. Numerous small craters give the area the appearance of being rougher than the surrounding mare surface. Several domes can be found southeast of Prinz and the rilles of Rimae Prinz extend north from Prinz. The low ridges of Dorsa Argand enclose the northeast side of the region. Aristarchus rays cover the region (Figure 2).

Discussion

Montes Harbinger were named as such because they are the "harbingers" (that is, those in advance and who make known the approach) of dawn for Aristarchus. They are a loose group of individual, blocky mountains northeast of Prinz that seem to be the highest points of a flooded section of Mare Imbrium rim. There are three main peaks and several smaller ones, plus several low relief features that look like traces of buried peaks. With very low sun illumination, the surface has the appearance of a very shallow, broad dome.

Prinz is a partially buried crater on the southern end of the plateau, with its southern rim buried in the mare channel between it and Aristarchus. About three quarters of the rim is visible, but the western quarter is barely above the mare surface. The floor is completely flooded. The outer

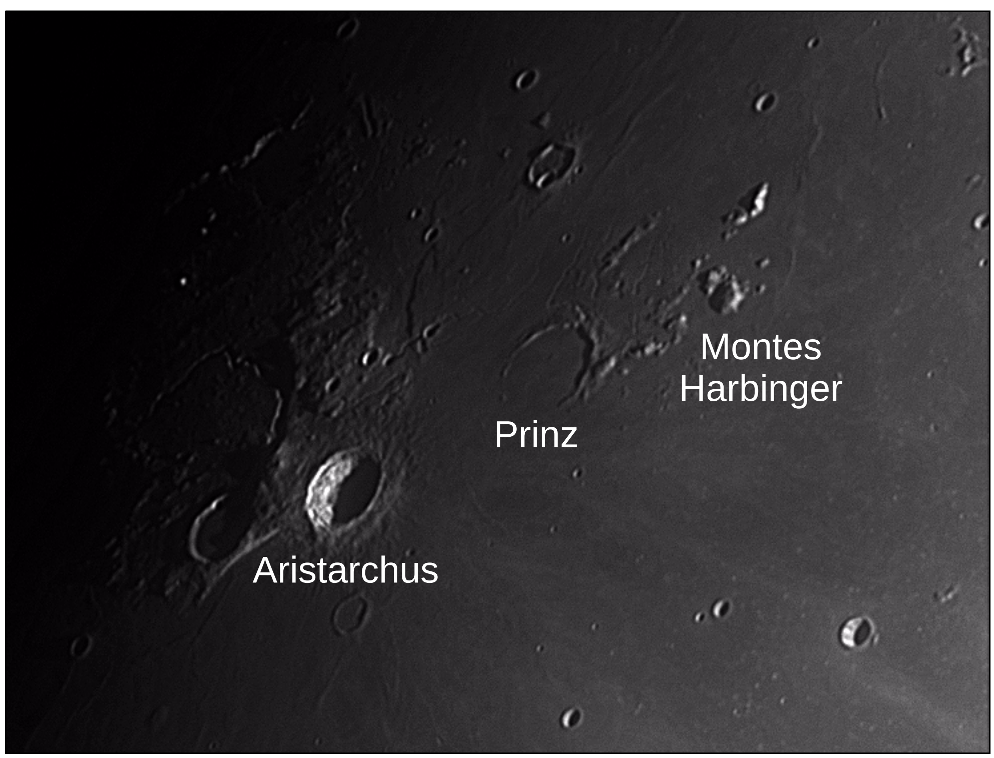

Figure 1. Aristarchus-Montes Harbinger area. Cropped from an image by Howard Eskildsen, Ocala, Florida, USA. November 29, 2009, 02:07 UT. Seeing 8/10, transparency 5/6. Meade 6-in., f/8 refractor, 2x barlow, DMK 41AU02.AS, no filter.

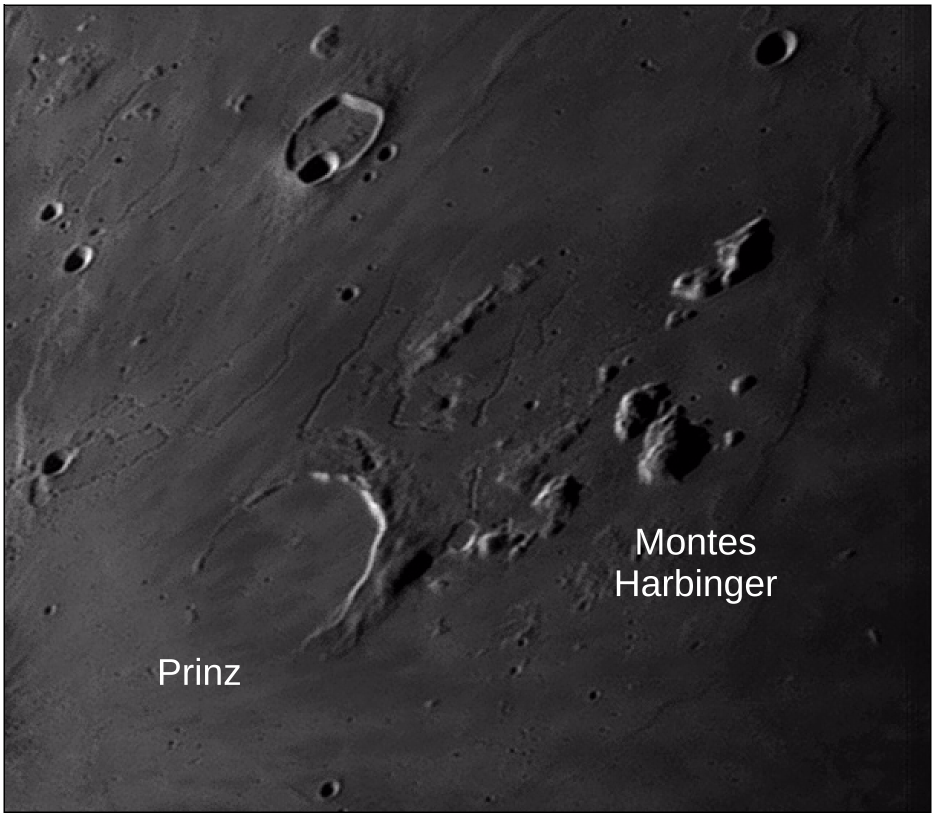

Figure 2. Montes Harbinger Region. Cropped from an image by Paolo R. Lazzarotti, Massa, Italy. August 15, 2009, 03:58 UT. Seeing 6/10, Transparency 4/5. Gladius CF-315 Lazzarotti Optics telescope, LVI-1392 PRO experimental camera, Edmund Optics R filter.

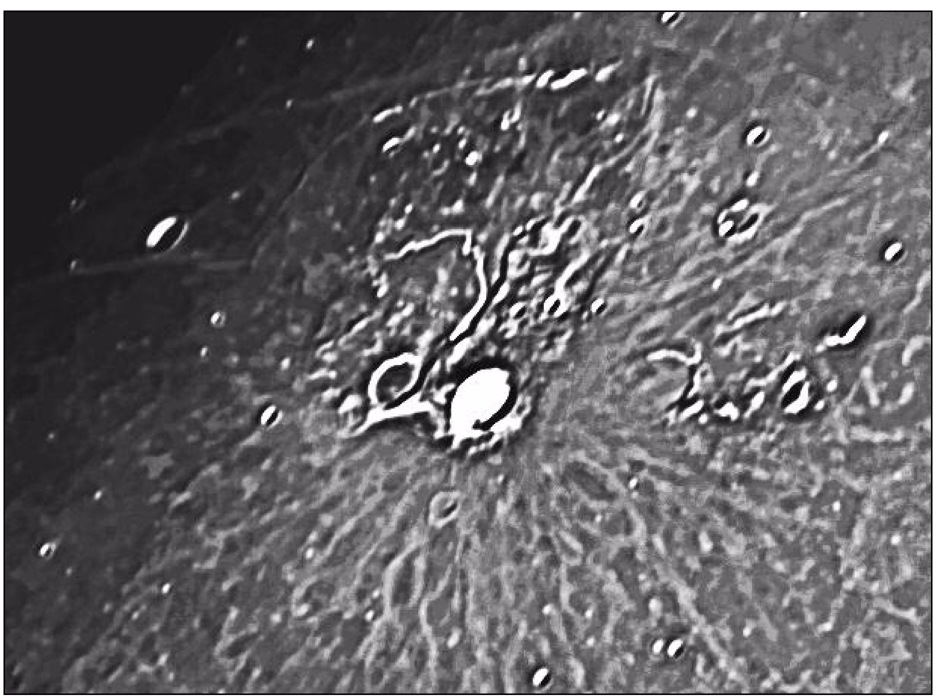

Figure 3. Aristarchus Rays. Richard Hill, Tucson, Arizona, USA. July 16, 2008, 05:19 UT. Seeing 5/10. Questar, 2x barlow, SPC900NC, UV/IR blocking filter. North upper right, East lower right. Processed to emphasize rays.

wall on the north and east is mostly intact.

A small crater on the north rim of Prinz, Vera (Prinz A), is the source of the longest rille of the Rimae Prinz. This rille proceeds northwest down the wall, then west around the base before making a sharp turn to the north, and finally meanders only slightly until it fades out northeast of Krieger C. Another rille begins south of Ivan (Prinz B), extends west, then makes a sharp turn to the north past the south end of a prominent ridge, and finally parallels the previous rille onto the mare. A third rille begins in a small depression just east of Ivan and extends toward the north end of the ridge, but fades out before reaching it. Another short rille is located east of the northern section of this rille. And a fifth short, but wide rille is just north of a depression between Prinz and the southernmost small peak. These rilles are more challenging objects to observe than Vallis Schroteri and the Cobra Head, but they are visible in 4-inch or larger telescopes.

Dorsa Argand form a low ridge east of the Montes Harbinger, continuing northward past Angstrom. They seem to combine with the Dorsum Arduino. These low wrinkle ridges are best viewed under very low sun illumination.

Rays from nearby Aristarchus coat much of this area. Richard Hill's image (Figure 3), which he processed to emphasize rays, illustrates the extent of ray coverage. Note that the rays are visible even in Figure 1, which was taken shortly after local sunrise.

Crater density is noticeably lower on the mare surrounding the Montes Harbinger area, indicating that the surface here predates the flooding of

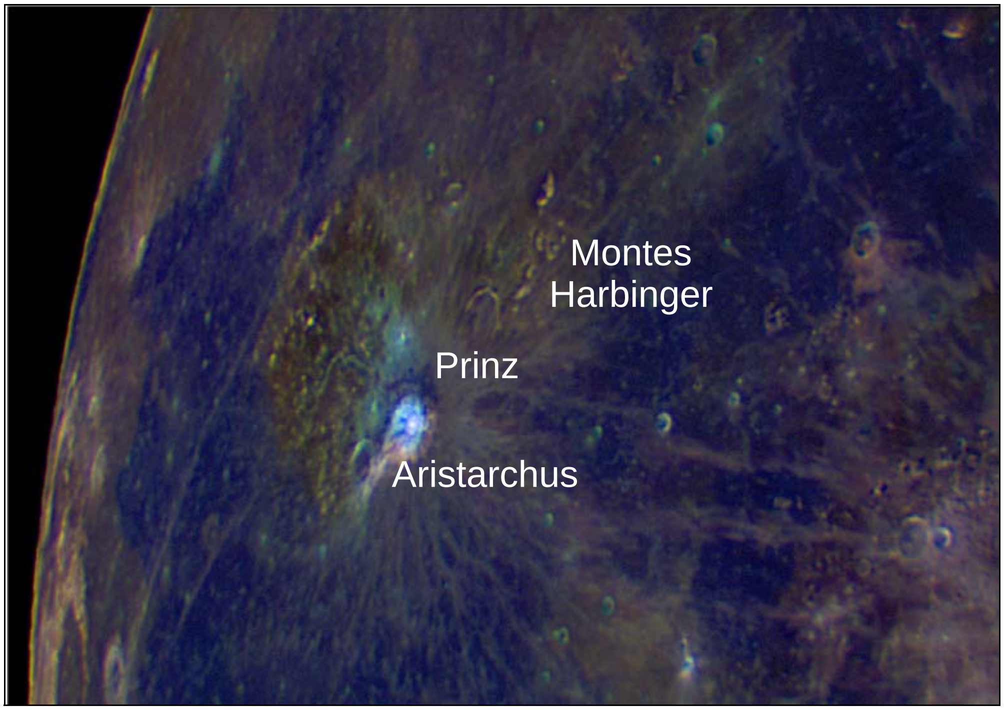

Figure 4. False-color image of the Aristarchus-Montes Harbinger area. Wayne Bailey, Sewell, New Jersey, USA. December 10, 2006, 07:05 UT. Seeing 3/10, Transparency 5/6, Colongitude 150°. C-11, SCT, f/10, Lumenera Skynyx 2-1M, Schuler IR83, R, U filters (RGB channels). (Note: Color version of this image viewable in online pdf only.)

the mare. Prinz, which is partially buried by mare lava, confirms this. Whether Prinz was created on a sloping surface or instead on a horizontal surface that was subsequently tilted by uplift of the Montes Harbinger area cannot be unambiguously determined from topography alone, although Wood (2003, pg 169) argues that the rilles indicate uplift after formation. The color of this area is similar to that of the Aristarchus plateau and distinctly different from the mare surface. These seem to be two islands, separated by a mare channel, at the juncture of Oceanus Procellarum and Mare Imbrium. Figure 4 is a false color image of the area, created by combining near-infrared, red and ultraviolet images. The Montes Harbinger area, the Aristarchus plateau and the channel between them are brown, the mare surfaces are blue, and the Aristarchus rays appear slightly pink in this image.

It's notable that a relatively narrow channel of mare material separates the two plateaus. Is this just a topographically low valley that happened to be below the level of the mare flood, or was there some geologic event that depressed this section, raised the plateaus, or even split a single, pre-existing plateau? The color indicates a relation to the plateaus.

Finally, if as suggested earlier, the Montes Harbinger are the tops of a buried section of Imbrium basin rim, why is the color of the area so different from the neighboring mare?

Summary

The Montes Harbinger area is a compact area with several interesting features. While some of those features present challenges to the observer, they are not so difficult as to be frustrating to locate or observe. The region is also conveniently observable under low-angle illumination several days before Full Moon, when the Moon is available reasonably early in the evening. This is a time when even deep-sky aficionados are looking for interesting objects to observe.

Additional Reading

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A.L.P.O. Lunar Section: Selected Areas Program

Albedo and Supporting Data for Lunar Drawings

Lunar Feature Observed : ______________________________

(use ***Drawing Outline Chart*** for making drawings and attach to this form)

Observer: ____________________________________ Observing Station: __________________________________

Mailing Address: ____

street city state zip

Telescope: ____

instrument type aperture (cm.) focal ratio

Magnification(s): __________X __________X __________X Filter(s): F1 ________ F2 ________

Seeing: ____________________ [A.L.P.O. Scale = 0.0 (worst) to 10.0 (perfect)]

Transparency: _______________________ [Faintest star visible to unaided eye]

Date (UT): _______________________ Time (UT): ___________ ____________

year month day start end

Colongitude: _________________° _________________°

start end

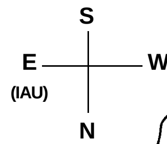
Albedo Data

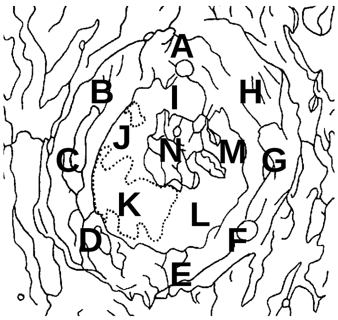
(refer to ***Albedo Reference Chart*** which shows "Assigned Albedo Indices" for feature and attach to this form)

Assigned Albedo Index	Albedo IL	Albedo F1	Albedo F2	Assigned Albedo Index	Albedo IL	Albedo F1	Albedo F2
A				J			
B				K			
C				L			
D				M			
E				N			
F				O			
G				P			
H				Q			
I				R			

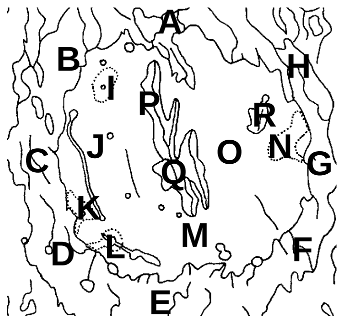
NOTES:

A.L.P.O. Lunar Selected Areas Program





Theophilus



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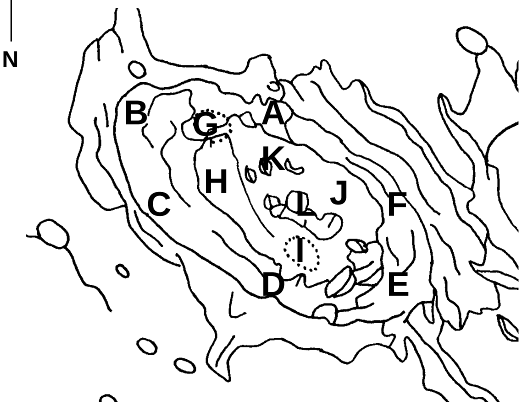

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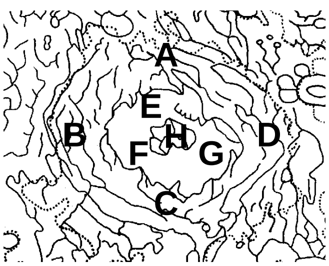

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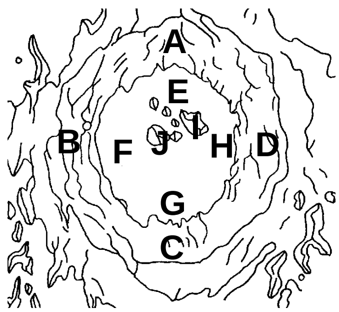

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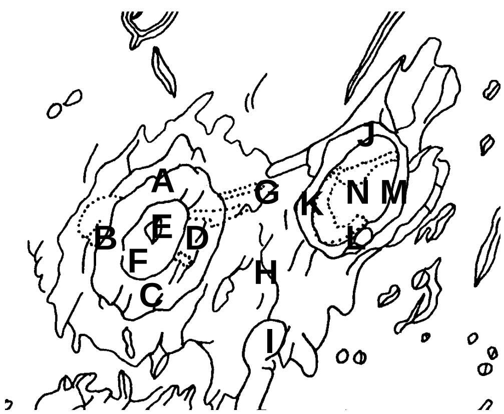

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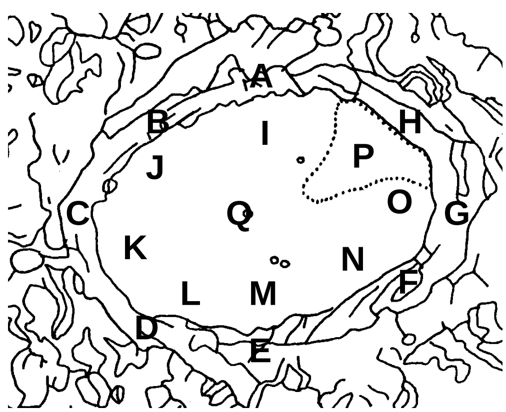

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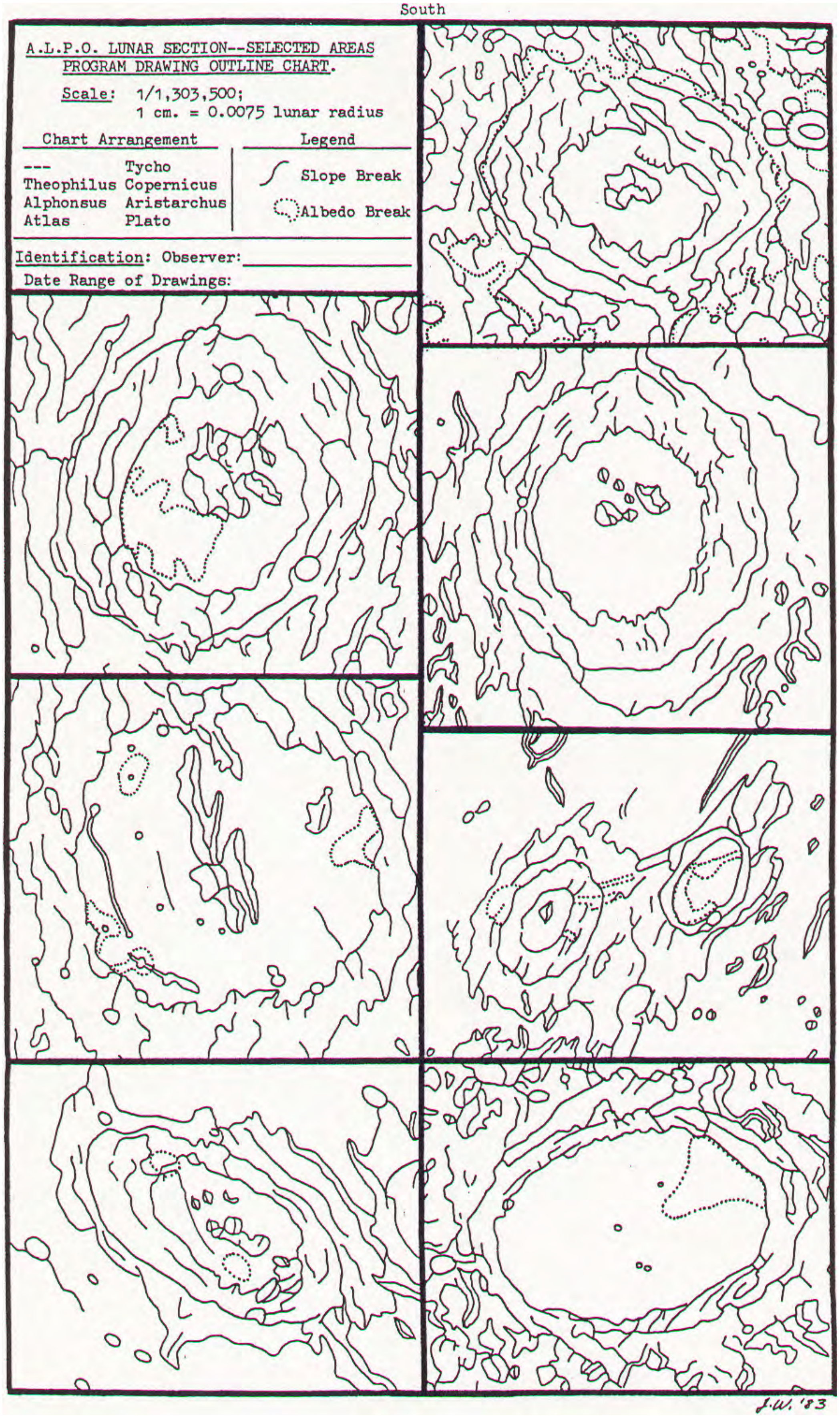
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J.W. '83

Feature Story: Reflections About Martian Flares

A Retrospective on the Tenth Anniversary of the 2001 ALPO Expedition

By Tom Dobbins,
tomdobbins@gmail.com
and Bill Sheehan
sheehan41@charter.net

"It is a test of true theories not only to account for but to predict phenomena." William Whewell (1794-1866)

As the 20th century drew to a close, the exploration of Mars by spacecraft had in many ways relegated telescopic observers to the status of tourists. Orbiters had surveyed the entire surface of the Red Planet, mapping features no larger than the Los Angeles Coliseum. The instruments of the Viking and Pathfinder landers had sifted dusty Martian soils and sniffed thin Martian air. In the span of a single generation "the very character of the scientific questions changed as the planets went from being astronomical objects to geological objects," recalls William K. Hartmann of the University of Arizona's Planetary Science Institute, a distinguished planetary scientist who was a prolific contributor of observations to the ALPO in his youth [1]. Yet buried in the observational records of the bygone era of earthbound planetary astronomy a few minor mysteries still lingered. One of those old telescopic enigmas seems to be reluctantly yielding an unexpected geological solution.

Figure 1. One of the leading planetary observers of his era, Percival Lowell penned a dramatic account of his observation of brilliant reflections on Mars in 1894. (All images courtesy of the author.)

In his 1897 science fiction masterpiece "The War of the Worlds," H.G. Wells set the stage for his classic tale of an invasion by ruthless Martians in the following passage:

> "During the opposition of 1894, a great light was seen on the illuminated part of the disc, first at the Lick Observatory, then by Perrotin of Nice, and then by other observers. English readers heard of it first in the issue of *Nature* dated August 2nd... Peculiar markings, as yet unexplained, were seen near the site of that outbreak during the next two oppositions... As Mars approached opposition, Lavelle of Java set the wires of the astronomical exchange palpitating with the amazing intelligence of a huge outbreak of incandescent gas upon the planet... He compared it to a colossal puff of flame suddenly and violently squirted out of the planet, 'as flaming gases rushed out of a gun.'"

All Readers

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Online Features

Left-click your mouse on:

•The author's e-mail address in blue text to contact the author of this article.

Trapped on a dying world, but equipped with "intellects vast and cool and unsympathetic," the Martians had regarded our planet "with envious eyes" and prepared to venture across interplanetary space in projectiles fired from a colossal cannon. In a gloss on the supposed observations by astronomers at the Lick and Nice observatories, Wells added: "I am inclined to think that this blaze may have been the casting of the huge gun, in the vast pit sunk into their planet, from which their shots were fired against us."

Wells' account was a mixture of fact and fiction. An avid reader of the British journal *Nature*, where his close friend Richard Gregory was editor, Wells had been following the debate raging about the network of canals on Mars reported by the celebrated

Figure 2. Tsuneo Saheki's drawings depicting the development of the 1951 “flare” at Tithonius Lacus.

Italian astronomer Giovanni Schiaparelli (1835-1910) in 1877 and its implications for the possibility of intelligent life of some sort existing there. There really were astronomers at Lick Observatory studying Mars during the 1894 apparition, and Henri Perrotin (1845-1904) and Stephane Javelle (1864-1917), presumably the inspiration for “Lavelle of Java”) of the Nice Observatory, were real figures as well. Indeed, Wells' literary inspiration derived in part from an article that had appeared in *Nature* in August of 1892 describing observations of bright projections on the edge of the disc of Mars.

Interest in bright flashes on the planet soon reached a fever pitch, especially in France. The establishment of the Pierre Guzman Prize was announced in 1899 by Camille Flammarion (1842-1925), founder of the French Astronomical Society and a prolific author eagerly read by the French public of the “Belle Epoque” for his lively descriptions of astronomical and atmospheric phenomena. The sum of 5,000 gold francs had been bequeathed to the French Academy of Sciences by a wealthy Bordeaux widow, Clara Goguet Guzman, whose departed son Pierre had been an ardent admirer of Flammarion's writings. Madame Guzman stipulated that the prize was to be awarded to “the person of whatever nation who will find the means within the next ten years of communicating with a star (planet or otherwise) and of receiving a response.” She specifically excluded Mars from the competition, however, based on her understanding that communicating with Martians would be too easy!

An ardent proponent of the existence of life on other planets, Flammarion did everything he could to publicize the Guzman Prize, and even went so far as to suggest that “the idea is not at all absurd, and it is, perhaps, less bold than that of the telephone, or the phonograph, or the photophone, or the kinetograph.” Indeed, at a time before the possibility of wireless telegraphy or radio had been grasped, the best prospect of making contact with the inhabitants of other planets still seemed to depend in one way or another on the use of mirrors to flash messages across the intervening void. Such schemes had been toyed with by the great German mathematician Carl Friedrich Gauss (1777-1855) and were later elaborated by the French inventor and Flammarion protegé Charles Cros (1842-1888). In the pages of the *London Times* for August 1892, one of Britain's leading intellectuals, Francis Galton (1822-1911), had weighed in with his own proposal to use a combination of mirrors to reflect sunlight to Mars.

In this climate, it was inevitable that reports of transient bright spots on Mars by leading observers of the planet would electrify both the astronomical world and the general public. Martian “signal lights” would continue to seize the popular imagination on several occasions during the next few years.

One of the most widely publicized reports was of a bright projection on the Martian terminator (the boundary between day and night) observed in December 1900 by Andrew Ellicott Douglass (1867-1962) at Lowell Observatory in Arizona. In this instance, even Flammarion found it necessary to combat the notion that what had been seen had involved an attempt by Martians to communicate with Earth. Before a packed lecture hall in Paris the following month, he announced to the great disappointment of his audience: “We are dealing not with signals from the Martians, but with snowy or cloudy mountaintops lit by the rising or setting sun.” In the light of current knowledge of Martian topography, the bright projections on the terminator seen by Perrotin and Douglass were high-altitude clouds, not the sunlit summits of mountains.

The Guzman Prize was never claimed, although in 1905 a smaller award, funded from the interest accrued on the principal, was presented to the astronomer Henri Perrotin's niece in recognition of her late uncle's Mars research. Eventually, the value of the prize was wiped out by rampant inflation during the First World War.

The question of attempts by inhabitants of Mars to communicate with Earth by means of mirrors aside, the possibility of observing natural reflections from Martian seas was also considered. Through a telescope, Mars presents an ochre disc dappled with dusky markings and crowned by gleaming polar caps. On the basis of what was admittedly circumstantial evidence, most early astronomers had interpreted the dark areas as bodies of

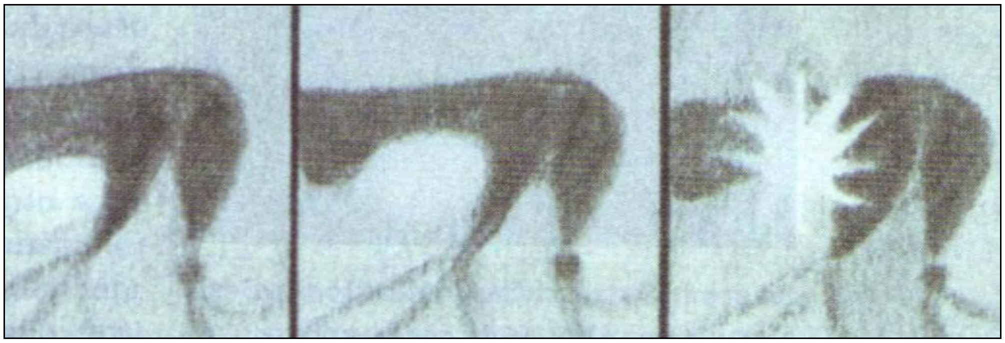

Figure 3. The 1954 "flare" at Edom Promontorium depicted in these sketches by Tsuneo Saheki was uncannily similar in both location and appearance to the phenomena recorded by the ALPO Mars Flares Expedition in 2001.

water. As Percival Lowell (1855-1916) wrote in 1906:

> "In the Martian disc, as in the lunar one, we seem to be looking at a cartographic presentation of some strange geography suspended in the sky; the first generic difference between the two being that the chart is done in chiaroscuro (Editor Note: extremely contrasty) for the Moon, in color for Mars. On mundane maps, we know the dusky washes for oceans; so on the Moon it was only natural to consider their counterparts as "maria"; and on Mars as "seas." Nor did the blue-green hue of the Martian ones detract from the resemblance."[2]

This had also been Schiaparelli's view of the matter. However, the sage Italian astronomer had noted that many regions on Mars had the muted intensity of halftones, suggesting that they were probably swamps or marshes rather than proper seas. Moreover, changes in both the size and the intensity of many of the dark areas had been recorded over the years, suggesting that any Martian seas must be quite shallow and their shorelines very flat. Eventually Schiaparelli found it necessary to caution against too literal an acceptance of the maritime scheme of nomenclature he had introduced for Martian features, which included designations such as seas, rivers, canals, gulfs and lakes.

One predictable consequence flowed from the widespread belief that there really were seas on Mars. Whenever the observing geometry is just right, any Martian sea ought to produce a brilliant reflection of the Sun. When parallel rays of light strike a smooth, planar surface like a mirror or a calm body of water, they are reflected at an angle equal to but opposite that of the incident beam. Because the irregularities of a shiny surface are smaller than the wavelength of light, the reflected rays maintain their parallelism, producing a specular reflection (from the Latin for "mirror, speculum"). However, any surface that contains a large number of microscopic irregularities, like rock or soil, will scatter the reflected rays in all directions and produce a diffuse reflection.

As early as 1863, the British geologist John Phillips (1800-1874) had suggested that the failure of astronomers to observe specular reflections on Mars could only mean that the planet's dark markings must be something other than bodies of water. Schiaparelli calculated that these reflections ought to rival a third magnitude star in brilliance. By the 1890s, the once dominant view of the dark areas as seas had been abandoned, and they came to be widely regarded as tracts of vegetation. As Percival Lowell (1855-1916; Figure 1) summed up in his book *Mars and Its Canals*:

> "One phenomenon we might with some confidence look to see exhibited by them were they oceans, and that is the reflected image of the Sun visible as a burnished glare at a calculable point. Specular reflection of the sort was early suggested in the case of Mars, and physical ephemerides of the planet registered for many years the precise spot where the starlike image should be sought. But it was never seen. Yet not till the marine character of the Martian seas had been otherwise disproved was the futile quest for it abandoned."[3]

Lowell's words attest to what would become the non-expectation by astronomers of seeing specular reflections on Mars. In fact, the failure of these phenomena to appear seemed to argue not only against the existence of seas on Mars, but against the presence of any significant bodies of water. Refining Schiaparelli's calculations, during the 1920s the Russian astronomer Vasily Fesenkov (1879-1972) estimated that any open expanse of water more than 300 meters across should make its presence known in this way. And not only liquid water but ice as well, for a smooth surface of ice is no less capable of serving as a mirror. Indeed, long after the furor over the bright limb projections had died down and the ephemerides mentioned by Lowell had been consigned to the trash bin with other discarded theories, short-

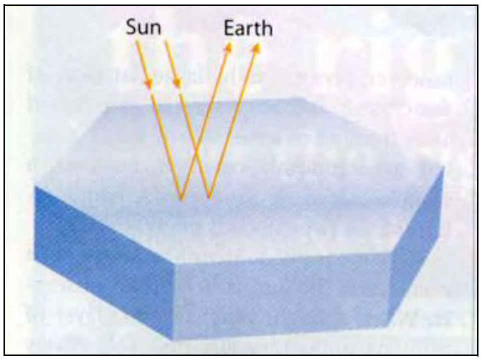

Figure 4. The University of Michigan astronomer Dean McLaughlin suggested that sunlight reflected by the mirror-like surfaces of hexagonal crystals of water ice was the most plausible explanation for Martian "flares."

lived, brilliant flashes would be observed on Mars.

When he took his place at the eyepiece of a borrowed telescope in the early morning of June 7, 1894, Percival Lowell was the leader of the most hastily organized and ambitious expedition to observe Mars the world had ever seen. The handiwork of the renowned Pittsburgh instrument maker John Brashear (1840-1920), the powerful 18-inch refractor had been shipped to his observing site at Flagstaff in the Arizona Territory earlier that spring.

As dawn took hold and the rising Sun began to throw long shadows, Lowell could barely contain his growing disappointment in not catching a glimpse of Schiaparelli's canals. In his observing notebook he rather austerely recorded the presence of "dazzling white specks" in the south polar cap. Only later would he elaborate on the experience:

> "On that morning, at about a quarter of six (or, more precisely, on June 8, 1 h. 17m., GMT), as I was watching the planet, I saw suddenly two points like stars flash out in the midst of the polar cap. Dazzlingly bright upon the duller white background of the snow, these stars shone for a few moments and then slowly disappeared. The seeing at the time was very good."[4]

Lowell did not hesitate to assign a cause to these strange sparkles:

> "It is at once evident what the other-world apparitions were — not the fabled signal-lights of Martian folk, but the glint of ice-slopes flashing for a moment earthward as the rotation of the planet turned the slope to the proper angle; just as, in sailing by some glass-windowed house near set of Sun, you shall for a moment or two catch a dazzling glint of glory from its panes, which then vanishes as it came. But though no intelligence lay behind the action of these lights, they were nonetheless startling for being Nature's own flash-lights across one hundred million miles of space. It had taken them nine minutes to make the journey; nine minutes before they reached Earth they had ceased to be on Mars, and, after their travel of one hundred millions of miles, found to note them but one watcher, alone on a hill-top with the dawn."[5]

Lowell's vision was repeated In May of 1937 when Latimer J. Wilson, one of the most highly regarded amateur observers of the Moon and planets during the years between the world wars, observed a series of bright flashes that extended across the south polar cap of Mars. "Some of these seemed to coalesce and swell into a brilliant light which passed, generally, across the cap in the direction contrary to that of the planet's rotation."[6] This spectacle lasted for almost an hour and a half. Like Lowell, Wilson surmised that "ice on slopes along an escarpment might flash sunlight if the angle between Earth, Sun and Mars is just right."

Flashes amid the polar snows seemed to be easily explained. It wasn't difficult to imagine snowfields that thawed superficially and refroze, acquiring a glassy, mirror-like crust. Other reports were quite puzzling, however. For example, during the 1896 apparition of Mars, the British amateur J.M. Offord had reported that a "brilliant star-like scintillating point" briefly stood out in Hellas, a vast tract of ochre deserts in the planet's southern hemisphere centered at a latitude of only 45 degrees [7].

On the night of December 8, 1951, Tsuneo Saheki (1916-1996) of the Osaka Planetarium, one of Japan's leading planetary observers, was examining Mars through his 8-inch Newtonian reflector at a magnification of 400x in fairly good seeing. A "very small but extremely brilliant spot" suddenly appeared at the eastern end of a feature in the Martian tropics known as Tithonius Lacus, which had just rotated over the planet's morning limb (Figure 2):

> "At first I could not believe my sight because the appearance was so completely unexpected, and I thought that it must be an illusion caused by motes in my eye. More careful examination revealed that it was not such an illusion but was a true phenomenon on Mars! I continued to observe it carefully for half an hour. During the next five minutes it remained present and always twinkled like a fixed star."[8]

At its brightest, the feature surpassed the planet's polar cap, then quite brilliant late in the northern Martian

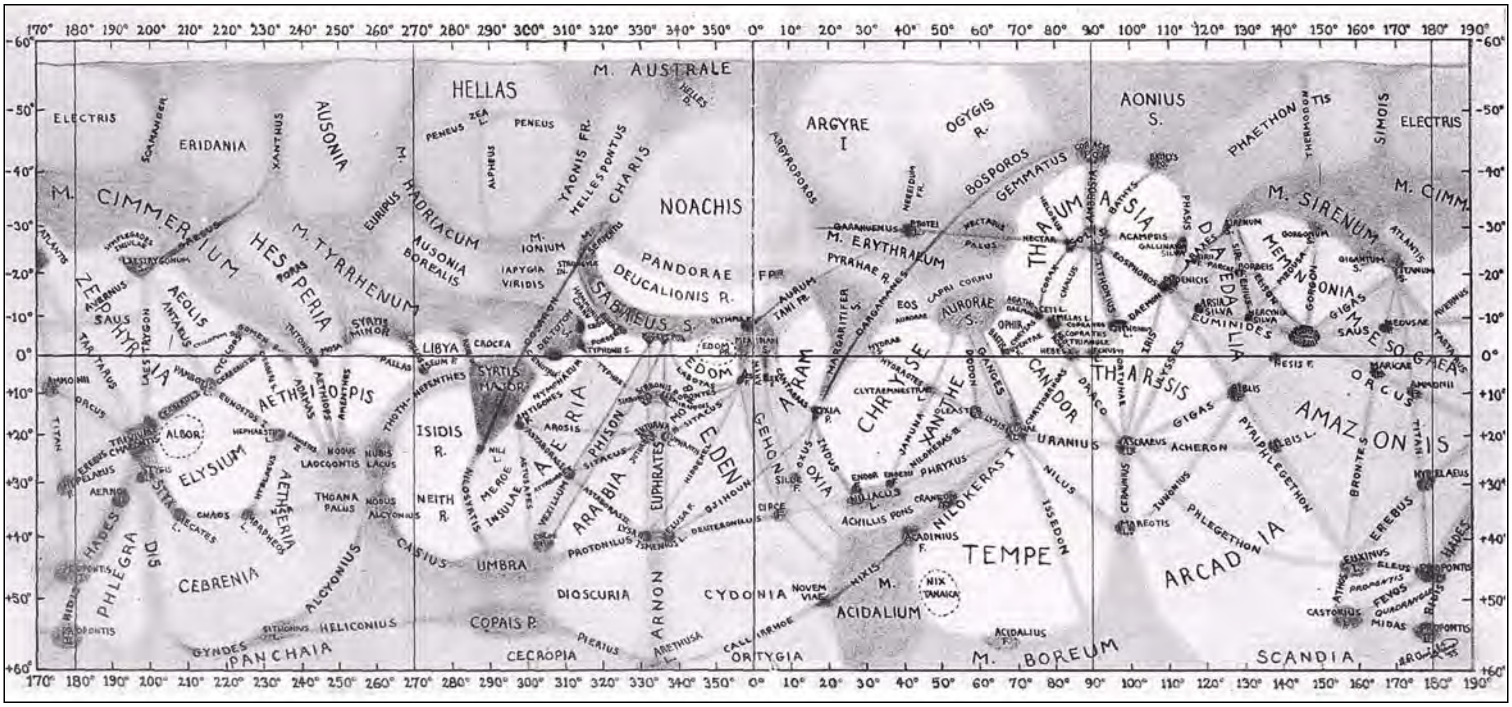

Figure 5. The iconic 1954 ALPO Mars map delineates Edom Promontorium with a dashed line.

spring. Ten minutes after it appeared, the spot began to diminish in brightness, gradually taking on the appearance of a white cloud before it faded from view 40 minutes later.

Saheki's report created quite a stir, eliciting a flurry of comment and speculation. Given the 10-minute duration of the flare, a meteorite impact seemed rather far-fetched, but not nearly as far-fetched as some of the ideas that were bandied about. Memories of Hiroshima and Nagasaki were still fresh, particularly in Japan, and ever more powerful nuclear weapons were being tested at a feverish pace on remote atolls in the Pacific and in the desolate wastes of Soviet Central Asia. Shortly after news of Saheki's observation reached Europe, the British astronomer Patrick Moore received a telephone call from the science reporter of a famous London daily eager to hear his comments about "the atomic bomb that had gone off on Mars."[9]

Although Saheki dismissed this explanation out-of-hand as "unreasonable," his flare was included in a list of Martian features "most easily understood on the assumption that they are the product of intelligent beings" that appeared in the journal *Science* in 1962, the year of the Cuban Missile Crisis. The author, University of Colorado Professor of Plant Physiology Frank Salisbury, asked: "Was this volcanic activity, or are the Martians now engaged in debates about the long-term effects of nuclear fallout?"[10]

A specular reflection from a brine pool or sheet of ice was also considered, but the viewing geometry seemed all wrong. If the source of the reflection were a horizontal surface like a frozen body of water, a specular reflection would have appeared midway between the sub-Sun and sub-Earth points on Mars, far from the planet's morning limb. "Reflection from an ice-covered mountainside is free from this objection," Saheki conceded, "but cannot explain the formation of a cloud just after the disappearance of the light."[11]

On July 1, 1954, Saheki saw another flare, this time at Edom Promontorium, a bright elliptical feature on the Martian equator that is tucked in the nook formed by the junction of the dusky features known as Sabaeus Sinus and Sinus Meridiani. Far less spectacular than the 1951 flare despite the closer proximity of Mars, this event lasted only five seconds and at maximum brilliance was only about half as bright as the polar cap (Figure 3). Although no explicit confirmation followed Saheki's announcement of this sighting, another prominent Japanese Mars observer, Ichiro Tasaka (b. 1929), had recorded in his observing log that Edom Promontorium looked unusually bright that night through his 13-inch reflector [12].

Another flare at Edom Promontorium was seen only 23 days later by Clark

Figure 6. Members of the ALPO Martian Flares Expedition at the Cudjoe Key observing site. From left to right, Mark Collins-Petersen, Patty D'Auria, Rick Fienberg, Don Parker (squinting through the eyepiece of the 12-inch Meade SCT), Tippy D'Auria, Gary Seronik, Carolyn Collins-Petersen and Dan Troiani.

McClelland, who was observing Mars with a 13-inch refractor at the Allegheny Observatory in Pittsburgh. McClelland reported that a white spot abruptly appeared and rapidly grew in brightness until it equaled a star of the first magnitude seen with the unaided eye. It faded from view in less than a minute.

Japanese observers reported a spate of flares during the 1958 apparition of Mars. On November 6, Sigeji Tanabe was observing the planet with a telescope of only 3 inches aperture when he saw a spot at the southwest edge of Tithonius Lacus that grew as bright as the polar cap and faded from view after four minutes [13]. Four days later almost to the minute, Sanenobu Fukui, observing with a 10-inch reflector, recorded a “curious bright spot” northeast of nearby Solis Lacus that persisted for about a minute. On November 21, flares were seen by Tasaka at two widely separated locations on Mars, Edom Promontorium and Hellas [14].

Tasaka thought he had witnessed “the sudden development of white clouds as a special meteorological phenomenon of a limited area on the surface of the planet.” Saheki was inclined to believe that his colleague might have seen volcanic eruptions, although he conceded that “the observed duration of the light may be too short, and the probable scarcity of water on Mars may raise difficulties — terrestrial volcanoes eject large quantities of steam.”[15]

The University of Michigan astronomer Dean B. McLaughlin (1901-1965) might have been voted the man most likely to embrace an explanation involving volcanism. An accomplished stellar spectroscopist, McLaughlin was a man of wide-ranging interests in many subjects, especially geology. He had recently argued against the prevailing view that the dark areas on Mars were tracts of vegetation. Instead, he had boldly proposed that they were drifts of ash ejected from a multitude of active volcanoes and blown around by prevailing winds. Point-source emissions of ash, he argued, would account for the characteristic caret or chevron shape of features like Sinus Meridiani and the serrations along the northern boundaries of Mare Tyrrhenium and Mare Cimmerium.

Despite his belief that Mars harbored active volcanoes, McLaughlin took an admirably cautious approach to interpreting the flare reports. Noting that the intensity of the Martian flares was enormous compared with any volcanic glare ever recorded on Earth, he pointed out that terrestrial volcanoes just don’t emit much light: “The “fiery cloud” of Mt. Pelée which destroyed St. Pierre in 1902 was probably two kilometers in diameter and very hot, but not brilliantly glowing. Later clouds erupted by Pelée appeared dull by daylight.”

Seen from the distance of Mars, McLaughlin estimated that even the fire fountain produced by the violent eruption of Mount Vesuvius in 1779 would have appeared about 10,000 times fainter than Saheki’s 1951 flare. “If these Martian flares were volcanic,” he argued, “they would indicate that Martian volcanism is characterized by occasional great outbreaks of incandescent gas a few kilometers in diameter and with temperatures very far above those known in terrestrial volcanism.”[16]

McLaughlin’s objections certainly seemed to rule out the possibility that the fires of any Martian volcano would be visible from the Earth, although the prolific British author Valdemar Axel Firsoff (1910-1981), an "original thinker" renowned for his often fanciful theories, proposed that the flares might signify a strange sort of nuclear-powered volcanism in which "fissile radioactive materials could become concentrated by geological processes into a natural atomic pile, which could occasionally blow up."[17] Small wonder that many of his countrymen were fond of saying: "There's fact, there's fiction, and there's Firsoff!"

McLaughlin offered a very plausible alternative to volcanic eruptions, suggesting that "it would be worthwhile to explore the possibility of a solar reflection from oriented ice crystals in the Martian atmosphere -- a sort of sundog phenomenon in reverse!"[18] Sundogs (also known as mock suns or "parhelia") form when sunlight passes through a field of ice crystals like the thin, wispy cirrus clouds that form at altitudes of 25,000 feet or more, where temperatures are always far below freezing. They are usually seen when the Sun hangs low in the sky and a layer of cirrus clouds is present, appearing as a pair of diffuse bright spots with prismatic colors located 22 degrees on opposite sides of the Sun and at the same elevation above the horizon.

Figure 7. Tom Dobbins at the eyepiece of Don Parker's venerable 6-inch f/8 Newtonian reflector, a classic instrument that provided excellent images of Mars.

Why 22 degrees? Because the tiny ice crystals high in the atmosphere are almost invariably hexagonal in shape like snowflakes. Some are rod-like ("columns"), while others resemble thin slices cut from a pencil ("plates"). Under the influence of gravity, the plates tend to slowly descend like falling leaves, their large basal faces aligned parallel to the ground by aerodynamic drag. When a ray of sunlight passes through one of these crystals, it is refracted through an angle of 22 degrees, so that sunlight entering crystals at an angular distance from the Sun of 22 degrees is refracted directly toward an observer. Above and below the Sun, however, the rays entering the large flat faces of the crystals and are refracted away from an observer. When the ice crystals are oriented randomly rather than parallel to one another a complete halo appears. A combination of the two effects is often seen.

A related phenomenon can be seen when the Sun is behind an observer. The subsun occurs when sunlight is reflected off a layer of millions of ice crystals that collectively act as a giant mirror (Figure 4). Horizontally aligned plate crystals are the usual source, and the Sun's rays are reflected externally from their upper basal faces as well as internally from their lower basal faces. The more uniformly aligned the crystals, the more brilliant and sharply defined a subsun will appear. Subsuns are often seen by the crews and passengers of commercial airliners flying above a deck of cirrostratus clouds, the thin sheets of ice crystals that look like fine veils or torn, wind-blown patches of gauze. This vantage point is not unlike looking at Mars through a telescope. Perhaps once in a great while they are seen by observers of Mars as well.

In 1969, the Russian astronomer Victor D. Davydov of Moscow's Sternberg Astronomical Institute, published a pair of papers that echoed McLaughlin's hypothesis that flares may be reflections of sunlight off of layers of aligned ice crystals floating in the Martian atmosphere [19]. Davydov attributed the fleeting visibility of the flares to the effect of the planet's rotation, which would displace a reflection by a little more than one degree of longitude on Mars during a five-minute interval. His survey of the literature also turned up additional sightings of flares that helped to dispel the widespread impression that Japanese observers had a unique combination of talent and luck when it came to detecting these rare phenomena.

During the 1950s, the French astronomer Audouin Dollfus (1924-2010) determined that the polarization properties of the clouds over the Martian tropical and temperate zones are "radically different from a cloud of droplets, but similar to that for a fog of ice particles," leading him to conclude that they were "veils of crystals like our own cirrus clouds."[20] For many years it seemed that sundogs, halos, and subsuns must occur frequently on Mars, just as they do in the most Mars-like place on Earth, Antarctica. However, the situation proved to be a bit more complicated.

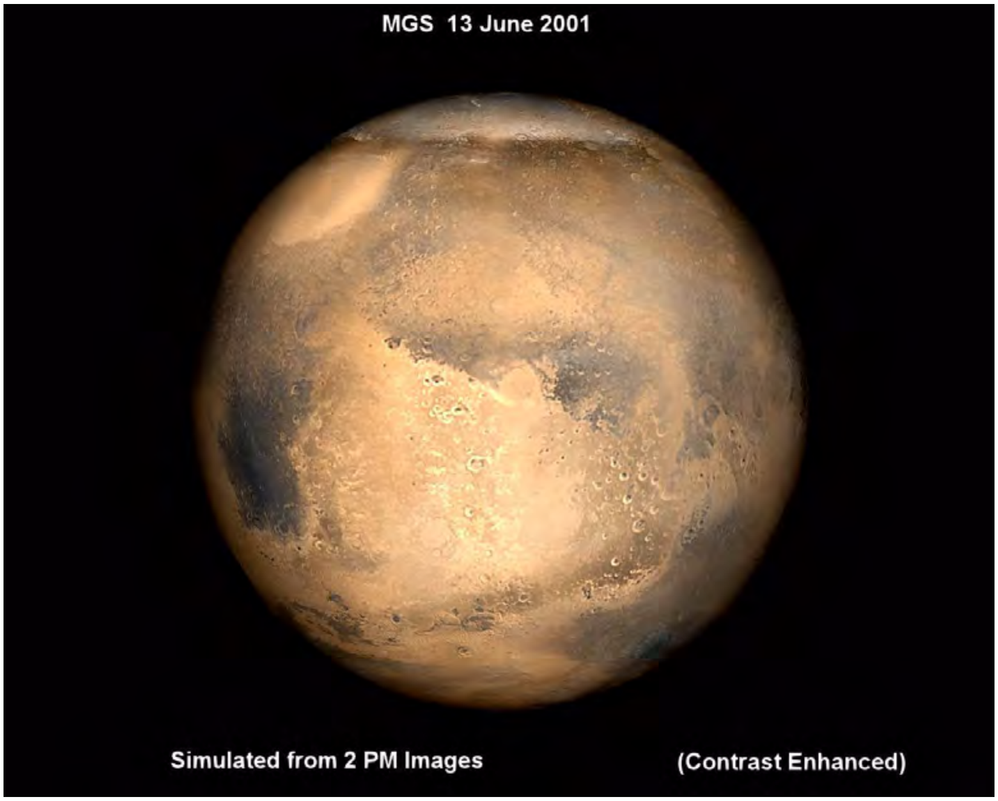

Figure 8. This mosaic assembled from Mars Global Surveyor spacecraft images captured the virtually cloudless state of the Martian atmosphere in June 2001.

At high latitudes on Mars, clouds and hazes are composed of frozen carbon dioxide ("dry ice"), but in the Martian tropics, water ice is the major constituent. This may be an important clue about why most Martian flares have been seen at low latitudes.

Crystals of frozen carbon dioxide are almost two orders of magnitude smaller than their water ice counterparts and usually take the form of octahedrons – a pair of four-sided pyramids joined at their bases. Clouds of particles this small are very efficient at producing diffuse reflections, but they never present an array of aligned crystal faces to reflect or refract sunlight in a preferred direction. For that, water ice is required. This fact seemed to lend the Martian flares a special significance, because the search for evidence of water, past or present, has long been one of the principal goals of the exploration of Mars by spacecraft. The flares seemed to indicate that Mars has been signaling the presence of water, the one sure and absolute prerequisite of life, either in the form of ice crystals suspended in its tenuous atmosphere or patches of frost on its surface.

During the 1970s, the Viking Lander imaging team looked for and failed to record halos and sundogs, but the landing sites on the northern plains of Chryse and Utopia would not be expected to favor such phenomena. The cameras on the Mars Pathfinder rover (which also landed in Chryse) frequently recorded bluish water-ice clouds in the early morning sky in the direction of the rising sun, but most of these clouds produced forward scattering of sunlight, indicating that their constituent ice crystals were as tiny as the particles in cigarette smoke.

In February 1998, the Mars Global Surveyor spacecraft captured images of a weak subsun from Martian orbit, but the glint was far too small and feeble to be seen from Earth. Nevertheless, close inspection by spacecraft of the locales that are most prone to flare events, Edom Promontorium and Tithonius Lacus, seemed to lend credence to McLaughlin and Davydov's ice crystal hypothesis. On a global scale, concentrations of water vapor in the Martian atmosphere correspond closely to differences in elevation. Water vapor tends to concentrate in valleys and depressions like the floors of craters. The local topography and meteorology of both sites seemed particularly favorable for generating reflections from patches of frost, surface-hugging ice fogs, or dense cloud decks.

Edom Promontorium was depicted as an elliptical bright patch straddling the Martian equator on the maps compiled by telescopic observers (Figure 5). In 1969, the Mariner 6 spacecraft revealed that this outline corresponds to the ramparts of an ancient, eroded impact crater 460 kilometers in diameter and six kilometers deep that now bears the name Schiaparelli Basin. The area has long been recognized as the site of a discrete, localized cloud that varies seasonally. This cloud is usually best seen through a blue-green or blue filter, though at times it is more pronounced through green or even yellow filters. When the cloud appears brighter in blue light than in green light, it resides high in the Martian atmosphere, but when it is more prominent in green light, it is probably a low altitude fog of ice particles like those that have long plagued

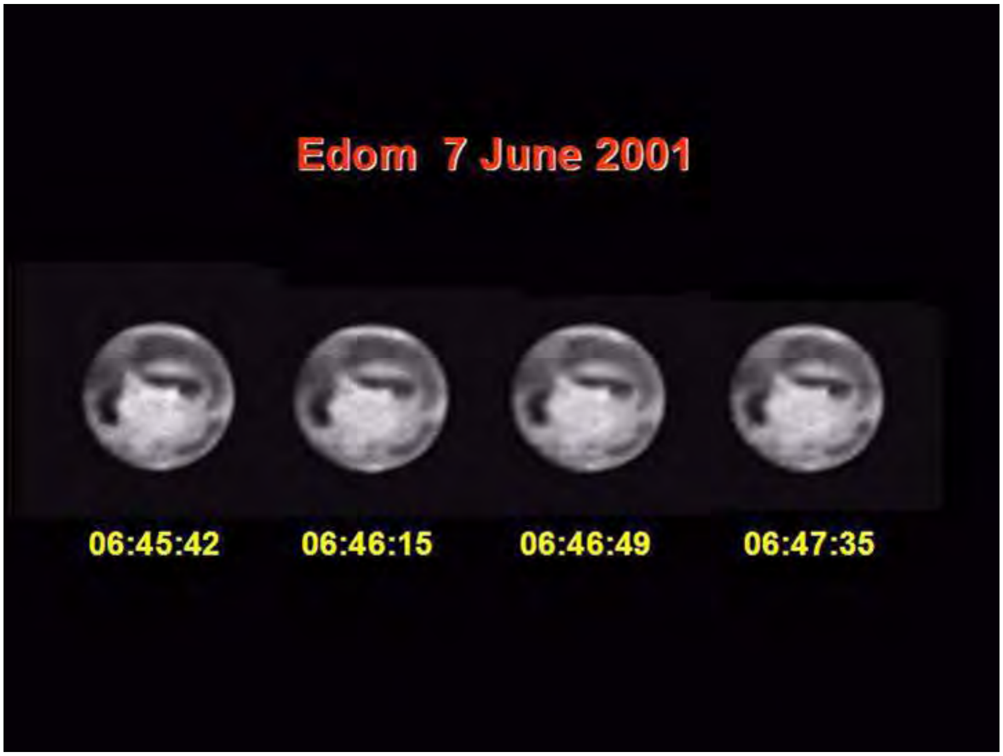

Figure 9. This sequence of video frames captures the alternating brightness maxima and minima of the pulsating flare.

explorers and aviators in the arctic. When a sharply defined boundary is visible in yellow light, a deposit of frost may be present on the surface.

Tithonius Lacus also lies near the Martian equator. It encompasses a pair of topographic features that are now designated Tithonium Chasma ("Tithonius Canyon") and Noctis Labyrinthus ("The Labyrinth of Night"). In 1972, the Mariner 9 orbiter revealed that the dark patch seen by telescopic observers is an immense, branching canyon system that measures as much as a staggering two kilometers deep, one of the western arms of a globe-girdling trough known as Valles Marineris. In Viking Orbiter images, this network of intersecting, fault-bounded valleys was often seen brimming with morning clouds, hazes, and ice fogs that spilled over onto the surrounding plateaus.

In the autumn of 2000, we began to analyze the historical flare observations in the hope of gleaning some insight into the nature of the source of the reflections. A century ago, determining the precise Mars-Earth-Sun geometry on any given date required hours of tedious manual calculations. Equipped with the WIMP ephemeris software developed by ALPO Mars observer Jeff Beish, a few strokes on the keyboard of a personal computer were all that was required.

Four parameters must be considered when evaluating the possibility of a specular reflection: D_s, D_e, *CM*, and *i*. D_s and D_e define the latitudes of the sub-Sun and the sub-Earth points on Mars, denoting the declination of the Sun and the declination of the Earth as seen from Mars.

For example, if on a given date D_s has a value of 0 degrees and D_e is -10 degrees, an observer on the Martian equator would see the Sun directly overhead at local noon, while the Earth would be located 10 degrees south of the zenith. If the reflector is a perfectly horizontal plane, a specular reflection will appear halfway between the sub-Sun and sub-Earth points on Mars, in this case at a latitude 5 degrees south of the equator.

CM stands for central meridian, the imaginary line passing through the planet's poles of rotation and bisecting its disc. The longitude of the sub-Earth point lies along the *CM*.

Finally, *i* defines the Earth-Mars-Sun phase angle in degrees. The reflected ray of sunlight is displaced by this angle.

Two of the flares occurred under these textbook conditions. The flare at Edom Promontorium sighted by McClellan in 1954 and the flare between Solis Lacus and Tithonius Lacus reported by Fukui in 1958 were seen at times when the Sun was near the local zenith on Mars and separated from the apparent position of the Earth by only a few degrees. The Mars-Sun-Earth geometry of several other reports suggested that the reflectors must have had a modest but appreciable tilt. Tithonius Lacus seemed to be a special case, however. The geometry of the flares there required reflecting surfaces inclined by as much as 45 degrees. Because the area is a maze of canyons with sloping walls, such a scenario wasn't difficult to envision.

A few days before Christmas of 2000, we suddenly realized that during the upcoming 2001 apparition of Mars, the Mars-Earth-Sun geometry would be almost identical to that in 1954 when flares were seen at Edom Promontorium by Saheki and McClelland. My own heart raced

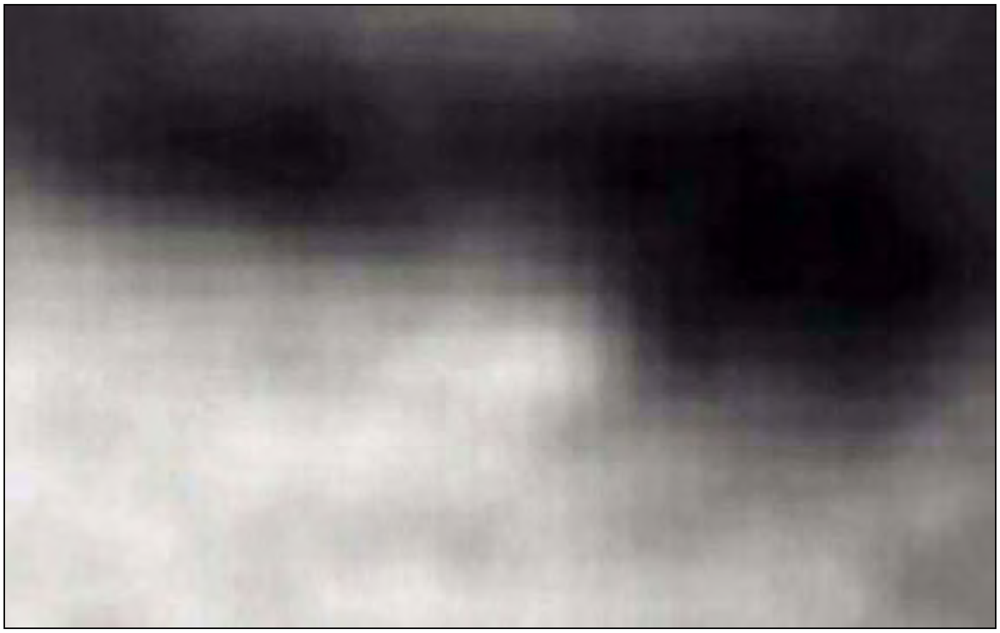

Figure 10. By grossly over-enlarging the sharpest video frames it was possible to pinpoint the site of the flare with a considerable degree of precision.

when the numbers indicated that for a few days in early June, when Mars would be closer to the Earth than it had been in well over a decade, both the sub-solar and sub-Earth points would virtually coincide at Edom Promontorium at the time that the planet's rotation would carry that feature across the center of the Martian disc.

In the May 2001 issue of *Sky & Telescope* magazine, an article appeared announcing our prediction and urging observers to monitor the region carefully on the nights in question [21]. This promised to be the opportunity of a lifetime to capture images of a Martian flare, provided of course that the weather on Mars and on Earth cooperated, so an expedition to observe the planet under favorable conditions hastily organized. Mars would lie far south of the celestial equator during the 2001 apparition, so the planet would rise above the turbid, turbulent air near the horizon only from low-latitude observing sites. As far as longitude was concerned, Mars would be near its maximum elevation and Edom Promintorium near the center of the Martian disc at the times of the predicted events for observers located in the eastern or central time zones of the United States.

Southern Florida met both of these criteria. The incidence of clear skies during late spring and early summer is considerably higher in the Florida Keys than on the mainland of the Florida peninsula, where convective thunderstorms frequently form late in the afternoon and skies fail to clear until well into the night. Consequently, an observing site on Cudjoe Key about 20 miles northeast of Key West was selected. It proved to be a wise choice. As luck would have it, we enjoyed clear or partly cloudy skies every night while a tropical storm churned over the western Gulf of Mexico, drenching Texas and Louisiana with heavy rains. The skies of northern and central Florida were generally overcast, and most of the eastern and central United States was clouded out.

Our mixed bag of amateur and professional astronomers included ALPO luminaries Donald Parker, Jeff Beish, Dan Troiani and Richard Schmude, Rick Fienberg, Gary Seronik, and Carolyn Collins-Petersen of *Sky and Telescope* magazine, Timothy Parker, a jovial planetary geologist from NASA's Jet Propulsion Laboratory, the noted astrovideographer David Moore, and Tippy D'Auria of Miami's Southern Cross Astronomical Society (Figure 6).

Contrary to the glowing descriptions of a tropical paradise in tourism brochures, the Florida Keys consist largely of malodorous, mosquito-infested mangrove swamps and beaches covered with jagged shards of coral rather than sand. Wilting heat and humidity reduced us to a state of poolside torpor by mid-afternoon, but the companionship, rum, and clear skies more than made up for any disappointment with our surroundings.

Our vigil began on the night of June 2. Sustained winds of 10 to 15 knots buffeted our telescopes, but this laminar airflow produced remarkably steady seeing that revealed a wealth of subtle Martian detail (Figure 7). Daubed with a remarkably ineffective assortment of insect repellents, we stayed glued to the eyepieces of our telescopes, pausing occasionally to stretch our legs and inspect the impressive, grapefruit-sized image of Mars displayed on a television monitor that was fed by the video camera mounted at the focus of a 12-inch aperture telescope, our largest instrument. Edom Promontorium, which rounded the planet's morning limb 37 minutes later on each successive night, was carefully scrutinized as it was slowly carried across the disc by the rotation of Mars.

Despite the favorable observing conditions, hopes of seeing a flare quickly faded when we realized that the Martian atmosphere was unusually transparent and almost free of clouds (Figure 8). After nothing out of the ordinary was seen for five consecutive nights, interest began to wane and conversation consisted of little more than a chorus of muttered profanities directed at the relentless mosquitoes.

To our immense surprise, in the wee hours of the morning of June 7, we noticed that Edom Promontorium appeared unusually bright in the image on the video monitor. Within five minutes, dramatic pulsations in the feature's brightness began to occur at intervals of about 30 seconds. Synchronized cries of "Now! Now!" and "There it is again!" soon pierced the cloying night air all across the observing field.

The recurring brightness maxima of two to three seconds duration looked like someone was blowing on a glowing ember, pausing to inhale, and then blowing again (Figure 9). They were certainly not caused by turbulence in the Earth's atmosphere, which was quite modest at the time. For 50 minutes, the pulsations were accompanied by sparkles that appeared and disappeared very rapidly. These glints were seen by the visual observers as well as the group clustered around the video monitor. Sky & Telescope Associate Editor Gary Seronik described the spectacle as "the most exciting planetary show since Comet Shoemaker-Levy 9 slammed into Jupiter in July 1994." [22]

Both the location and the appearance of the flares were uncannily similar to the 1954 observations by Saheki and McClellan. At their brightest, they were far more reflective than the clouds covering the polar region and the Hellas basin near the evening limb.

In the wee hours of the following morning, the flares reappeared in the same location, but this time in two discrete waves. The first wave, which lasted 20 minutes, consisted of a series of three- to five-second pulsations that were very similar in intensity to the previous night's phenomena. After a hiatus of half an hour, a second series began that would last for 31 minutes. Although theory suggested that June 9 would be the date of the most favorable Earth-Sun-Mars geometry, no flares were seen on that date by any observers, nor did any appear on June 10.

After we returned from Florida, the real work of analyzing our data began in earnest. David Moore undertook the Herculean task of the painstaking, frame-by-frame examination of hours of videotape in order to determine the precise time, duration, location, and brightness of each flare event.

The first surprise came after the central location of the flares, measured with a precision of +/- 2 degrees, was determined to be latitude 0 degrees and longitude 350 degrees (Figure 10). These coordinates correspond to a very nondescript patch of terrain on the outer ramparts of Schiaparelli that is pocked with a sprinkling of ancient impact craters, not the expansive, flat floor of the crater that we had expected (Figure 11).

Curiously, on both nights, the flares appeared earlier than predicted — 20 minutes earlier on June 7 and 43 minutes earlier on June 8. The model employed for the predictions had

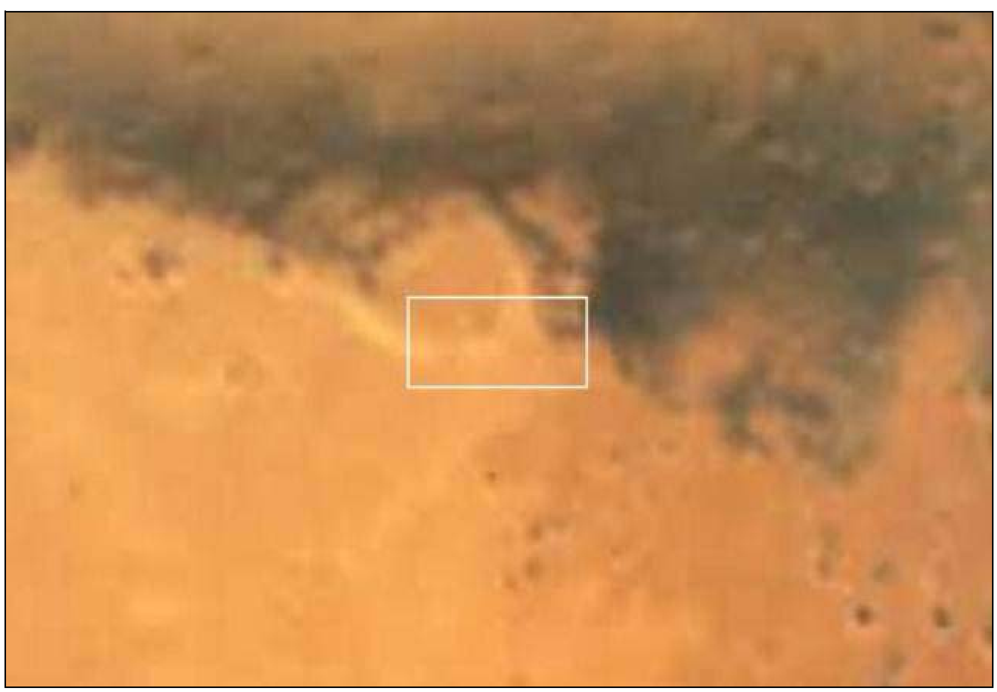

Figure 11. The flare site is outlined in this Hubble Space Telescope image of the region

assumed a flat, horizontal reflector because I was strongly inclined to believe that sunlight reflected by a deck of cirrostratus cloud high above the floor of the Schiaparelli Basin would prove to be the source of the flares seen at Edom Promontorium. Surprisingly, the early onset of the flares indicated that the reflector was appreciably inclined to the horizontal, sloping upward from east to west by as much as 19 degrees.

Following the announcement of our success in International Astronomical Union Circular 7642, many comments were received from the professional astronomical community. Some of the most insightful came from University of Nebraska astronomer Martin Gaskell, a quasar specialist who still grinds telescope mirrors and observes the planets from his backyard. He was particularly intrigued by the pulsations, which implied a succession of reflectors, each measuring a few hundred meters in diameter, that were displaced about 200 meters every four seconds by the rotation of Mars:

> "Since the Martian reflectors are inclined to the horizontal a fair bit, this strongly rules out clouds. It's got to be on the surface. The range of inclinations can be readily explained by a range of slopes on the surface. The rapidity of the fluctuations tells us that there are regions of the reflector with slightly different slopes. The size of region needed to explain the flashes of a few seconds is only a few times bigger than a football field. There are plenty of flat regions on this scale. I think the faces of sand dunes are an interesting possibility, although by no means the only one. These flashes are only seen when the weather is right, not every day, so they are fog/frost induced.
>
> "Here's my scenario for what happens: In the morning, the Sun heats the ground and makes water evaporate. The Martian air is always close to saturation and significantly colder than the ground. Ice crystals therefore condense in the air above the ground, forming a fog. The ice crystals fall onto the ground, creating a deposit of frost. Fog and frost must go hand in hand. The ice crystals have a very high albedo [reflectivity], so they inhibit any more heating of the ground where they fall and they can stay there for quite a while. On Mars, unlike on the Earth, the surface temperature is ruled almost entirely by the amount of sunlight absorbed and by the emissivity of the surface, not by the atmosphere. On the Earth, with a much denser atmosphere, heating by the air dominates instead. What governs when frost is seen in Schiaparelli? How windy it is. Fog and frost will only be seen on the calmest days, as on the Earth."[23]

Jet Propulsion Laboratory planetary geologist Tim Parker examined Mars Orbiter Camera images that were acquired during our Florida Keys expedition. He was struck by the absence of clouds in the region where the flares occurred. Echoing Gaskell, he commented:

> "This suggests the intriguing possibility that the specular reflections from that area may be due to surface materials — frost, mineralogy, or texture. Many of the narrow-angle images of the terrain southwest of Schiaparelli show dune fields with crests oriented roughly north to south. The eastward-facing slopes could easily be on the order of 10 or 20 degrees, and might be acting as a field of reflectors. Dunes will tend to have steeper lee [downwind] slopes than stoss [upwind] slopes, unless they're formed by bi-directional winds."

Gaskell agreed, noting that "the sand dune field of reflectors could certainly provide the right angle to the horizontal. Different angles would be seen in different years depending on what the wind had done. Flashes would only be seen on days when frost happened to cover the dunes."

In October 2001, the Mars Odyssey spacecraft swung into a polar orbit around Mars on a decade-long mission. A few months later the spacecraft's gamma ray and neutron spectrometers seemed to provide another clue about the Edom flares. Designed to detect traces of the hydrogen signature of water on or near the Martian surface, they confirmed the long-suspected presence of vast deposits of permafrost at depths of less than a meter at high latitudes on Mars. Although soils throughout the Martian tropics have become very desiccated over the aeons, these instruments revealed a hydrogen enrichment in Edom, indicating the presence of near-surface water ice at the flare site [24]. This certainly seemed like a plausible source for Gaskell's fogs and frosts.

The idea of the frost-covered slopes of dunes as sources of specular reflections seemed to be a very elegant explanation for the pulsating flares, but it was not without difficulties. Parker asked a very pointed question: "Why didn't we see flashes when Edom was past the central meridian and the opposite slopes were facing us?" Even more troubling was the fact that high-resolution spacecraft images of the site where the flares appeared show no dunes, even though fields of unusually bright dunes have been discovered at several locations in the Schiaparelli Basin and its surroundings.

While I took great satisfaction that the prediction came to pass, for years we have been frustrated by the fact that no matter how many times we have pored over images of the flare site, it has always remained an unremarkable landscape that would never have warranted a second glance were it not for the events of June 2001. It is only when the site was examined at wavelengths invisible to the human eye that its special character becomes evident.

One of the principal instruments aboard the Mars Odyssey spacecraft was the Thermal Emission Imaging System (THEMIS), which imaged the surface of the planet at high resolution in five wavelengths of visible light and at ten wavelengths in the thermal infrared region of the spectrum. This remote sensing data has enabled investigators to map the distribution of Martian surface minerals.

The designers and operators of the THEMIS instrument at Arizona State University posted on the World Wide Web interactive maps graphically depicting the distribution of Martian surface minerals. When we examined these maps, it quickly became obvious that site of the June 2001 flares is inordinately rich in two materials — plagioclase and calcium-rich pyroxene. These minerals are feldspars, that is, silicates that crystallize from magma.

The other site that has produced a multitude of flare sightings, Tithonius Lacus, proved to be even richer in plagioclase and pyroxene. We would never have imagined that regions so superficially dissimilar in appearance and that topography could have so much in common as far as surface mineralogy.

This realization immediately triggered a memory of a remark made by Andrew Young of San Diego State University back in 2001 when we were analyzing the Mars-Sun-Earth geometry of the historical reports of Martian flares, months before we actually videotaped one from the Florida Keys. Young had written: "If you need a surface inclined by more than a couple of degrees, you'd be better off trying to do this with aligned mineral grains. On Earth, it's not uncommon for minerals like feldspars to be highly aligned in igneous rocks, and faulting sometimes exposes fairly large surfaces with nearly specular reflections."[25]

Frankly, we didn't think much of Young's suggestion back in 2001, but now it seems to be the only explanation that is actually supported by spacecraft data. Feldspar crystals may also account for a peculiarity of the Edom flares that was noted by Masatsugo Minami, director of the Mars Section of the Oriental Astronomical Association. Minami pointed out that from the vantage point of the flare site, the Sun and the Earth would have been located very close to the zenith and separated by an angle of less than two degrees. The fact that flares are rarely seen led him to infer that the sources of the reflections might be located at the bottoms of fissures:

> "Perhaps the reflection is not seen more frequently because the reflector is located inside a narrow trench… We can consider that the width of the trench is sufficient to allow a reflection of a beam of sunlight at vertical incidence, but too narrow to admit an inclined sunbeam. If the zigzagged walls of the trench are high, the flash would not be seen except around the time when $D_e = D_s$."[26]

If feldspar crystals share a common orientation, the geometry required to produce a visible specular reflection might mimic a location at the bottom of a narrow trench. The crystal faces would only be capable of receiving and transmitting a narrow beam of light because each crystal would be partially shaded by its neighbor with regard to both incident and reflected light.

This suggestion is not without precedent. During the early 1950s, specular reflections were suspected of producing the fleeting, illusory appearance of a brilliantly illuminated central peak on the flat floor of the lunar crater Herodotus. Writing in *The Strolling Astronomer*, D.W. Rosebrugh, recalled an observation that he had made as a youth along the shores of Lake Huron:

> "The coast is quite rocky and there are many feldspar faults, perhaps 30 feet wide and hundreds of feet long in the granite and gneiss surface rocks which form most of the bare rocky shores. These feldspar faults are quite shiny if viewed from a suitable angle, but if viewed from other angles they appear darker than the surrounding rock.
>
> "At one time, the writer picked up a small boulder of feldspar. From every direction it was a dull, dirty pink, but when held in a certain way it shone like a mirror. It was a little hard to see why, but an examination showed a myriad of tiny facets, all acting like mirrors, all pointing one way. These crystals shielded each other in

part, so that the whole effect was confined to a narrow angle."[27]

Unfortunately, spacecraft like the Mars Odyssey orbiter are not capable of recording specular reflections because they obtain images under mid- to late-afternoon lighting, not when the Sun lies directly over the underlying terrain. It is rather frustrating that the Martian flares mystery is only partially solved despite the close-up vantage point provided by spacecraft cameras. While it would be rash to insist that a single explanation has to account for all of the flares that have been observed, I now believe that fields of exposed, aligned mineral crystals are the best candidate. Ten years after the 2001 Edom phenomena, we can only take solace in the fact that partaking of the mysterious can be as gratifying in a way as actually solving a mystery.

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Feature Story: Mars

The Current Apparition of Mars: 2011 – 2012

By Jeff Beish
dustymars@embarqmail.com
and Roger Venable
rjvmd@hughes.net

A new apparition of Mars has begun. At the time of this writing (late April 2011), Mars is a difficult, tiny-appearing object visible in the east, in morning twilight. As the apparition progresses the planet will reveal more of its secrets, and thousands of observers will turn their telescopes to it. Even in this day of robotic spacecraft, the mysteries of the Red Planet captivate us. We see more surface detail on it than on any other celestial body except the Moon. The changing clouds, the frosts and the remarkable polar caps that grow and shrink with the seasons make each observation different. This year, will you spy one of the small dust storms that are frequently detected near the edge of the North Polar Cap? Will some new alterations in albedo features be seen? Will your interest be quickened by the prospect of monitoring the planet for the flash of a specular reflection from surface ice?

In the latter half of June 2011, Mars will be located about 30 degrees west of the Sun in the pre-dawn sky (Figure 1.) At about that time, the most stalwart observers will begin imaging the planet despite its small apparent size of only 4.2 arc seconds (Figure 2.) Historically, an apparent diameter of about 6 seconds of arc has been considered the smallest at which useful observations can be made. The 6 arc second number was the norm years ago when visual observations revealed more detail than any image could show, and it is still a good rule of thumb for visual observers. This size will not be reached until November 3, 2011 (Figure 2), when the elongation will be 74 degrees west (Figure 1.) On that date, Mars will rise at about 1 a.m. local Standard Time, and will be high in the pre-dawn sky. Mars will continue to subtend more than 6 arc seconds until July 22, 2012, when it will be an evening object 71 degrees east of the Sun.

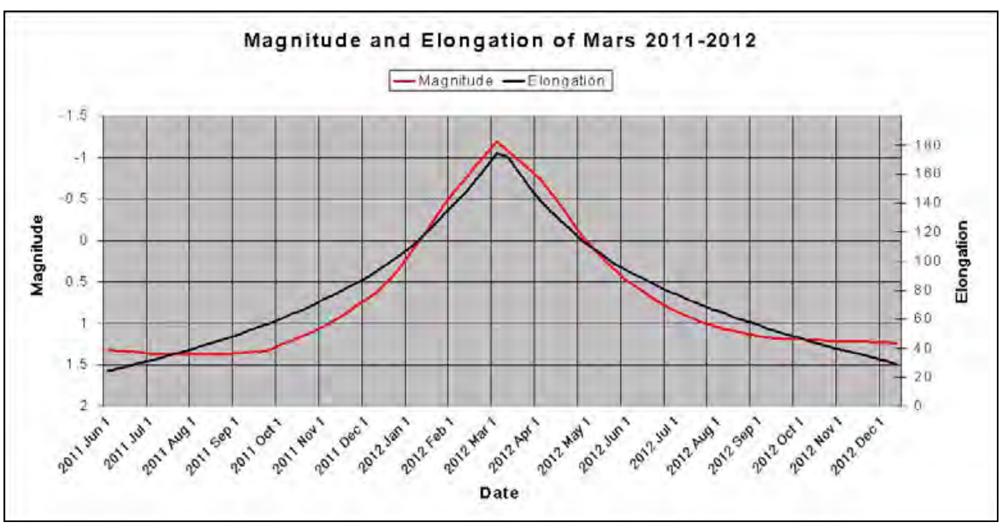

Figure 1. The brightness expressed as stellar magnitude, and the elongation from the Sun in degrees of arc, of the planet Mars in the 2011-2012 apparition. The time near the opposition of March 3, 2012, forms the peak in the center of the graph. Elongation before opposition, to the left of the peak in the graph, is western elongation, measured westward from the Sun. Elongation after opposition, to the right of the peak in the graph, is eastern elongation, measured eastward from the Sun.

Opposition will be on March 3, 2012, with an apparent diameter of 13.9 arc seconds and a brightness of -1.2 magnitudes (Figures 1 and 2.) This is a relatively small apparent size for an opposition, as the Red Planet will be near the aphelion of its oval-shaped orbit (Figure 3). Compare this to the apparent diameter of 25 arc seconds and brightness of -2.9 magnitudes at opposition in 2003, when it was near perihelion.

The present apparition is the third — and the most distant — of a series of four aphelic apparitions. Mars goes through a 15.8-year cycle of three

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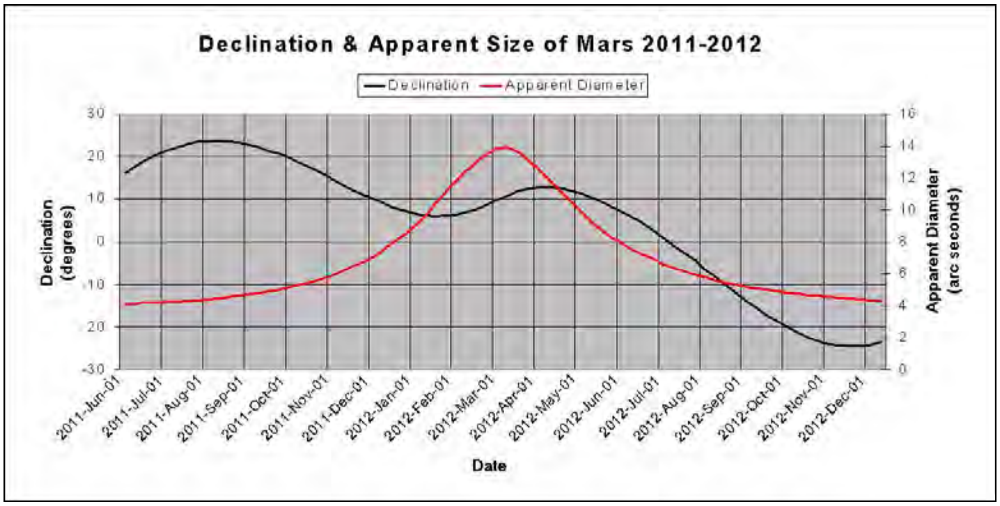

Figure 2. The declination of Mars in the sky of Earth-based observers, and the apparent size of Mars in arc seconds subtended by its diameter, during the 2011-2012 apparition

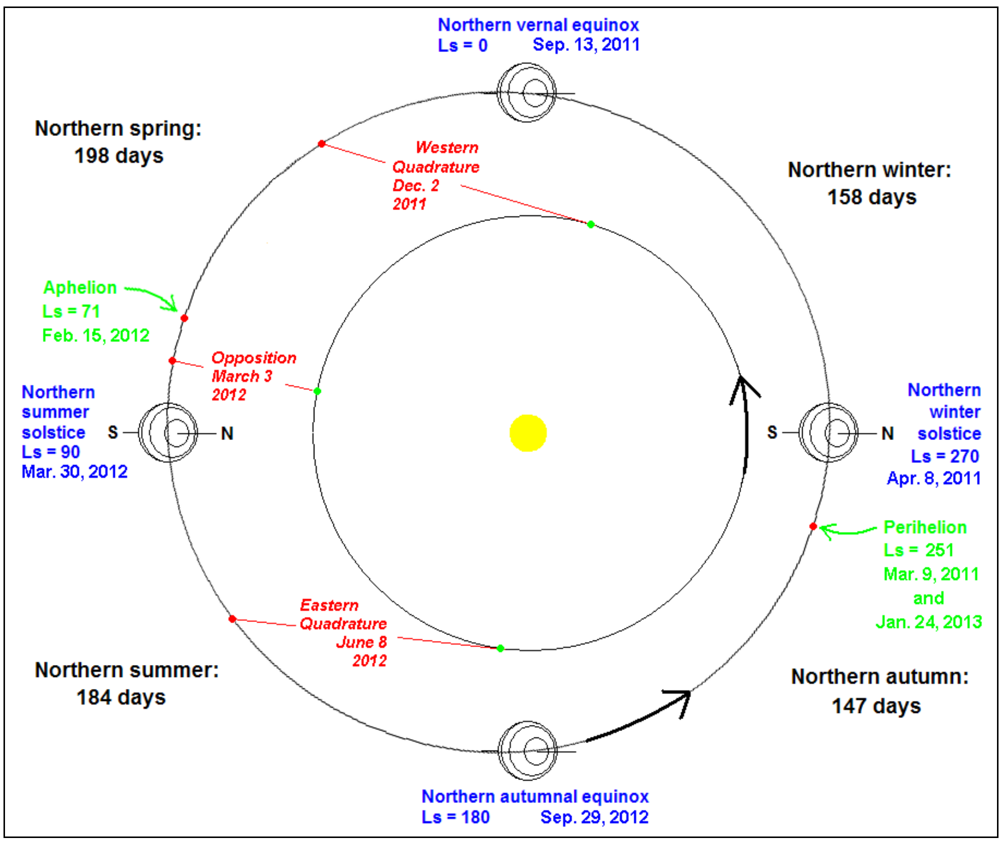

Figure 3. The orbits of Mars (larger circle) and Earth (smaller circle) drawn to scale. The planets and Sun are not drawn to scale. Notice that the two orbits are not concentric. Though the orbit of Earth is nearly round, that of Mars is oval in shape. When opposition occurs near the aphelion of Mars, as it does in 2012 (drawn here,) the closest approach of the two planets is much farther than when opposition occurs near perihelion, as it did in 2003 and will do again in 2018. The depictions of the axial tilt of Mars at the equinoxes and solstices demonstrate that the north pole of Mars will be tilted toward Earth during the best, middle part of this apparition. The lengths of the Martian seasons are given. Notice that there is much variation in the lengths of the seasons, due to the oval shape of Mars' orbit and due to the deviation of the line of apsides (the long axis of the ellipse that is Mars' orbit) from the direction of axial tilt. .

perihelic apparitions followed by four aphelic apparitions. Aphelic apparitions have briefer periods during which the apparent size of the planet is greater than 6 arc seconds. For example, the planet will stay above that apparent size for only 262 days in the present apparition, but for 358 days in the aphelic apparition of 2018-2019.

During nearly the entire time that Mars subtends more than 6 arc seconds, it will have a declination north of the celestial equator. Though not so far north as during the last two apparitions, it will still favor northern observers. Only after the first week of July 2012 does it slip south of the equator (Figure 2). In the last few months of 2012, it attains relatively far southerly declinations, so that it will be a difficult object for northern observers, low in the southwestern sky in the evenings.

As shown in Figures 3 and 4, the Martian north pole will be tipped towards Earth during the entire time of best observing. We will be watching the north polar cap shrink during the first half of the apparition, and this will be among the best opportunities to look for albedo detail in the cap itself. The "aphelic chill" documented in the apparitions of the 1960's and 1970's has not been evident in more recent apparitions, and it has not shown up in observations by spacecraft. Will it appear this in apparition?

The *Calendar of Selected Events* is a list of highlights for observers for this apparition.

In the last decade, imaging equipment and techniques have improved so dramatically that images made by many amateurs during the last apparition rival those taken during the closer apparitions of 2003 and 2005.

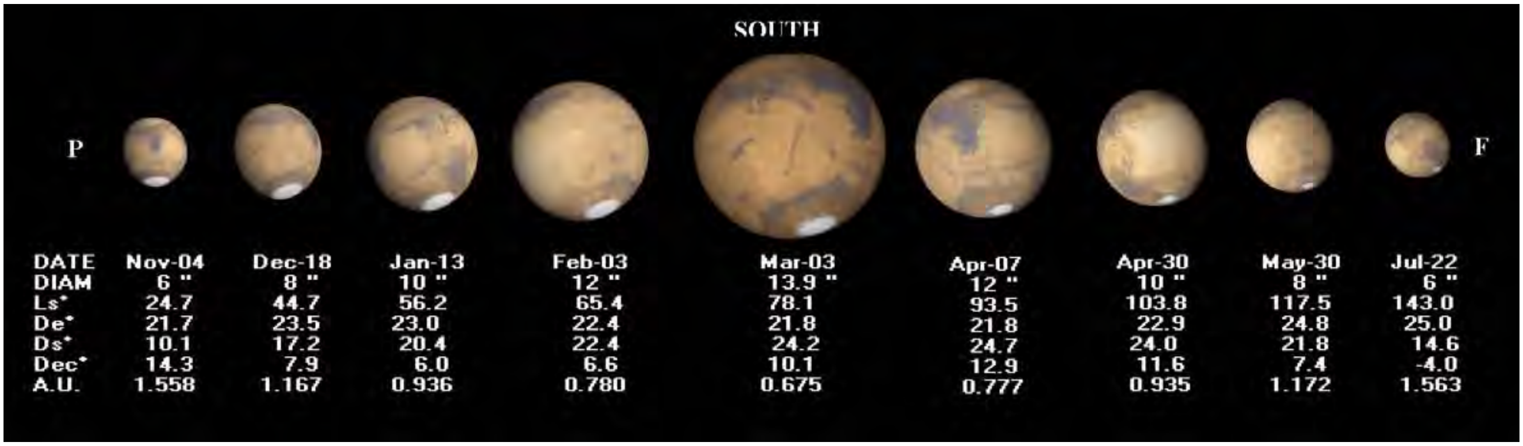

Figure 4. Depictions of the expected appearance of Mars at certain dates of the central, best part of the apparition. South is up. Note that the north polar cap is visible during the entire time from November 4, 2011, to July 22, 2012, and northern latitudes are better seen than those in the south. Abbreviations: **Ls:** longitude of the Sun in degrees, measured along Mars' orbit from the northern vernal equinox; this is an indicator of the Martian season. **De:** Declination of the Earth in the Martian sky; this is an indicator of the angle to which the north pole of Mars is tilted toward or away from Earth. **Ds:** Declination of the Sun in the Martian sky; this is an indicator of the season and, with De, indicates whether there is a phase defect in the north or south of the planet's disc. **Dec:** The declination of Mars in Earth's sky; an indicator of the observability of Mars. **A.U.:** The distance of Mars from Earth, measured in units of the Earth's mean distance from the Sun; the determiner of the apparent size of Mars.

For instance, images taken during the last two apparitions showed good detail when the planet was even as small as 4.5 arc seconds. We encourage imagers to tackle this planet even during the very early and very late parts of the apparition.

The ALPO Mars Section seeks observations from all over the world. This effort is a continuation of the International Mars Patrol program that was begun by Chic Capen in the 1960's.

Please send us your observations -- either directly to Roger Venable, ALPO Mars section coordinator at *rjvmd@hughes.net* , or else place them in the photos section of the ALPO Mars Observers list on Yahoo at *http://tech.groups.yahoo.com/group/marsobservers* .

Calendar of Selected Events — Mars in 2011

DATE	PHYSICAL	REMARKS
2011 Feb 04	Ls 229.9°	**Conjunction**. Mars is behind the Sun ~2.375 AU.
2011 Mar 08	Ls 250.2° De -24.6° Ds -23.2° RA 22:48 Dec -08.7° A.Dia 3.97''	**Mars at Perihelion** . Late southern spring. SPC in rapid retreat. Novus Mons smaller. Dust clouds expected over Serpentis-Hellaspontus (Ls 250 - 270). Syrtis Major narrow. Frost in bright deserts? Orographic clouds (W-clouds) possible. Elysium and Arsia Mons bright? Frost in bright deserts? Novus Mons smaller. Note: Several "planet-encircling dust storms have been reported during this season. High probability 255° Ls.
2011 Sep 14	Ls 0° De 13.5° Ds 0.1° RA 07:56 Dec 21.6° A.Dia 4.9''	**Equinox - Northern Autumn/Southern Spring** . North Polar Hood (NPH) begins to break up. North Polar Cap (NPC) should be exposed at approximately 65° Areographic latitude. ("Areo-" is a prefix often employed when referring to Mars or "Ares."). South Polar Cap (SPC) maximum diameter, subtending ~ 60.5° W. Does SPH or frost cover Hellas? Hellas should begin to clear and darken. Are W-clouds present?

Calendar of Selected Events — Mars in 2011 (Continued)

2011 Nov 04	Ls 24.7° De 21.7° Ds 10.1° RA 09:56 Dec 14.3° A.Dia 6''	**Apparition begins for observers using 4-inch to 8-inch apertures telescopes and up.** Begin low-resolution CCD imaging. Views of surface details not well defined. NPC nearly static and begin erratic retreat, hood continues to dissipate. Orographic cloud over Apollinaris Petera? Windy season on Mars begins, dust clouds present? Watch for initial dust clouds in south. White patches in bright areas? Hellas bright spots? Numerous bright patches. (NPC W ~65°).
2011 Dec 18	Ls 44.7° De 23.5° Ds 17.2° RA 11:12 Dec 7.9° A.Dia 8''	**North Polar Hood (NPH) breaking up**, North Polar Cap (NPC) should be exposed Hellas and Argyre bright? Limb arcs increasing in frequency or intensity. Arctic hazes and clouds present? (NPC W ~52° ±4°).
2012 Jan 13	Ls 56.2° De 23.0° Ds 20.4° RA 11:37 Dec 6.0° A.Dia 10''	**Watch for "Aphelic Chill" in NPR** – (usually between 60° and 70° Ls) and possible halt in thawing of NPC. Views of surface details well defined. Rima Tenuis may appear (140° and 320° Areographic meridians). Cloud activity in north increasing? (NPC W ~45° ±5°).
2012 Jan 25	Ls 61.5° De 22.7° Ds 21.6° RA 11:40 Dec 6.1° A.Dia 11.1''	**Retrogression Begins**. Mars begins retrogression, or retrograde motion against the background stars nearly 355 days after conjunction, when it appears to move backwards toward the west for a brief period before, during and after opposition. (NPC W ~42° ±4°).
2012 Feb 03	Ls 65.4° De 22.4° Ds 22.4° RA 11:38 Dec 6.6° A.Dia 12'	**Watch for "Aphelic Chill" in NPR** – (usually between 60° and 70° Ls) and possible halt in thawing of NPC. High-resolution CCD imaging and photography. (NPC W ~38° ±4°).
2012 Feb 14	Ls 70° De 22.2° Ds 23.2° RA 11:30 Dec 7.6° A.Dia 13''	**Mars at Aphelion** . Is North Cap fairly static or entering rapid retreat phase. Watch for "Aphelic Chill" in NPR (usually between 60° and 70° Ls). NPC Rima Tenuis may appear. Antarctic hazes, hood. South polar regions becoming difficult to observe. Any signs of SPH? Cloud activity increases. Are limb arcs increasing in frequency, intensity? (NPC W ~33° ±5°).
2012 Mar 03	Ls 78.1° De 21.8° Ds 24.2° RA 11:07 Dec 10.1° A.Dia 13.9''	**Mars at Opposition**. NPC in rapid retreat? Are limb arcs increasing in frequency, intensity. Antarctic hazes/hood. Cloud activity increases. "Aphelic Chill" in NPR should be ended. (NPC W ~28° ±4°).

Calendar of Selected Events — Mars in 2011 (Continued)

2012 Mar 05	Ls 79.0° De 21.7° Ds 24.3° RA 11:04 Dec 10.4° A.Dia 13.9''	**Mars at Closest Approach**. Few clouds. Limb arcs increasing in frequency or intensity. Arctic hazes and clouds present. (NPC W ~28° ±4°).
2012 Mar 30	Ls 90° De 21.6° Ds 24.8° RA 10:33 Dec 12.8° A.Dia 12.7''	**Solstice - Northern Summer/Southern Winter**. Orographic clouds over the Tharsis volcanoes – W-Cloud? Local seasonal clouds should wrap around Syrtis Major and be prominent in Lybia. Hellas white cloud and Ice-fog activity? Discrete clouds? NPC remnant? Lemuria (210° W, 82° N) detached from NPC? Any other detachments (projections at 135° W and 290° W) near NPC remnant? . (NPC W ~20° ±4°).
2012 Apr 07	Ls 93.5° De 21.8° Ds 24.7° RA 10:28 Dec 12.9° A.Dia 12'	**Orographic clouds over the Tharsis volcanoes** – W-Cloud? Local seasonal clouds should wrap around Syrtis Major and be prominent in Lybia. Hellas white cloud and Ice-fog activity? Discrete clouds? Rima Tenuis may appear (140° and 320° Areographic meridians. . (NPC W ~19° ±3°).
2012 Apr 15	Ls 97.1° De 22.0° Ds 24.6° RA 10:26 Dec 12.7° A.Dia 11.3''	**Retrogression Ends.** Mars begins westward motion against the background stars. (NPC W ~19° ±3°).
2012 Apr 30	Ls 103.8° De 22.9° Ds 24.0° RA 10:31 Dec 11.6° A.Dia 10''	**Is North Cap fairly static or entering rapid retreat phase.** South polar regions becoming difficult to observe. Any signs of SPH? Discrete clouds? Increasing ice-fogs and clouds? Watch for dust clouds and possible dust storms. (NPC W ~15° ±2°).
2012 May 30	Ls 117.5° De 24.8° Ds 21.8° RA 11:02 Dec 7.4° A.Dia 8''	**Is Mare Acidalium broad and dark?** Bright spots in Tempe-Arcadia-Tharsis-Amazoins? "Domino effect" appears around 120 - 125° Ls. Topographic clouds increase. (NPC W ~15° ±2°).
2012 Jul 22	Ls 143.0° De 25.0° Ds 14.6° RA 12:37 Dec -4.0° A.Dia 6''	**If both polar caps are visible look for haze canopy?** Clouds and frosts prominent in north. Clouds area in south. Syrtis Major broad.
2012 Sep 30	Ls 180°	**Equinox - Northern Autumn/Southern Spring** . South Polar Cap (SPC) maximum diameter, subtending ~ 60.5° W. Is the North Polar Hood present. Does SPH or frost cover Hellas? Hellas should begin to clear and darken. Are W-clouds present? South cap emerges from darkness of Winter. SPH thinning and forms "Life Saver Effect."
2013 Apr 17	Ls 302°	**Conjunction**. Mars is behind the Sun ~2.430AU.

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****

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Publisher & Editor-in-Chief

- Ken Poshedly (all papers, submissions, etc); 1741 Bruckner Ct., Snellville, GA 30078-2784

Science / Peer Reviewers

- Klaus R. Brasch; 10915 Sage Rd, Flagstaff, AZ, 86004
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- Roger J. Venable, MD, P.O. Box 117, Chester, GA 31012
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Book Review Editor

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****

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Lunar & Planetary Training Section

http://www.alpo-astronomy/training

- Coordinator; Timothy J. Robertson, 195 Tierra Rejada Rd., #148, Simi Valley, CA 93065

Website

http://www.alpo-astronomy.org/

- Webmaster; Larry Owens, 4225 Park Brooke Trace, Alpharetta, GA 30022
- Assistant Webmaster; Jonathan D. Slaton, P. O. Box 496, Mansfield, MO. 65704

Youth Section

http://www.cometman.net/youth

- Coordinator; Timothy J. Robertson,195 Tierra Rejada Rd., #148, Simi Valley, CA 93065

****

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http://www.alpo-astronomy.org/solar

- Coordinator (including all submissions, photo, sketches, filtergrams); Kim Hay, 76 Colebrook Rd, RR #1,Yarker, ON, K0K 3N0 Canada
- Assistant Coordinator; Brad Timerson (e-mail contact only; see listing in *ALPO Staff E-mail Directory* on page 45)
- Assistant Coordinator & Archivist; Jamey Jenkins, 308 West First Street, Homer, Illinois 61849
- Scientific Advisor; Richard Hill, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721

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http://www.alpo-astronomy.org/Mercury

- Coordinator; Frank J. Melillo, 14 Glen-Hollow Dr., E-#16, Holtsville, NY 11742

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http://www.alpo-astronomy.org/venus

- Coordinator; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410

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http://moon.scopesandscapes.com/tlo.pdf

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- Coordinator; Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080
- Assistant Coordinator; William Dembowski, 219 Old Bedford Pike, Windber, PA 15963

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http://www.alpo-astronomy.org/lunar/LTP.html; also http://www.LTPresearch.org

- Coordinator; Dr. Anthony Charles Cook, Institute of Mathematical and Physical Sciences, University of Aberystwyth, Penglais, Aberystwyth, Ceredigion. SY23 3BZ, United Kingdom
- Assistant Coordinator; David O. Darling, 416 West Wilson St., Sun Prairie, WI 53590-2114

Lunar Dome Survey Program

- Coordinator; Marvin W. Huddleston, 2621 Spiceberry Lane, Mesquite, TX 75149

Mars Section

http://www.alpo-astronomy.org/Mars

- Coordinator; Roger J. Venable, MD, 3405 Woodstone Pl., Augusta, GA 30909-1844
- Assistant Coordinator (CCD/Video imaging and specific correspondence with CCD/Video imaging); Donald C. Parker, 12911 Lerida Street, Coral Gables, FL 33156
- Assistant Coordinator (photometry and polarimetry); Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204
- Assistant Coordinator; Jim Melka, 14176 Trailtop Dr., Chesterfield, MO 63017

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http://www.alpo-astronomy.org/minor

- Coordinator; Frederick Pilcher, 4438 Organ Mesa Loop, Las Cruces, NM 88011
- Assistant Coordinator; Lawrence S. Garrett, 206 River Road, Fairfax, VT 05454
- Scientific Advisor; Steve Larson, Lunar & Planetary Lab, University of Arizona, Tuscon, AZ 85721

Jupiter Section

http://www.alpo-astronomy.org/jupiter

- Coordinator (Section); Richard W. Schmude Jr., 109 Tyus St., Barnesville, GA 30204
- Assistant Coordinator (Section); Ed Grafton, 15411 Greenleaf Lane, Houston, TX 77062
- Assistant Coordinator & Scientific Advisor; Sanjay Limaye, University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bldg. 1017, 1225 W. Dayton St., Madison, WI 53706
- Assistant Coordinator, Transit Timings; John McAnally, 2124 Wooded Acres, Waco, TX 76710
- Assistant Coordinator, Newsletter; Craig MacDougal, 821 Settlers Road, Tampa, FL 33613
- Assistant Coordinator, Eclipses of Galilean Satellites; John E. Westfall, P.O. Box 2447, Antioch, CA 94531-2447
- Scientific Advisor; Prof. A. Sanchez-Lavega, Dpto. Fisica Aplicada I, E.T.S. Ingenieros, Alda. Urquijo s/n, 48013, Bilbao, Spain wupsalaa@bicc00.bi.ehu.es

Saturn Section

http://www.alpo-astronomy.org/saturn

- Coordinator; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410

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http://www.alpo-astronomy.org/remote

- Coordinator; Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204

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- Coordinator; Robert D. Lunsford, 1828 Cobblecreek St., Chula Vista, CA 91913-3917
- Assistant Coordinator; Robin Gray, P.O. Box 547, Winnemuca, NV 89446

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http://www.alpo-astronomy.org/meteorite

- Coordinator; Dolores Hill, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721

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There is NO CHARGE for any of the ALPO monographs.

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- **Monograph No. 2**. *Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994. 52* pages. File size approx. 6.0 megabytes.

- **Monograph No. 3**. *H.P. Wilkins 300-inch Moon Map.* 3rd Edition (1951). Available as one comprehensive file (approx. 48 megabytes) or five section files (Part 1, 11.6 megabytes; Part 2, 11.7 megabytes; Part 3, 10.2 megabytes; Part 4, 7.8 megabytes; Part 5, 6.5 megabytes)

- **Monograph No. 4.** *Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.127* pages. Hard copy $17 for the United States, Canada, and Mexico; $26 elsewhere. File size approx. 2.6 megabytes.

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- **Monograph No. *6.*** *Proceedings of the 47th Convention of the Association of Lunar and Planetary Observers, Tucson, Arizona, October 19-21, 1996.*20 pages. Hard copy $3 for the United States, Canada, and Mexico; $4 elsewhere.File size approx. 2.6 megabytes.
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- **Monograph Number 9**. *Does Anything Ever Happen on the Moon?* By Walter H. Haas. Reprint of 1942 article. 54 pages.Hard copy $6 for the United States, Canada, and Mexico; $8 elsewhere.File size approx. 2.6 megabytes.
- **Monograph Number 10.** *Observing and Understanding Uranus, Neptune and Pluto*. By Richard W. Schmude, Jr. 31 pages. File size approx. 2.6

ALPO Staff E-mail Directory

Bailey, W .... *wayne.bailey@alpo-astronomy.org*
Benton, J.L. .... *jlbaina@msn.com*
Benton, J.L. ....*jlbaina@gmail.com*
Brasch, K.R. .... *m_brasch@earthlink.net*
Baum, R. .... *richard@take27.co.uk*
Cook, A. .... *tony.cook@alpo-astronomy.org*
Cudnik, B. .... *cudnik@sbcglobal.net*
Darling, D.O. .... *DOD121252@aol.com*
Dembowski, W. .... *dembowski@zone-vx.com*
Dobbins, Tom .... *tomdobbins@gmail.com*
Garfinkle, R.A. .... *ragarf@earthlink.net*
Garrett, L.S. .... *atticaowl@yahoo.com*
Grafton, E. .... *ed@egrafton.com*
Gray, R. .... *sevenvalleysent@yahoo.com*
Haas, W.H. .... *haasw@haasw@agavue.com*
Hay, K. .... *kim@starlightcascade.ca*
Hill, D. .... *dhill@lpl.arizona.edu*
Hill, R .... *rhill@lpl.arizona.edu*
Jakiel, R .... *rjakiel@earthlink.net*
Jenkins, J. .... *jenkinsjl@yahoo.com*
Kronk, G .... *kronk@cometography.com*
Larson, S. .... *slarson@lpl.arizona.edu*
Limaye, S. .... *sanjayl@ssec.wisc.edu*
Lunsford, R.D. .... *lunro.imo.usa@cox.net*
MacDougal, C. .... *macdouc@verizon.net*
McAnally, J. .... *CPAJohnM@aol.com*
Melillo, F. .... *frankj12@aol.com*
Melka, J. .... *jtmelka@yahoo.com*
Owens, L. .... *larry.owens@alpo-astronomy.org*
Parker, D.C. .... *park3232@bellsouth.net*
Pilcher, F. .... *pilcher@ic.edu*
Poshedly, K. .... *ken.poshedly@alpo-astronomy.org*
Reynolds, M. .... *mreynold@fscj.edu*
Robertson, T.J. .... *cometman@cometman.net*
Sanchez-Lavega, A. .... *wupsalaa@bicc00.bi.ehu.es*
Schmude, R.W. .... *schmude@gdn.edu*
Slaton, J.D. .... *jd@justfurfun.org*
Timerson, B. .... *btimerson@rochester.rr.com*
Ulrich, R.K. .... *rulrich@uark.edu*
Venable, R.J. .... *rjvmd@hughes.net*
Westfall, J.E. .... *johnwestfall@comcast.net*
Will, M. .... *matt.will@alpo-astronomy.org*

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- **Lunar & Planetary Training Section:** *The Novice Observers Handbook* $15. An introductory text to the training program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. Available as pdf file via e-mail or send check or money order payable to Timothy J. Robertson, 195 Tierra Rejada Rd., #148, Simi Valley, CA 93065; e-mail *cometman@cometman.net*.

- **Lunar (Bailey):** (1) *The ALPO Lunar Selected Areas Program (*$17.50). Includes full set of observing forms for the assigned or chosen lunar area or feature, along with a copy of the *Lunar Selected Areas Program Manual.* (2) o*bserving forms,* free at *http://moon.scopesandscapes.com/alpo-sap.html*, or $10 for a packet of forms by regular mail. Specify *Lunar Form*s. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO lunar SAP section. Observers should make copies using high-quality paper.

- **Lunar**: *The Lunar Observer*, official newsletter of the ALPO Lunar Section, published monthly. Free at *http://moon.scopesandscapes.com/tlo.pdf* or $1.25 per hard copy: send SASE with payment (check or money order) to: Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080.

- **Lunar (Jamieson):** *Lunar Observer's Tool Kit*, price $50, is a computer program designed to aid lunar observers at all levels to plan, make, and record their observations. This popular program was first written in 1985 for the Commodore 64 and ported to DOS around 1990. Those familiar with the old DOS version will find most of the same tools in this new Windows version, plus many new ones. A complete list of these tools includes Dome Table View and Maintenance, Dome Observation Scheduling, Archiving Your Dome Observations, Lunar Feature Table View and Maintenance, Schedule General Lunar Observations, Lunar Heights and Depths, Solar Altitude and Azimuth, Lunar Ephemeris, Lunar Longitude and Latitude to Xi and Eta, Lunar Xi and Eta to Longitude and Latitude, Lunar Atlas Referencing, JALPO and Selenology Bibliography, Minimum System Requirements, Lunar and Planetary Links, and Lunar Observer's ToolKit Help and Library. Some of the program's options include predicting when a lunar feature will be illuminated in a certain way, what features from a collection of features will be under a given range of illumination, physical ephemeris information, mountain height computation, coordinate conversion, and browsing of the software's included database of over 6,000 lunar features. Contact *harry@persoftware.com*

- **Venus (Benton):** Introductory information for observing Venus, including observing forms, can be downloaded for free as pdf files at *http://www.alpo-astronomy.org/venus*. The *ALPO Venus Handbook* with observing forms included is available as the *ALPO Venus Kit* for $17.50 U.S., and may be obtained by sending a check or money order made payable to "Julius L. Benton" for delivery in approximately 7 to 10 days for U.S. mailings. The *ALPO Venus Handbook* may also be obtained for $10 as a pdf file by contacting the ALPO Venus Section. All foreign orders should include $5 additional for postage and handling; p/h is included in price for domestic orders. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO Venus section. Observers should make copies using high-quality paper.

- **Mars:** *(1) ALPO Mars Observers Handbook,* send check or money order for $15 per book (postage and handling included) to Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-DEEP-SKY (816-333-7759); e-mail *leaguesales@astroleague.org*. *(2) Observing Forms;* send SASE to obtain one form for you to copy; otherwise send $3.60 to obtain 25 copies (send and make checks payable to "Deborah Hines", see address under "Mars Section").

- **Jupiter:** *(1) Jupiter Observer's Handbook*, $15 from the Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-DEEP-SKY (816-333-7759); e-mail *leaguesales@astroleague.org*. (2) *Jupite*r, the ALPO section newsletter, available online only via the ALPO website at *http://mysite.verizon.net/macdouc/alpo/jovenews.htm;* (3) *J-Ne*t, the ALPO Jupiter Section e-mail network; send an e-mail message to Craig MacDougal. (4) *Timing the Eclipses of Jupiter's Galilean Satellites* free at *http://www.alpo-astronomy.org/jupiter/GaliInstr.pdf*, report form online at *http://www.alpo-astronomy.org/jupiter/*

ALPO Resources

People, publications, etc., to help our members

GaliForm.pdf; send SASE to John Westfall for observing kit and report form via regular mail. (5) *Jupiter Observer's Startup Kit*, $3 from Richard Schmude, Jupiter Section coordinator.

- **Saturn (Benton):** Introductory information for observing Saturn, including observing forms and ephemerides, can be downloaded for free as pdf files at *http://www.alpo-astronomy.org/saturn*; or if printed material is preferred, the *ALPO Saturn Kit* (introductory brochure and a set of observing forms) is available for $10 U.S. by sending a check or money order made payable to "Julius L. Benton" for delivery in approximately 7 to 10 days for U.S. mailings. The former *ALPO Saturn Handbook* was replaced in 2006 by *Saturn and How to Observe It* (by J. Benton); it can be obtained from book sellers such as *Amazon.com*. NOTE: Observers who wish to make copies of the observing forms may instead send a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the ALPO Saturn Section.

- **Meteors:** (1) *The ALPO Guide to Watching Meteors* (pamphlet). $4 per copy (includes postage & handling); send check or money order to Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-DEEP-SKY (816-333-7759); e-mail *leaguesales@astroleague.org*. (2) *The ALPO Meteors Section Newsletter*, free (except postage), published quarterly (March, June, September, and December). Send check or money order for first class postage to cover desired number of issues to Robert D. Lunsford, 1828 Cobblecreek St., Chula Vista, CA 91913-3917.

- **Minor Planets (Derald D. Nye):** *The Minor Planet Bulletin*. Published quarterly; free at *http://www.minorplanetobserver.com/mpb/default.htm*. Paper copies available only to libraries and special institutions at $24 per year via regular mail in the U.S., Mexico and Canada, and $34 per year elsewhere (airmail only). Send check or money order payable to "Minor Planet Bulletin", c/o Derald D. Nye, 10385 East Observatory Dr., Corona de Tucson, AZ 8564I-2309.

Other ALPO Publications

Checks must be in U.S. funds, payable to an American bank with bank routing number.

- ***An Introductory Bibliography for Solar System Observers.*** **No charge.** Four-page list of books and magazines about Solar System objects and how to observe them. The current edition was updated in October 1998. Send self-addressed stamped envelope with request to current ALPO Membership Secretary (Matt Will).

- ***ALPO Membership Directory.*** Provided only to ALPO board and staff members. Contact current ALPO membership secretary/treasurer (Matt Will).

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- Download JALPO43-1 thru current issue as pdf file from the ALPO website at *http://www.alpo-astronomy.org/djalpo* (free; most recent issues are password-protected, contact ALPO membership secretary Matt Will for password info).

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THE ASSOCIATION OF LUNAR & PLANETARY OBSERVERS (ALPO)

The Association of Lunar & Planetary Observers (ALPO) was founded by Walter H. Haas in 1947, and incorporated in 1990, as a medium for advancing and conducting astronomical work by both professional and amateur astronomers who share an interest in Solar System observations. We welcome and provide services for all individuals interested in lunar and planetary astronomy. For the novice observer, the ALPO is a place to learn and to enhance observational techniques. For the advanced amateur astronomer, it is a place where one's work will count and be used for future research purposes. For the professional astronomer, it is a resource where group studies or systematic observing patrols add to the advancement of astronomy.

Our Association is an international group of students that study the Sun, Moon, planets, asteroids, meteors, meteorites and comets. Our goals are to stimulate, coordinate, and generally promote the study of these bodies using methods and instruments that are available within the communities of both amateur and professional astronomers. We hold a conference each summer, usually in conjunction with other astronomical groups.

We have "sections" for the observation of all the types of bodies found in our Solar System. Section coordinators collect and study submitted observations, correspond with observers, encourage beginners, and contribute reports to our quarterly Journal at appropriate intervals. Each section coordinator can supply observing forms and other instructional material to assist in your telescopic work. You are encouraged to correspond with the coordinators in whose projects you are interested. Coordinators can be contacted either via e-mail (available on our website) or at their postal mail addresses listed in our Journal. Members and all interested persons are encouraged to visit our website at http://www.alpo-astronomy.org. Our activities are on a volunteer basis, and each member can do as much or as little as he or she wishes. Of course, the ALPO gains in stature and in importance in proportion to how much and also how well each member contributes through his or her participation.

Our work is coordinated by means of our periodical, *The Strolling Astronomer*, also called the *Journal of the Assn. of Lunar & Planetary Observers*, which is published seasonally. Membership dues include a subscription to our Journal. Two versions of our ALPO are distributed — a hardcopy (paper) version and an online (digital) version in "portable document format" (pdf) at considerably reduced cost.

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