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The Strolling Astronomer

Volume 57, Number 2, Spring 2015
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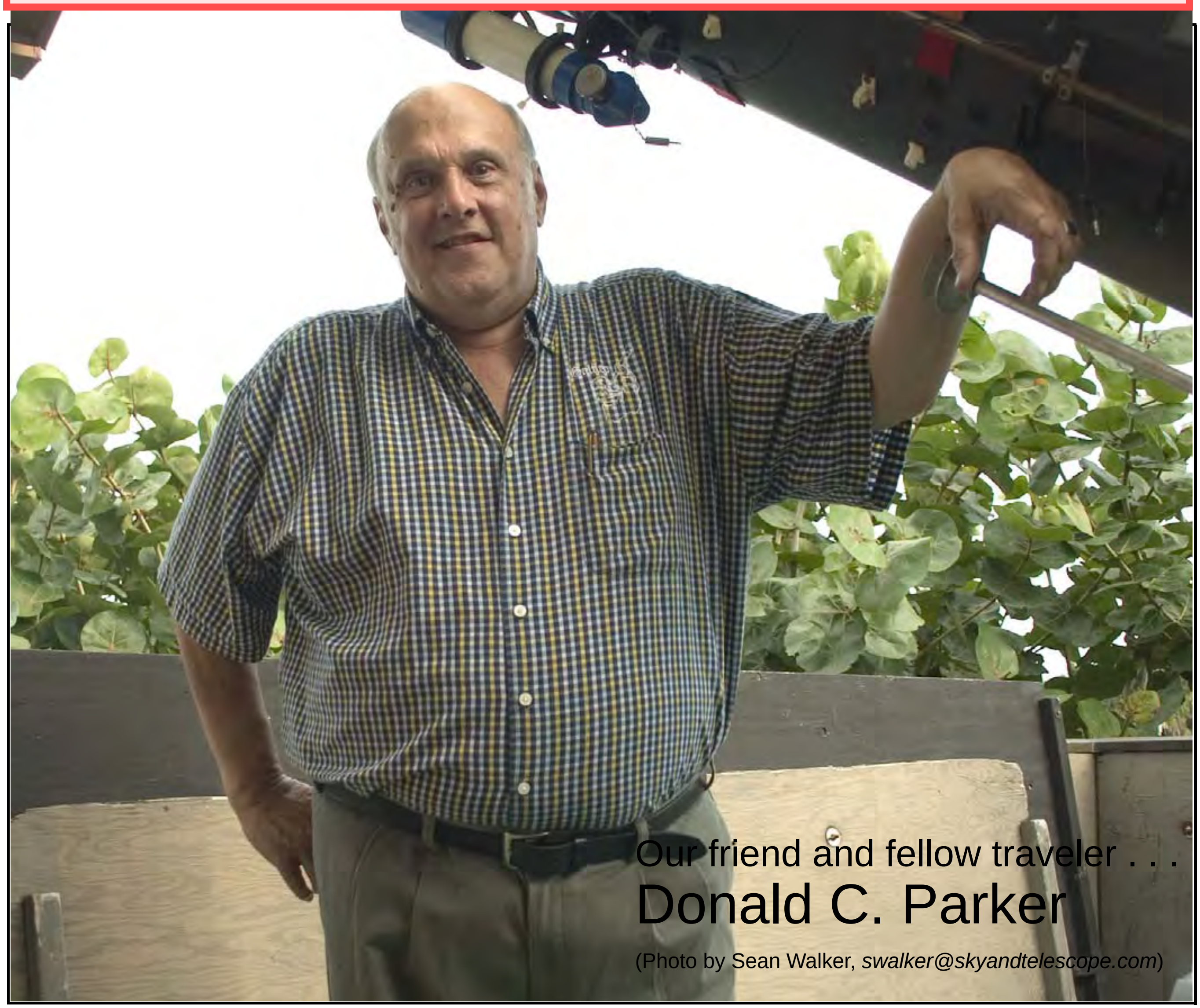

ALCON 2015

LAS CRUCES, NEW MEXICO

AMERICA'S DARK-SKY PARADISE

JULY 6 - 11

HOSTED BY: THE ASTRONOMICAL SOCIETY OF LAS CRUCES
AND THE ASTRONOMICAL LEAGUE

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*TOUR #2: NEW MEXICO MUSEUM OF SPACE HISTORY
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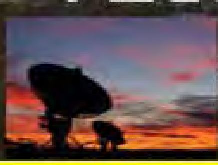

VERY LARGE ARRAY

APACHE POINT OBSERVATORY

DUNN SOLAR TELESCOPE

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 57, No.2, Spring 2015
This issue published in March 2015 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:

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Springfield, Illinois 62791-3456

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

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

Founded in 1947

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Lunar Meteoritic Impact Search; Brian Cudnik
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Point of View
Don Parker: Humorist. Seriously.
By Ken Poshedly, executive director& editor of this Journal

When Don Parker passed away on February 22, a big chunk of what makes astronomy fun and educational went with him. I say that because the Don Parker that I knew had a heck of a sense of humor and still knew how to inspire those who were just starting out in this hobby as well as the old pros who seemed to need someone like himself to keep the flame of interest burning.

Others who talked with Don far more frequently than I did have lots of remembrances of his deadpan one-liners. The biggest instance of Don's humor to me was when author Antonin Rukl, Walter Haas and a number of other ALPO officers attended the year 2000 Peach State Star Gaze just south of Atlanta. Without meaning to, the event turned into sort of a mini-ALPO convention. (Mr. Rukl, author of the much-cherished *Atlas of the Moon* was there for two presentations as our keynote speaker, while Walter's talk "Those Unnumbered Reports of Lunar Changes: Were They All Blunders?" got everybody fired up about Lunar Transient Phenomena.)

At the close of the event, it was interesting to find an unopened can of "ALPO" dog food sitting on my car's hood. Somebody told me it was Don who left it and I've got no reason to believe otherwise. It had to be Don.

But on the serious side, Don continued to work with beginners and pros like himself to produce some of the most awesome astrophotos. Sometime it's hard to discern if it was a Don Parker image or a Hubble image.

We miss you, Don.

A number of you have already made donations to the ALPO in memory of Don. Online contributions can be made via the URL below:

https://www.astroleague.org/store/index.php?main_page=product_info&cPath=10&products_id=50&zenid=7vfjtfsce7miss48rh3tnnh4u6

Or you can mail your the check to:

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

Please make your check payable to "The ALPO" and add "Don Parker donation" in the lower left corner note of the check.

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News of General Interest

Donald C. Parker

Information about our longtime ALPO member, board member, energetic contributor and friend Don Parker appears later in this Journal.

Don passed away Sunday evening, February 22.

Membership Update

The most recent recognition of contributors to the ALPO and a listing of our newest members compiled by ALPO Membership Secretary/Treasurer Matt Will also appears later in this issue.

Besides those whose names appear in the various listings,

- A special thank you to the late Don Parker for an especially generous contribution to the ALPO. Special thanks also to John and Elizabeth Westfall, for their generous support to the ALPO in providing contributions that cover record-keeping expenses.
- Thanks to Bob O'Connell, Mike Dillon, Wesley Erickson, Jim Lamm and Howard Eskidsen for their special donations given separately from their Sustaining Memberships.

ALCon 2015 Update

As shown on the full-page ad on the inside front cover of this Journal, ALCon 2015 will be held Monday thru Saturday. July 6 - 11, in Las Cruces, NM.

The paper presentation sessions will be Thursday, Friday and the first part of Saturday, while Monday and Tuesday have been set aside for astronomy-themed tours and Wednesday for the Astronomical League annual council meeting and non-astronomy tours.

The traditional "Star-B-Que" will be held on Friday night and the annual awards banquet on Saturday night will include a special tribute to Walter H. Haas, founder and director emeritus of the Assn of Lunar & Planetary Observers.

This will be the second time in five years that the ALPO will be meeting in Las Cruces. We held our own conference there in July 2011.

There will be a total of 20 speakers at ALCon2015. This year, four ALPO papers will be mainstreamed and scheduled for presentation with the other talks in the San Andres Ballroom.

Additional ALPO presentations will be offered in a separate meeting room close by the main presentation venue.

Participants are encouraged to submit research papers, presentations, and experience reports concerning various aspects of Earth-based observational astronomy. Suggested topics for papers and presentations include the following:

- New or ongoing observing programs and studies, specifically, how those programs were designed, implemented and continue to function.
- Results of personal or group studies of solar system or extra-solar system bodies.
- New or ongoing activities involving astronomical instrumentation, construction or improvement.
- Challenges faced by Earth-based observers such as changing interest levels, deteriorating observing conditions brought about by possible global warming, etc.

The preferred format for presentations is PowerPoint, though video and audio materials can also be accepted on a flash drive, CD or DVD. Presentations sould be no longer than 50 minutes in length, including questions/answers.

A form letter to all potential speakers will be distributed this month by convention chairman Ron Kramer. The letter will request the following information be returned to him by May 1, 2015:

- A one-paragraph biography of the speaker
- A one-paragraph abstract of the presentation
- The name, title, etc, of the speaker
- The preferred time/day slot
- Any special requirements (35 mm projector, etc.)

This information will be added to the program brochure currently in preparation.

"There is no formal request for 'papers,'" according to the chairman. "All we ask for are dynamic … animated, lively speakers."

Laser pointers will be provided (and must be returned).

E-mail address is the preferred method for contact:

ronjkramer@aol.com

If regular mail must be used, address all materials to, please send all materials or requests for information to:

Ron Kramer
9520 Dragonfly Ave.
Las Cruces, NM 88012 USA

Fees and other information are detailed on the event website at:

https://alcon2015.astroleague.org/

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ALPO Interest Section Reports

ALPO Online Section

Larry Owens, section coordinator
Larry.Owens@alpo-astronomy.org

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

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

Lunar & Planetary Training Program

Tim Robertson, section coordinator
cometman@cometman.net

The ALPO Lunar & Training Program isn't easy. It takes time, dedication and the willingness to commit to making systematic observations over an extended period of time to properly complete the program.

I myself went through the training program in the early 1970's, and it took me over 18 months to complete. During that time, I made over 100 observations of the lunar crater Eratosthenes.

The current statistics show that for every 10 ALPO Training handbooks I send out, 3 of those individuals actually submit an observation to begin the program. But overall, out of 100 handbooks, 6 students actually complete the program.

ALPO Lunar & Planetary Training Program graduate Steve Tzikas with his Meade Starfinder 8" reflector.

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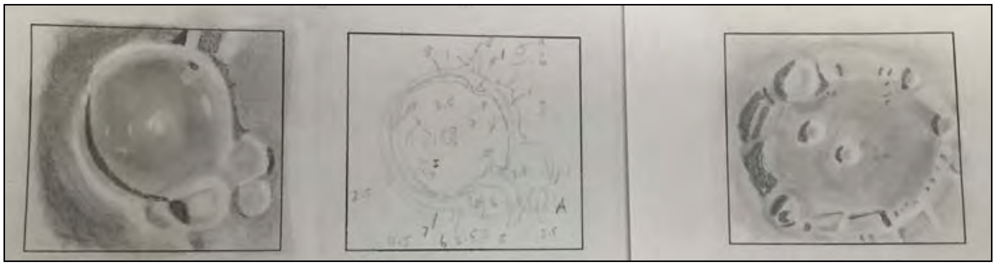

Sketches of lunar craters Gassendi and Clavius by ALPO Lunar & Planetary Training Program graduate Steve Tzikas.

This brings me to recent ALPO Training Program graduate, Steve Tzikas.

Steve Tzikas joined the ALPO in late 2013 and started in the training program in May 2014. He uses a Meade Starfinder 8" reflector telescope for his observations and has regularly submitted his observations and detailed observation notes since the beginning of his training. I have seen a great improvement in not only his observing skills, but also the detail of which he presents in his observations. A few of his observations that he has submitted accompany this report.

Steve plans on being active in the ALPO Lunar and ALPO Comets sections.

He has been interested in astronomy since childhood and has a MAppSc in Chemical Engineering and Industrial Chemistry from the University of New South Wales (Australia), and a Bachelor of Science degree in Chemical Engineering from Rensselaer Polytechnic Institute in Troy, NY.

He is a member of the Northern Virginia Astronomy Club (NOVAC), the Society of Amateur Radio Astronomers (SARA), and the Rensselaer Astrophysical Society (RAS). He currently is a Management Analyst/Computer Modeler for the Department of Homeland Security in Washington, DC, and has 30 years of combined experience in both the federal government and the private sector. The early part of his career was focused on environmental engineering. Steve's many personal interests include travel, genealogy, philosophy, art and classical music."

When I asked Steve what his overall thoughts about the ALPO Lunar & Training Program, this was his well-thought-out response: "It is easy to dismiss the value of an observation program when our eyes look through a telescope and we conclude we have seen an object and that there is nothing more to learn. On the contrary, unfocused human perception is prone to much error and completely blind to details to which it is not aware. Learning to understand and perceive details through a disciplined long-term regimen that builds on each prior set of observations is a remarkable elevation of cognition. This is a fundamental skill that all astronomers and amateurs should have. Participating in the ALPO training program is nothing short of enlightenment."

The ALPO Lunar & Planetary Training Program is open to all members of the ALPO, the beginner as well as the expert observer. The goal is to help make members proficient observers. The ALPO revolves around the submission of astronomical observations of members for the purposes of scientific research. Therefore, it is the responsibility of our organization to guide prospective contributors toward a productive and meaningful scientific observation.

I, Tim Robertson, as program coordinator, heartily welcomes you to the ALPO and our training program and look forward to hearing from you!

To began the first phase of training at the basic level, interested persons should contact me at the following address:

Timothy J. Robertson
ALPO Training Program
195 Tierra Rejada #148
Simi Valley, California 93065

Or send e-mail to me at:
cometman@cometman.net

For more information about the ALPO Lunar & Planetary Training Program, go to: *www.cometman.net/alpo/*

ALPO Observing Section Reports

Mercury / Venus Transit Section

John Westfall, section coordinator
johnwestfall@comcast.net

Visit the ALPO Mercury/Venus Transit Section online at *www.alpo-astronomy.org/transit*

Meteors Section

Robert 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.

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Meteorites Section

Report by Dolores H. Hill, section coordinator
dhill@lpl.arizona.edu

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

Comets Section

Report by Carl Hergenrother, acting section coordinator
chergen@lpl.arizona.edu

Comet C/2014 Q2 (Lovejoy) was the highlight of the past winter. Far exceeding expectations, Lovejoy brightened at a very rapid rate from discovery through perihelion peaking at an apparent magnitude of ~3.5 to 4.0. Though now fading as it moves away from the Earth and Sun, the comet continues to become intrinsically brighter and remains brighter than 6th magnitude as of early March. At some point, the comet will start to fade more rapidly but it still should remain a small telescope/ binocular object for much of the spring.

The Comet Section has received 139 magnitude estimates for Lovejoy from observers Salvador Aguirre (66 estimates), Carl Hergenrother (24), Willian Souza (22), Luis Mansilla (15), John D. Sabia (8), Gary T. Nowak (2) and Stephen Tzikas (1). Also 65 images and drawings were submitted by Salvador Aguirre, Denis Buczynski, Geoff Chester, Jean-Francois Coliac, Carson Fuls, Carl Hergenrother, Rik Hill, Manos Kardasis, Gianluca Masi, Frank Melillo, Jim Melka, Richard Owens, John D. Sabia, Chris Schur, Emmanuel Subes and Stephen Tzikas.

The April-to-June quarter of this year will see short-period comet 88P/Howell (T = 1.36 AU on 2015 Apr. 6) brighten to ~8th or 9th magnitude in the morning sky. Howell has an orbital period of 5.5 years and this marks its 8th observed return.

Two long-period comets may be bright enough for small telescope observers over the next three months. Both C/2013 US10 (Catalina) (T = 0.82 AU on 2015 Nov. 15) and C/2014 Q1 (PANSTARRS) (T = 0.31 AU on 2015 Jul. 6) were predicted to become naked-eye objects based on their discovery brightness. As is common with these first-timers, both comets have brightened very slowly and may or may not be bright

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enough for small-telescope observers by early summer.

Due to PANSTARRS' small perihelion distance, it has the potential to become a bright naked-eye object. Unfortunately both comets will be very poorly placed for northern observers over the next few months. Observers south of the equator will have a much easier view of Catalina. PANSTARRS will be visible though poorly placed for southern observers.

The ALPO Comet Section solicits all observations of comets, including drawings, magnitude estimates, images and spectra. Drawings and images of current and past comets are being archived in the ALPO Comet Section image gallery at *http://www.alpo-astronomy.org/gallery/main.php?g2_itemId=4491*

Please send all observations and images to Carl Hergenrother at the e-mail address shown at the beginning of this section report.

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

Solar Section

Report by Kim Hay, section coordinator
kim.hay@alpo-astronomy.org

To join the Yahoo Solar ALPO list, please go to *https://groups.yahoo.com/neo/groups/SolarAlpo*

If you would like to send your sketches, or images of your observations, and have them archived in the Carrington Rotation periods, please send jpg or gif images no larger than 250 mb in size to myself (*kim.hay@alpo-astronomy.org*) Be sure to include all information on your image, and the CR number as well.

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

Photo of Mercury and Venus (grouped together to the left of the utility pole at center of this image). Taken January 10 by Ann Kochendorfer of the Astronomical Society of Long Island about 40 minutes after sunset in Richmond Hill, NY, from a a moving train (Ms. Kochendorfer is a conductor for the Long Island Railroad). It was taken with a Nikon D7000 DSLR camera at 28mm, f/5.6 and 1/6 of a second.

Mercury Section

Report by Frank J. Melillo, section coordinator
frankj12@aol.com

I hope that many of you saw the fine conjunction between the two planets Mercury and Venus in the January evening sky. Mercury was in a favorable position, especially the second and the third week of January. Normally, Mercury is more eye-catching when it is close to any of the brighter planets. But this conjunction was exceptional, especially when Mercury was about only 1 degree from Venus, near the greatest elongation on January 14.

If you missed the January evening apparition, Mercury will appear favorably again after sunset in both April and May:

- On April 22, Mercury will slide 1 degree above Mars and be at magnitude -1.1; the dimmer Mars will be at nearly its faintest magnitude of +1.4. Count on using a pair of binoculars to see this for a fine view.
- On May 1, Mercury will appear 1 degree to the right of the Pleaides. It will be at magnitude -0.2 and, again, will be a fine sight through binoculars.

Mercury will reach the greatest elongation of 21 degrees east of the Sun on May 6. Mercury will also be on the same side of Venus, so together, there will create a nice presentation of the two inner planets during the twilight.

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Additionally, Mercury will set about 1 hour and 45 minutes after sundown - which is good, as this makes it easier to see Mercury against a darker sky.

If you have any observations of Mercury recently, please send them in. We need more drawings and images that will add a nice touch to the 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

Venus is a rather conspicuous object this spring in the western sky after sunset at apparent visual magnitude of -4.0, moving eastward relative to the Sun as the 2014-15 Eastern (Evening) Apparition progresses.

The planet is now passing through its waning phases (a progression from fully illuminated through crescent phases) as observers witness the leading hemisphere of Venus at the time of sunset on Earth. Venus will attain Greatest Elongation East of 45.4 on June 6, 2015 and reach theoretical dichotomy (half phase) also on June 6. The planet will reach greatest brilliancy on July 12, 2015 at visual magnitude -4.5

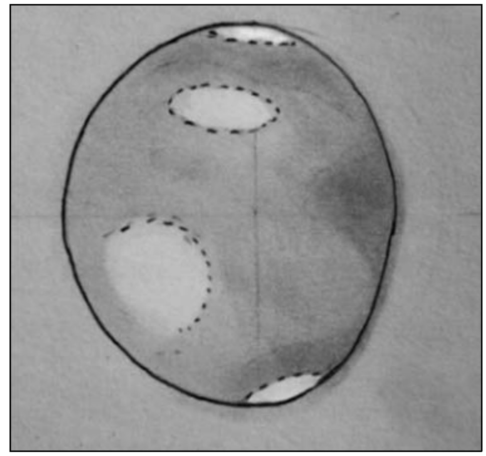
The Table of Geocentric Phenomena in Universal Time (UT) is included here with this report for the convenience of observers for the 2014-15 Eastern (Evening) Apparition for planning purposes.

As of this writing In early March, the ALPO Venus Section has started receiving increasing numbers of drawings and images, with more expected as observers follow the planet as it attains a higher position above the western horizon this spring and summer.

ESA's Venus Express (VEX) mission, that started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in May 2006, ended its highly successful campaign early in 2015 as it made its final descent into the atmosphere of the planet. This was a very meaningful Pro-Am collaborative effort involving ALPO Venus observers around the globe, and those who actively participated are to be commended for their persistence and dedication.

It should be pointed out that it is not too late for those who have not yet sent their images to the ALPO Venus Section and the VEX website (see below) to do so. Sought after also are drawings of Venus in Integrated Light and with color filters of known transmission. These collective data are important for further study and will continue to be analyzed for several years to come as a result of this endeavor. The VEX website is at:

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



Michel Legrand of La Baule-Escoublac, France submitted this excellent sketch of Venus using a W80A (light blue) filter on February 09, 2015 at 15:28 UT using a 21.0 cm (8.3 in.) Newtonian good seeing (S = 8) and favorable transparency (Tr = 5.0). Amorphous dusky markings and bright areas exclusive of the cusp depicted in this drawing. The apparent diameter of Venus is 11.4", phase (k) 0.904 (90.4% illuminated), and visual magnitude -3.9. South is at top of image.

The observation programs carried out 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, which is 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 (for instance, categorization of dusky atmospheric markings, visibility of cusp caps and cusp bands, measurement of cusp extensions,

Geocentric Phenomena of the Upcoming 2014-15 Eastern (Evening) Apparition of Venus in Universal Time (UT)

Superior Conjunction	2014	Oct 25 (angular diameter = 9.7 arc-seconds)
Greatest Elongation East	2015	Jun 06 (Venus will be 45.4º East of the Sun)
Predicted Dichotomy		Jun 06.38 (exactly half-phase predicted)
Greatest Illuminated Extent		Jul 12 (m_V = -4.5)
Inferior Conjunction		Aug 15 (angular diameter = 63.1 arc-seconds)

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Lunar Calendar for Second Quarter 2015 (All Times UT)

Month	Date	UT	Event
Apr	01	12:59	Moon Apogee: 406000 km
	04	03:17	Moon Ascending Node
	04	12:01	Partial Lunar Eclipse
	04	12:06	Full Moon
	08	13:08	Moon-Saturn: 2.3° S
	10	07:46	Moon South Dec.: 18.2° S
	12	03:44	Last Quarter
	17	03:53	Moon Perigee: 361000 km
	17	13:07	Moon Descending Node
	18	18:57	New Moon
	21	16:35	Moon-Aldebaran: 0.9° S
	21	18:09	Moon-Venus: 6.8° N
	22	23:26	Moon North Dec.: 18.3° N
	25	23:55	First Quarter
	29	03:55	Moon Apogee: 405100 km
May	01	09:50	Moon Ascending Node
	04	03:42	Full Moon
	05	16:18	Moon-Saturn: 2.1° S
	07	13:39	Moon South Dec.: 18.3° S
	11	10:36	Last Quarter
	14	20:37	Moon Descending Node
	15	00:23	Moon Perigee: 366000 km
	18	04:13	New Moon
	20	09:41	Moon North Dec.: 18.4° N
	25	17:19	First Quarter
	26	22:12	Moon Apogee: 404200 km
	28	14:40	Moon Ascending Node
Jun	01	20:02	Moon-Saturn: 2° S
	02	16:19	Full Moon
	03	21:10	Moon South Dec.: 18.4° S
	09	15:42	Last Quarter
	10	04:39	Moon Perigee: 369700 km
	10	23:29	Moon Descending Node
	16	14:05	New Moon
	16	19:47	Moon North Dec.: 18.5° N
	20	11:28	Moon-Venus: 6.3° N
	23	17:01	Moon Apogee: 404100 km
	24	11:03	First Quarter
	24	17:23	Moon Ascending Node
	29	01:27	Moon-Saturn: 2.1° S

Table courtesy of William Dembowski and NASA's SkyCalc Sky Events Calendar

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.

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 102 new observations from 11 observers during the October-December quarter. Three contributed articles were published in addition to numerous commentaries on images submitted. The *Focus-On* series continued with an article on Ghost Craters. Upcoming *Focus-On* subjects include Oceanus Procellarum-Reiner, Hainzel and Rimae Sirsalis.

.All electronic submissions should now be sent to both me and Acting Assistant Coordinator Jerry Hubbell (*jerry.hubbell@alpo-astronomy.org*).

Hard copy submissions should continue to be mailed to me at the address provided in the *ALPO Resources* section of this *Journal*.

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Visit the following online web sites for more info:

- ALPO Lunar Topographical Studies Program moon.scopesandscapes.com/alpo-topo
- ALPO Lunar Selected Areas Program moon.scopesandscapes.com/alpo-sap.html
- 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/
- The Moon-Wiki: the-moon.wikispaces.com/Introduction
- Chandrayaan-1 M3: pds-imaging.jpl.nasa.gov/portal/chandrayaan-1_mission.html
- LADEE: www.nasa.gov/mission_pages/ladee/main
- LROC: lroc.sese.asu.edu/EPO/LROC/lroc.php
- GRAIL: http://www.nasa.gov/mission_pages/grail/main/

Lunar Meteoritic Impacts

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

Lunar Transient Phenomena

Report by Dr. Anthony Cook, program coordinator
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Three suspected Lunar Transient Phenomena (LTP) observations have been reported since the last LTP summary article, but two were somewhat uncertain:

- Aristarchus 2014 Dec 04 UT 03:14-03:15 Martin Homan (Grand Rapids, MI, USA) 11 digital images taken which show at times, possible transient blue colour in the Aristarchus area – however it could potentially be image noise or natural surface colour. ALPO/BAA weight=1.
- Picard 2015 Feb 17 UT 19:50 Giuseppe Macalli (Italy) observed visually an orange cloud form just to the west of the crater, and then it disappeared. The effect lasted about 1 minute. ALPO/BAA weight=2.
- Aristarchus 2015 Mar 03 UT 19:50 Brendan Shaw (UK) saw a flash on the NW rim, on the computer screen, in between imaging sessions. No other flashes seen, despite looking. Quite likely it was cosmic ray related, but we cannot say for sure. The ALPO/BAA weight=1.

Four other candidate observations from 2014 Oct 31 (Plato), 2014 Nov 01 (Timocharis), 2014 Dec 05 (Plato), and 2015 Feb 01 (Plato), did not make it onto the LTP list, for reasons explained in the monthly TLO newsletter. We are grateful for all candidate LTP observations submitted for study and hope that our feedback will make it easier for future observers to recognise false effects in optics, our atmosphere, and in CCD images.

We would like very much to encourage those with high-resolution imaging expertise to take part in repeat illumination observations in order to help eliminate past LTP by re-observing under similar lighting conditions. I would like especially to thank astronomers Jay Albert, Maurice Collins, Marie Cook, Brendan Shaw and Thierry Speth, as well as the UAI Lunar Section members Franco Taccogna and Claudio Vantaggiato, all of whom regularly contribute images, or highly detailed sketches, to support this research.

Dates and UTs on which to see features under similar illumination conditions to past LTPs can be found at http://users.aber.ac.uk/atc/tlp/tlp.htm. If you think that you see an LTP, please follow through the rigorous checklist also on that web site before contacting me.

Twitter LTP alerts are available on: http://twitter.com/lunarnaut.

Finally, please visit the ALPO Lunar Transient Phenomena site online at http://users.aber.ac.uk/atc/alpo/ltp.htm

Mars Section

Report by Roger Venable, section coordinator
rjvmd@hughes.net

Visit the ALPO Mars Section online and explore the Mars Section's recent observations: www.alpo-astronomy.org/mars

Minor Planets Section

Frederick Pilcher, section coordinator
pilcher35@gmail.com

The following are highlights published in the *Minor Planet Bulletin*, Volume 42, No. 1, 2015, January-March and represent

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the recent achievements of the ALPO Minor Planets Section.

Frederick Pilcher obtained 15 photometric measurements of 288 Glauke, which was already known to be very slowly rotating, on each of 187 nights between 2013 November and 2014 July. Each night's measurements were in effect a single data point. Each cycle of the approximately 50 day rotation period had a very different lightcurve, a clear sign of tumbling behavior. A principal rotation period of 1170 hours and tumbling about a second axis with a period of 740 hours were established.

Brian Warner published six papers on the rotational lightcurves of very small asteroids, many of them Earth-approachers. The variety of observational circumstances and results obtained is enormous, and it is not feasible to provide any summary of details. The interested reader is invited to download the above stated issue of the *Minor Planet Bulletin* from the web site at the end of this report.

Minor planets found to have probable or confirmed satellite companions are 2131, 18890, 27568, 68063, 399307, 1994 CJ1.

Minor planets found to have possible satellite companions, which require confirmation at future oppositions, are 1355, 15778, 30535, 2014 PL51.

Minor Planets found to have probable tumbling about two axes are, in addition to 288 Glauke, 9739, 14764, 134422, 398188, 2013 XM24.

In addition to asteroids specifically identified above, lightcurves with derived rotation periods are published for 144 other asteroids as listed below: 275, 309, 359, 457, 462, 474, 490, 584, 595, 616, 654, 782, 788, 924, 953, 978, 1019, 1088, 1095, 1103, 1132, 1341, 1589, 1614, 1626, 1727, 1762, 1823, 1917, 1938, 1943, 1967, 2007, 2014, 2078, 2102, 2132, 2150, 2484, 2669, 2704, 2882, 2956, 2995, 3015, 3039, 3089, 3332, 3401, 3523, 3544, 3894, 4002, 4388, 4401, 4531, 4555, 4716, 4909, 4910, 5492, 5841, 6050, 6394, 7173, 7330, 7660, 7749, 8024, 9182, 9387, 9837, 9854, 11048, 13903, 14051, 14299, 15609, 16636, 16641, 18219, 21486, 24443, 27713, 29242, 30770, 31351, 32814, 33324, 33684, 35087, 38047, 38063, 38268, 53110, 53424, 54686, 64107, 67404, 68348, 68537, 74338, 85713, 86819, 87309, 90075, 96327, 137799, 143624, 154275, 159493, 159857, 162980, 190166, 190208, 235086, 275611, 276049, 277616, 285944, 306790, 387733, 391033, 401998, 408751, 408980, 410778, 413038, 414387, 2003 EG16, 2012 TS, 2013 WT67, 2014 NE63, 2014 OT111, 2014 OX299, 2014 OZ337, 2014 PR62, 2014 QO33, 2014 SS1, 2014 SX261.

Secure periods have been found for some of these, and for others only tentative or ambiguous periods. Some are of asteroids with no previous lightcurve photometry, others are of asteroids with previous period determinations which may or may not be consistent with the previously determined values. The latter are of more value than the unitiated may realize. Observations of asteroids at multiple oppositions widely spaced around the sky are necessary to find axes of rotation and highly accurate sidereal periods.

The *Minor Planet Bulletin* is a refereed publication and that it is available online at *http://www.minorplanet.info/mpbdownloads.html*.

Annual voluntary contributions of $5 or more in support of the publication are welcome.

Please visit the ALPO Minor Planets Section online at *http://www.alpo-astronomy.org/minor*

Jupiter Section

Report by Ed Grafton, acting section coordinator
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Jupiter reached opposition on February 6, 2015 and is now well-placed for northern hemisphere observers. At opposition, Jupiter had a declination of +16 degrees and a diameter of over 44 arc seconds when it was 4.35 AU from Earth and shining at magnitude -2.6.

Observations of the anticyclonic Great Red Spot going back over one hundred years show that it has changed from a more oblong storm to recently becoming more circular. As recently as 1979, the rotational period of the GRS was measured to about 7 days by images acquired by the spacecraft Voyager 1. Images by amateurs sometimes reveal detail within the GRS and have enabled Michel Jacquesson to make recent measurements of its internal circulation period. Analysis by Michel Jacquesson and John Rogers have shown that the GRS has a period of about 3.7 days this apparition.

Circulation of detail within the GRS spot can be seen in the following amateur images.

http://egrafton.com/rs_rotation.jpg

One of the more interesting aspects of the 2014-2015 apparition is the occurrence of mutual satellite events. The Jupiter system will be edge-on to the Earth and Sun near opposition, allowing observers to capture mutual satellite occultations and mutual satellite shadow transits.

Mutual occultations tend to occur near when Earth's Jovian latitude is near zero.

An occultation and eclipse of Ganymede by Io was captured on February 12th 2015 with a C14 by John Sussenbach.

http://alpo-j.asahikawa-med.ac.jp/kk15/j150212j3.gif

On February 20th 2015 Silvia Kowillik captured the eclipse of Ganymede by Io with a 150mm maksutov. At the end of this animated sequence, Europa can be seen to reappear from the shadow of Jupiter.

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http://www.sternwarte-zollern-alb.de/mitarbeiterseiten/kowollik/jupiter/jupiter2015-02-20-ganymedeclips-by-io.gif

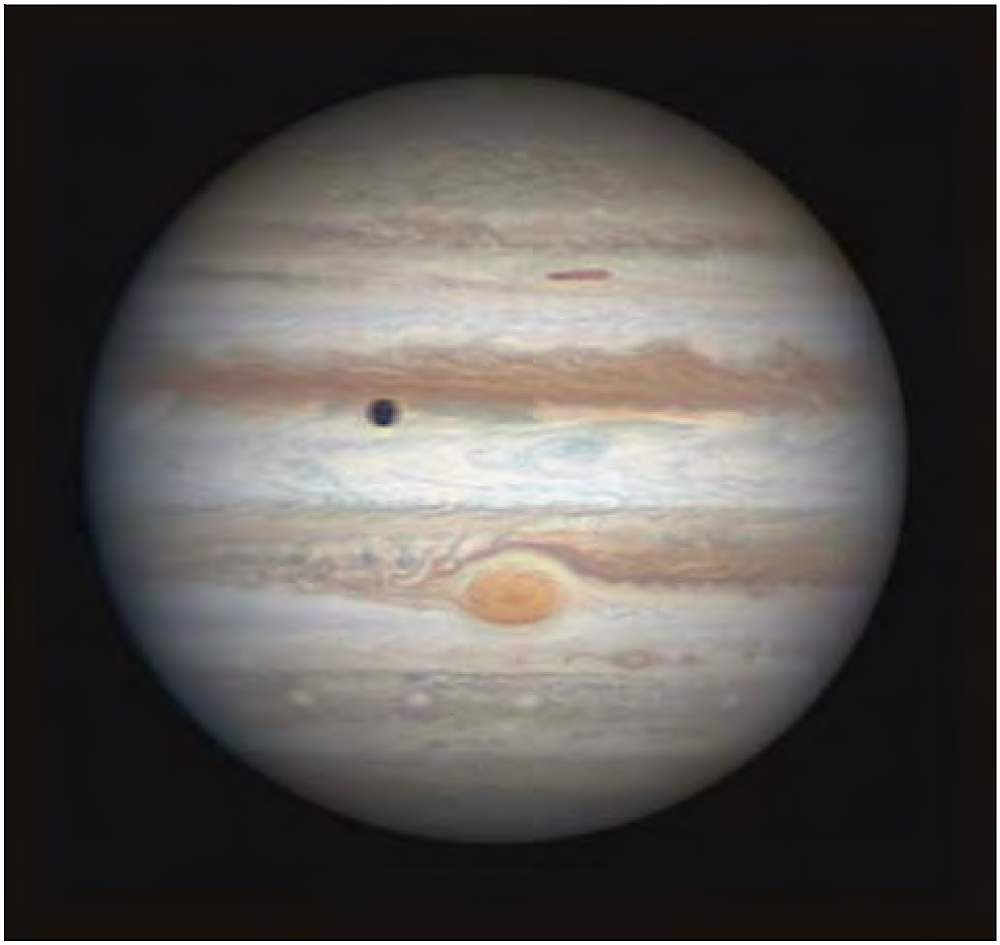
Tables of mutual satellite prediction events for 2015 produced by Jean Meeus of the British Astronomical Association Computing Section can be found at the following online locations:

• Occultations — *http://britastro.org/computing/handbooks_jocc2015.html*

• Eclipses — *http://britastro.org/computing/handbooks_jecl2015.html*

The mutual satellite events presents the opportunity to obtain light curves of mutual satellite shadow transits and occultations.

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



Jupiter image captured by Christopher Go on February 26th 2015 at 12:27 UT showing detail within the GRS and the moon Callisto transiting.

Galilean Satellite Eclipse Timing Program

Report by John Westfall, program coordinator
johnwestfall@comcast.net

Dr. Giles Hammond of the University of Glasgow is conducting a project to recreate Ole Roemer's 17th-century determination of the speed of light by using timings of the eclipses of Jupiter's Galilean satellites.

The concept is to measure the variation in observed eclipse times caused by Jupiter's varying distance from the Earth. Both visual and photographic observations are needed.

For further information, check the project's website:

http://speedoflight2015.co.uk/

(Editor's Note — The following text is repeated from the previous report as a reminder to observers interested in this phenomena, but with the list of mutual events shortened as required.)

In 2015, Jupiter remains well north of the celestial equator throughout the apparition, favoring observers in the Earth's northern hemisphere. The 2014-2015 Jupiter Apparition is notable in that it includes a season of satellite mutual events - eclipses and occultations of the satellites by each other.

Mutual-event seasons take place every six years when the Earth and Sun cross the planet's equator and thus the planes of the orbits of its Galilean satellites. The coming mutual-event season contains almost 500 predicted events - 270 mutual occultations and 207 mutual eclipses. Their schedule corresponds remarkably well with the Jupiter apparition itself:

- 2015 Apr 10 – Earth crosses Jupiter's equator (from south to north)*
- 2015 May 03 – Earth crosses Jupiter's equator (from north to south)*
- 2015 Aug 13 – Last mutual event predicted (Io occults Europa)
- 2015 Aug 26 – Jupiter in conjunction with the Sun

(*The last time the Earth crossed Jupiter's equator three times was during the 1919-20 Apparition.)

Satellite mutual events take many forms – eclipses versus occultations – but they also include total, partial and annular versions of both. You can simply view them, draw them, or take sequential photographs or videos of them. This program coordinator

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will be happy to receive these forms of observation (as well as your timings of the "normal" eclipses of the four satellites by Jupiter itself).

Furthermore, if you conduct sequential photometry of mutual events, your resulting "light curve" can provide the accurate mid-time, duration and "depth" (light drop) of the event, with potential scientific value in terms of refining the satellites' orbits.

You can find out more about observing these phenomena, obtain a schedule of events, and even learn how to participate in the "PHEMU15" event-photometry campaign (all this in English), at the website of the Institut de Méchanique Céleste et de Calcul des Éphémérides (IMCCE): www.imcce.fr/phemu. (Note that all photometric observations should be submitted to the IMCCE.)

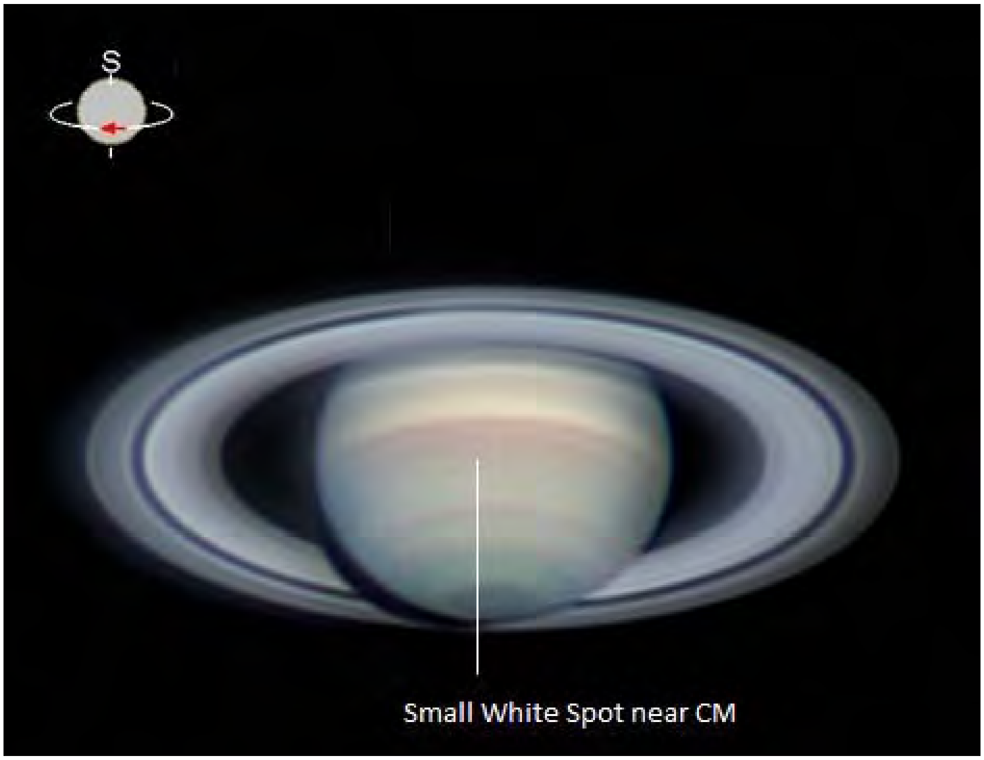
Contact John Westfall via e-mail at johnwestfall@comcast.net or via postal mail at 5061 Carbondale Way, Antioch, CA 94531 USA to obtain an observer's kit, also available on the Jupiter Section page of the ALPO website.

Saturn Section

Report by Julius Benton, section coordinator
jlbaina@msn.com

Saturn emerged from conjunction with the Sun on November 30, 2014, thereby signaling the start of the new 2014-15 apparition. As the month of April begins, it will become easier to observe in late evening as it approaches opposition to the Sun on May 23 with the rings tilted about +24° towards Earth. This affords increasing optimal views of the northern hemisphere of the globe and north face of the rings this apparition. The following geocentric phenomena for the 2014-15 apparition are presented for the convenience of readers for planning observations:

The accompanying table for the 2014-15 apparition are presented for the convenience of readers for planning observations.



NEW — One of the first images of Saturn received during the 2014-15 apparition taken on February 20, 2015 at 18:21 UT by Trevor Barry observing from Broken Hill, Australia, using a 40.6 cm (16.0 in.) custom Newtonian at visual (RGB) wavelengths showing an extremely small white spot just north of the NEBn. Numerous belts and zones are seen on the globe, including the hexagonal North polar hexagon and the major ring components. Cassini's division (A0 or B10) clearly runs all the way around the circumference of the rings (except where the globe blocks our view of the rings); looking carefully at this image, it's reasonably easy to see the southern hemisphere of the globe through Cassini's division where it crosses the globe. Also visible is Encke's "complex" (A5), Keeler's (A8) gap, and other "intensity minima" at the ring ansae. The dark shadow of the globe on the rings is situated toward the East (left) in this image since it is prior to opposition [the shadow will shift to the West (right) after opposition]. Seeing = 6.0 and transparency was not specified. The apparent diameter of Saturn's globe was 16.6" with a ring tilt of +24.0º. CMI = 124.2°, CMII = 328.4°, CMIII = 73.7°. South is at the top of the image.

As this report goes to press, observers had submitted well over 750 reports, images, and drawings of Saturn for the 2013-14 apparition, although this number should increase as Saturn Section participants finalize their reports and send them in.

As this report goes to press, although it is early in the observing season, we have already begun receiving observation reports of Saturn, along with reports of discrete white spot phenomena in the northern hemisphere just north of the NEB (North Equatorial Belt). Indeed, it will be interesting to see what features persist and emerge among Saturn's belts and zones this apparition to skillful observers who are imaging image the planet and to those making visual drawings.

So, readers are urged to keep Saturn under careful scrutiny now that the planet is becoming increasingly well-placed for detailed viewing and imaging during the 2014-15 observing season.

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Geocentric Phenomena for the 2014-15 Apparition of Saturn in Universal Time (UT)	
Conjunction	2014 Nov 18^d
Opposition	2015 May 23^d
Conjunction	Nov 30^d
Opposition Data:	
Equatorial Diameter Globe	18.5 arc-seconds
Polar Diameter Globe	16.5 arc-seconds
Major Axis of Rings	41.9 arc-seconds
Minor Axis of Rings	17.2 arc-seconds
Visual Magnitude (m_v)	0.0 m_v
B =	+24.2°
Declination	-18.3°

Our observing programs are listed on the Saturn page of the ALPO website at http://www.alpo-astronomy.org/saturn 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 strongly encouraged pursue digital imaging of Saturn at the same time that others are imaging or visually watching the planet (i.e., simultaneous observations). And while routine imaging of the Saturn is very important, far too many experienced observers neglect 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.

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

Remote Planets Section

Report by Richard W. Schmude, Jr., section coordinator
schmude@gordonstate.edu

Neptune is currently (early March) in conjunction with the Sun, while Uranus will reach conjunction with the Sun a month later, in early April. Therefore neither of these planets will be visible during April. Look for Neptune in the pre-dawn skies in early May.

Jim Fox has submitted over 50 high-quality brightness measurements of Uranus and Neptune. These measurements are consistent with Uranus and Neptune being about as bright as they were in the previous year.

This writer has also carried out brightness measurements of Uranus in the U, B, V, R and I filters and will combine them with those collected since 1954. The goal is to construct brightness models of both planets and publish the results in the professional journal *Icarus*.

In a study of Pluto last year by Frank Melillo, the results are consistent with Pluto undergoing a 0.15 magnitude change in brightness as it rotates.

If you have any images, drawings or other measurements of Uranus or Neptune then please send them to me.

As usual, I ask all remote planet observers, to please keep up the good work!

Finally, a reminder that the book *Uranus, Neptune and Pluto and How to Observe Them*, which was authored by this coordinator, is 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 www.alpoastronomy.org/remote.

Correction and Clarification

A production error resulted in image and caption problems in the paper, "Wrinkles and Rilles" by Wayne Bailey in JALPO, Vol. 56, No. 4, Autumn 2014.

- While the captions are correct, the image shown as Figure 1 should be Figure 11 and that shown as Figure 11 should be Figure 1.
- While the image shown for Figure 10 is correct, the caption is a duplicate of the Figure 3 caption. The caption should be: "Figure 10. Sabine-Dionysius. Phil Morgan, Lower Harthall-Tenbury Wells, Worcestershire, England. Sept. 10, 2009 02:50-03:30 UT. Seeing 6-8/10, transparency 4/5. Colongitude 160.0-160.4°. 305mm Newtonian, 400x.

We regret the error.

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Membership — Contributors and Newest Members (from November 16, 2013 through February 16, 2015)

By Matthew L. Will, ALPO Membership Secretary

The ALPO wishes to thank the following members listed below for voluntarily paying higher dues. The extra income helps in maintaining the quality of this *Journal* while also strengthening our endowment. Again thank you!

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Newest Members (from November 16, 2013)
(See next page for Interest code numbers)

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Clyde Foster	Gauteng		South Africa	
Walter Goldowski	Northfield	IL		035P
Rodger W Gordon	Nazareth	PA		123456HI
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Stephen Tzikas	Reston	VA		3456CDHISTX
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Juan Velasquez	Highlands Ranch	CO		
Sidney Webb	Las Cruces	NM		
Richard Williams	Markleeville	CA		
Ronald Zincone	Kingston	RI		
Richard R Zito	Tucson	AZ		OE9

Interest Abbreviations

0 = Sun	6 = Saturn	D = CCD Imaging	P = Photography
1 = Mercury	7 = Uranus	E = Eclipses	R = Radio Astronomy
2 = Venus	8 = Neptune	H = History	S = Astronomical Software
3 = Moon	9 = Pluto	I = Instruments	T = Tutoring
4 = Mars	A = Asteroids	M = Meteors	V = Videography
5 = Jupiter	C = Comets	O = Meteorites	X = Visual Drawing

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Don Parker: A Little About Him and His Work

Included below are several written pieces about our friend, the late Don Parker.

The first is a republication of a beautiful tribute by Sky & Telescope magazine's Sean Walker, the second is the obituary as it appeared in the Miami Herald newspaper, the third is the text of an interview Don gave some years ago, and the fourth is a list of papers authored by Don.

A planetary imaging pioneer passed away in Miami, Florida.

By Sean Walker of *Sky & Telescope magazine*

It is with a profound sense of loss that we announce the passing of long-time planetary observer and Sky & Telescope contributor Donald C. Parker on the evening of February 22, 2015 from lung cancer. Parker was a pioneer of planetary astrophotography and an inspiration to generations of imagers around the world.

Born in 1939, Parker was raised in Highland Park, Illinois, where he caught the astronomy bug at a young age. He built several telescopes during the 1950s, including an 8-inch f/7.5 Newtonian reflector that was featured in the November 1957 issue of Sky & Telescope.

Donald earned a medical degree from Northwestern University and served as a medical officer in the United States Navy, where he conducted research into diving physiology.

After relocating to Florida to begin a career in anesthesiology, Donald resumed his fascination with observing the planets, particularly Mars. He was a former director of the Association of Lunar and Planetary Observers (A.L.P.O.), where he became acquainted with the Lowell Observatory astronomer Charles F. Capen, who encouraged Don to refine his observing skills and introduced Don to advanced planetary photographic techniques. Don quickly mastered the extensive darkroom technique of stacking images and rose to the forefront of amateur planetary photography. In 1988 he co-authored the book "Introduction to Observing and Photographing the Solar System" with Capen and fellow amateur Thomas A. Dobbins.

He continued to be a pioneer at the forefront of planetary observing and imaging techniques, and played a role in developing many of the methods used in digital planetary imaging today, as well as being credited with the discovery of features on Mars and Jupiter. Many of his 20,000+ images of the planets have supported professional researchers at NASA, JPL, and other institutions.

Don Parker (4th from right, front row) surrounded by family and friends at the Winter Star Party on February 18, 2015. Photo courtesy of Manuel R. Padron.

Don Parker (4th from right, front row) surrounded by family and friends at the Winter Star Party on February 18, 2015. Photo courtesy of Manuel R. Padron.

Parker co-authored scores of papers in scientific journals, popular magazines, and news sites worldwide, including a paper in Nature published only weeks ago. In 1994, the International Astronomical Union named asteroid 5392 Parker in his honor for his contributions to solar system science. A frequent speaker at amateur conventions, he delighted audiences with his colorful and often self-deprecating humor.

As an astrophotographer myself, I had the honor of befriending Parker more than a decade ago. We traded imaging techniques and discussed the latest developments in camera technology and software. Parker was my inspiration to begin imaging the planets after seeing his series of images recording the impact scars of comet Shoemaker-Levy 9 in the cloud tops of Jupiter in 1994. He was never guarded about his techniques and gladly shared them with anyone who was interested. He maintained his razor-sharp intelligence, wit, and an unfailingly kind disposition to the end. It's difficult to convey in words just how funny and entertaining Don was. I'm certainly going to miss our frequent conversations about the latest discoveries in the solar system, which often focused on how amateurs contributed to them, as well as his famous "joke of the day." Donations in Parker's name can be made to the Association of Lunar & Planetary Observers.

Donald Parker was one for the cosmos

By Howard Cohen of *The Miami Herald*

As a noted astrophotographer — one who photographs the planets — Parker's planetary observance and imaging techniques came to the attention of professional researchers at NASA, Jet Propulsion Laboratory and other scientific institutions who would often cite his work for discoveries of features on Mars and Jupiter.

Parker, who died Sunday at age 76, was still writing and giving lectures at science gatherings right until the end. Four days before he died of complications from lung cancer, he delivered his final talk at the annual Winter Star Party in the lower Keys before a group of scientists, astronomers and other space experts.

"He gave a retrospective on his entire life and the breadth of everything he did," said

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his friend and colleague Dr. Manny Padrón, a Miami urologist. "This man had unspeakable wit and intelligence. He gave a long, detailed speech, no notes, took in-depth questions, and plenty of jokes were sprinkled in to lighten the mood."

In 1994, the International Astronomical Union named asteroid 5392 "Parker" in honor of his contributions to solar system science. That year, the amateur astronomer who lived in Coral Gables, along with two colleagues in Perrine, observed a fractured comet crashing onto Jupiter. The blast was so impressive that it was visible from 477 million miles away.

But Parker saw more near Jupiter's south pole, something like a "burn scar, really grotesque, strange," he said in a July 1994 Miami Herald article. "It's something that's never, ever been seen before and probably won't be seen again in our lifetimes. This is just absolutely incredible."

And, to the astronomy community, so was Parker.

He wrote numerous papers for scientific journals, magazines and news sites, including a recent piece published in Nature just weeks ago and one still to come for the science journal about the surface of Mars that will use his imaging data. His images over the years top 20,000.

Parker "was a pioneer of planetary astrophotography and an inspiration to generations of imagers around the world," wrote Sean Walker in an appreciation piece this week in Sky & Telescope.

In 1988, Parker co-authored the book Introduction to Observing and Photographing the Solar System (Willman-Bell; $15) with research chemist Thomas Dobbins, who said of Parker: "He could be completely serious without taking himself too seriously."

Parker is a past director of the Association of Lunar and Planetary Observers. In 1995, his planetary images earned the Amateur Achievement Award of the

Don Parker (4th from right, front row) surrounded by family and friends at the Winter Star Party on February 18, 2015, where he gave his final talk to a group of scientists and fellow astronomers, both amateur and professional. Photo courtesy of Manuel R. Padron.

stronomical Society of the Pacific and, in 2004, the Gold Medal of the Oriental Astronomical Association for his work studying Mars.

Born Jan. 28, 1939, in Highland Park, Illinois, Parker developed a love for astronomy as a child, thanks to parents who championed his interest. His father helped him build his first telescope, Padrón said.

Parker was an anesthesiologist who trained at Jackson Memorial Hospital a year after moving to Miami in 1965. He spent the rest of his career at Mercy Hospital in Coconut Grove.

"I got to know him astronomically when my wife, Chrissy, gave me a telescope," Padrón said. "This was a man who was extremely generous with his knowledge and time and bringing anyone along in this hobby gently, but he was a walking encyclopedia."

is children recall a father who loved sailboat racing and whose "excitement and intellectual curiosity about all subjects inspired each of us to follow our passion." His "love for scuba diving also helped motivate his interest in respiratory physiology, dolphin physiology research and, ultimately, anesthesiology," his daughter Kathleen Greenwood wrote in an email to the Herald.

But he never stopped looking up. In 1985, The Miami News reported that he got the first known photographic image of Halley's Comet in South Florida.

"He taught me to look at the sky," Padrón said. "One of his mottoes was, 'Come on over any time. We never close. But we don't do mornings.'"

Parker is survived by his children Kathleen Greenwood, Michael Parker and Suzanne Landsom, and grandchildren Megan, Kimberly, Dylan, Justin, Caitlyn and Kylie.

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Services will be 4 p.m. Sunday at Stanfill Funeral Home, 10454 S. Dixie Hwy. in Pinecrest, with a memorial at 11 a.m. Monday at Epiphany Catholic Church, 8235 SW 57th Ave. near Miami. Donations in Parker's name can be made to the Association of Lunar & Planetary Observers at www.alpo-astronomy.org.

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Feature Story: Venus

ALPO Observations of Venus During the 2010 Eastern (Evening) Apparition

By Julius L. Benton, Jr., coordinator
ALPO Venus Section
jlbaina@msn.com

An ALPO Venus Section Observing Report Form is located at the end of this report.

Abstract

Fifteen observers from the United States, Canada, Germany, Japan, Philippines, United Kingdom, Italy, and New Zealand contributed digital images and visual observations (drawings and descriptive reports) to the ALPO Venus Section during the 2010 Eastern (Evening) Apparition. This report summarizes the results of the 167 total observations. Types of telescopes and accessories used in making the observations, as well as sources of data, are discussed. Comparative studies take into account observers, instruments, visual and photographic results. The report includes illustrations and a statistical analysis of the long-established categories of features in the atmosphere of Venus, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths in integrated light and with color filters, as well as digital images captured at visual, ultraviolet (UV), and infrared (IR) wavelengths. Terminator irregularities and the apparent phase phenomena, as well as results from continued monitoring of the dark hemisphere of Venus for the enigmatic Ashen Light are discussed, including imaging of the dark side of Venus in the near-IR.

Introduction

The ALPO Venus Section received 167 observations for the 2010 Eastern (Evening) Apparition, comprised of visual drawings, descriptive reports, and digital images from fifteen observers residing in the United States, Canada, Germany, Japan, Philippines, United Kingdom, Italy, and New Zealand. Geocentric phenomena in Universal Time (UT) for this observing season are given in *Table 1*, while *Figure 1* shows the distribution of observations by month during the apparition. *Table 2* gives the location where observations were made, the number of observations submitted, and the telescopes utilized.

Observational coverage of Venus throughout this apparition was very good, with a few observers beginning their studies of the planet relatively early, about a month after Superior Conjunction that occurred on January 11, 2010. The observing season on which this report is based ranged from February 8th through October 13th, with 70.5% of the observations occurring from March through August. One observer (Detlev Niechoy) continued to follow Venus up to within roughly two weeks before Inferior Conjunction on October 29th. All observers are urged to attempt systematic observations of Venus when seeing conditions permit from conjunction to conjunction, and the ALPO Venus Section is quite fortunate to have a growing team of persistent, dedicated observers who have tried very hard to do that in recent observing seasons. For the 2010 Eastern (Evening) Apparition of Venus, the planet passed through maximum elongation from the Sun (46.0°), dichotomy, and greatest brilliancy ($-4.8m_v$).

All Readers

Your comments, questions, etc., about this report are appreciated. Please send them to: *poshedly@bellsouth.net* for publication in the next Journal.

Online Features

Left-click your mouse on:

The author's e-mail address in blue text to contact the author of this article.
The references in blue text to jump to source material or information about that source material (Internet connection must be ON).

Observing Scales

Standard ALPO Scale of Intensity:
0.0 = Completely black
10.0 = Very brightest features
Intermediate values are assigned along the scale to account for observed intensity of features

ALPO Scale of Seeing Conditions:
0 = Worst
10 = Perfect

Scale of Transparency Conditions:
Estimated magnitude of the faintest star observable near Venus, allowing for daylight or twilight

IAU directions are used in all instances.

Terminology: Western vs Eastern

"Western" apparitions are those when an "inferior" planet (Mercury or Venus, whose orbits lie inside the Earth's orbit around the Sun) is **west of the Sun**, as seen in our morning sky before sunrise.

"Eastern" apparitions are those when that planet is **east of the Sun,** as seen in our sky after sunset.

Figure 2 shows the distribution of observers and contributed observations by nation of origin for this apparition, where it can be seen that 33.3% of the participants in our programs were located in the United States, and they accounted for 23.4% of the total observations. Continued strong international cooperation took place during this observing season, whereby 66.7% of the observers resided outside the United States and contributed 76.6% of the overall observations. The ALPO Venus Section welcomes a widening global team of observers in the future.

Table 1: Geocentric Phenomena in Universal Time (UT) for the 2010 Eastern (Evening) Apparition of Venus

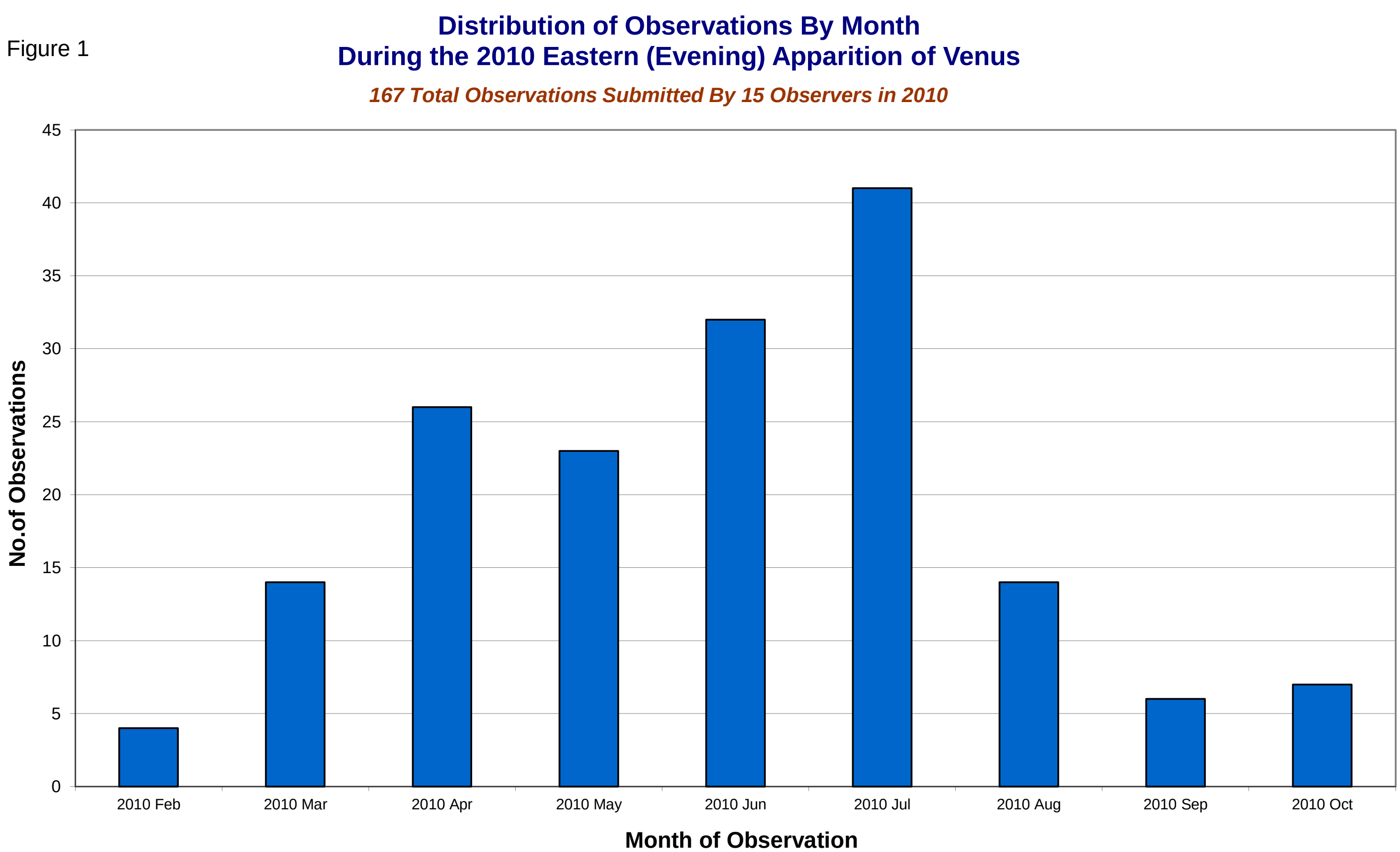
Superior Conjunction	2010 Jan 11^d 21^h UT
Initial Observation	Feb 08 16:48
Dichotomy (predicted)	Aug 17 15:21:36 (17.64^d)
Greatest Elongation East	Aug 20 04 (46.0°)
Greatest Brilliancy	Sep 23 20 (m_v = –4.8)
Final Observation	Oct 13 12:23
Inferior Conjunction	Oct 29 01
Apparent Diameter (observed range): 9".8 (2010 Feb 08) ↔ 59.7" (2010 Oct 13)	
Phase Coefficient, ***k*** (observed range): 0.993 (2010 Feb 08) ↔ 0.083 (2010 Oct 13)	

The types of telescopes used to observe and image Venus are shown in Figure 3. The majority of all observations (82.6%) were made with telescopes ^{3}15.2 cm (6.0 in) in aperture. During the 2010 Eastern (Evening) Apparition of Venus, the frequency of use of classical designs (refractors, Newtonians, and Cassegrains) was 38.3%, while utilization of catadioptrics (Schmidt-Cassegrains and Maksutovs) was 61.7%. All visual and digital observations were performed under twilight or daylight conditions, generally because more experienced Venus observers have found that viewing the planet during twilight or in full daylight substantially reduces the excessive glare associated with the planet. Also, viewing or imaging Venus when it is higher in the sky substantially cuts down on the detrimental effects of atmospheric dispersion and image distortion prevalent near the horizon.

The writer extends his gratitude to all twenty-seven observers who made this report possible by faithfully sending in

Figure 1

Figure 1



their drawings, descriptive reports, and digital images of Venus in 2010. Readers who wish to follow Venus in coming apparitions are urged to join the ALPO and start participating in our observational studies. Then brightness of Venus makes it easy to find, and surrounding around the dates of greatest elongation from the Sun, it can be as much as 15 times brighter than Sirius and can even cast shadows when viewed from a dark, moonless observing site. Getting started in the Venus Section programs requires only minimal aperture, ranging from 7.5 cm (3.0 in) for refractors to 15.2 cm (6.0 in) reflectors.

Observations of Atmospheric Details on Venus

The methods and techniques for visual studies of the notoriously faint, elusive "markings" in the atmosphere of Venus are described in detail in ***The Venus Handbook***, available from the ALPO Venus Section in printed or *.pdf format. Readers who maintain archives of earlier issues of this Journal may also find it useful to consult previous apparition reports for a historical account of ALPO studies of Venus.

Most of the drawings and digital images used for this analytical report were made at visual wavelengths, but several observers routinely imaged Venus in infrared (IR) and ultraviolet (UV) wavelengths. Some examples of submitted observations in the form of drawings and images accompany this report to help readers interpret the level and types of atmospheric activity reported on Venus this apparition.

Represented in the photo-visual data for this apparition were all of the long-established categories of dusky and bright markings in the atmosphere of Venus, including a small fraction of radial dusky features, described in the literature cited earlier in this report. *Figure 4* shows the frequency of identifiable forms of markings seen or suspected on Venus.

Most observations referenced more than one category of marking or feature, so totals exceeding 100% are not unusual. At least some level of subjectivity is inevitable when visual observers attempt to describe, or accurately represent on drawings, the variety of highly elusive atmospheric features on Venus, and this natural bias had some effect on the data represented in *Figure 4*. It is assumed, however, that conclusions discussed in

Table 2: ALPO Observing Participants in the 2010 Eastern (Evening) Apparition

Observer and Observing Site	No. Obs.	Telescope(s) Used*
Abel, Paul G. Leichester, UK	1 1	20.3 cm (8.0 in) NEW 11.4 cm (4.5 in) NEW
Akutsu, Tomio Cebu City, Philippines	1	35.6 cm (14.0 in) SCT
Arditti, David Middlesex, UK	8	35.6 cm (14.0 in) SCT
Benton, Julius L. Wilmington Island, GA	29	10.2 cm (4.0 in) REF
Collins, Maurice Palmerston North, NZ	9	20.3 cm (8.0 in) SCT
Combs, Brian Buena Vista, GA	1	35.6 cm (14.0 in) SCT
Frassati, Mario Crescentino, Italy	2	20.3 cm (8.0 in) SCT
Gasparri, Daniele Perugia, Italy	1	23.5 cm (9.25 in) SCT
Grego, Peter Cornwall, UK	2 1	20.3 cm (8.0 in) NEW 30.0 cm (11.8 in) NEW
Hernandez, Carlos Miami, FL	1	22.9 cm (9.0 in) MAK
Ikemura, Toshihiko Osaka, Japan	7	38.0 cm (15.0 in) NEW
Maxson, Paul Phoenix, AZ	1	25.4 cm (10.0 in) DAL
Melillo, Frank J. Holtsville, NY	7	20.3 cm (8.0 in) SCT
Niechoy, Detlev Göttingen, Germany	70	20.3 cm (8.0 in) SCT
Roussell, Carl Hamilton, Ontario, Canada	25	15.2 cm (6.0 in) REF
Total No. of Observers	**15**	
Total No. of Observations	**167**	
*REF = Refractor, SCT = Schmidt-Cassegrain, NEW = Newtonian, MAK = Maksutov, DAL = Dall-Kirkham, CAS = Cassegrain		

Figure 2

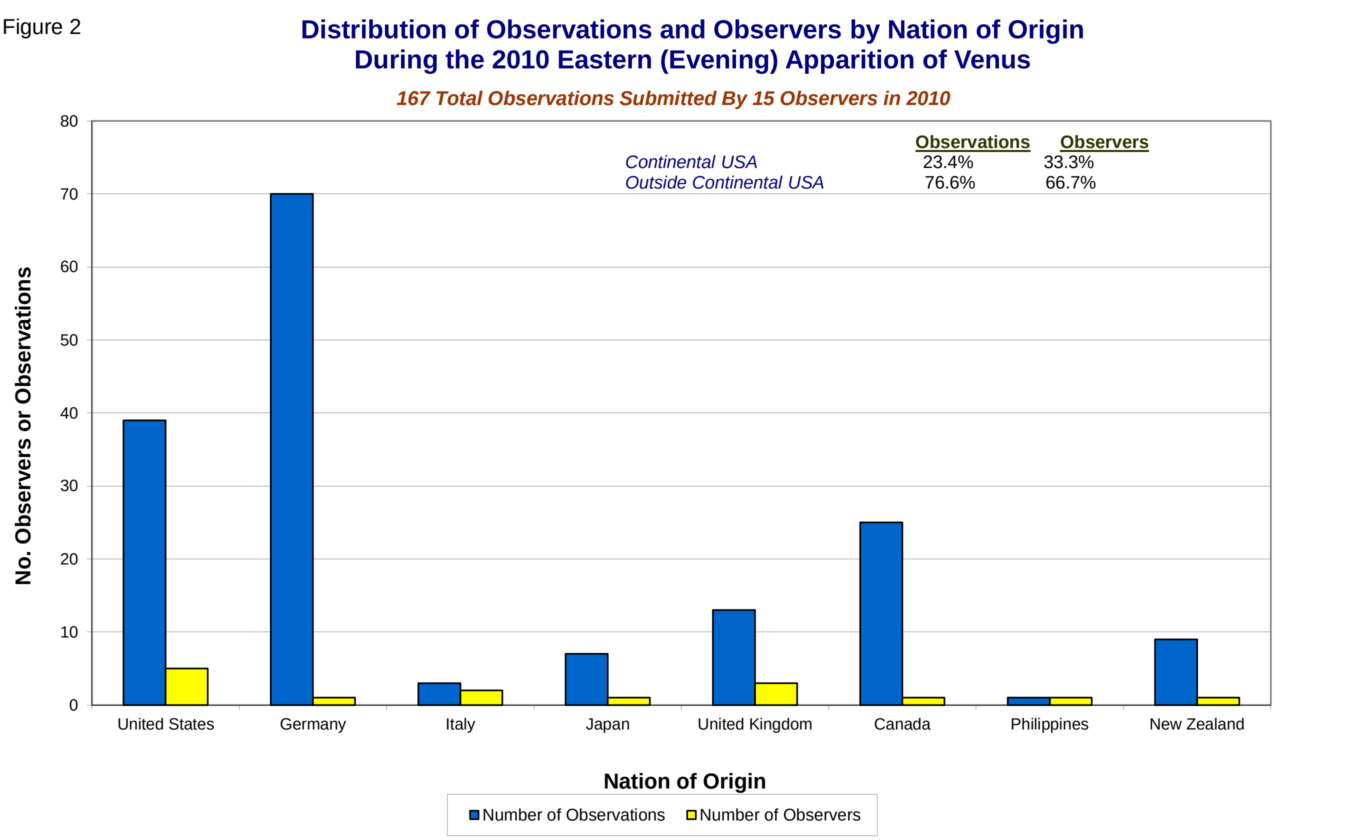
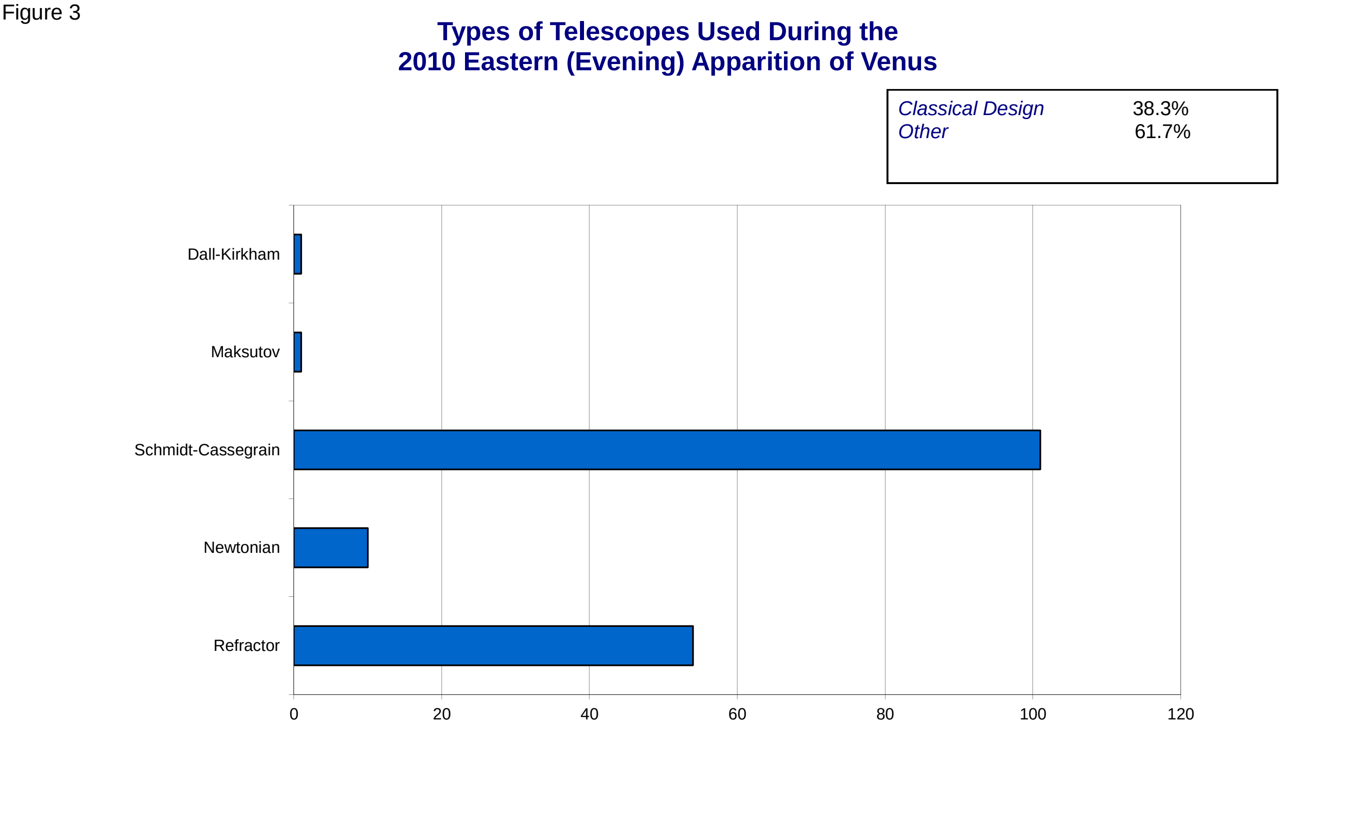


Figure 3



***General Caption Note for Illustrations 1-25**. REF = Refractor, SCT = Schmidt-Cassegrain, CAS = Cassegrain, MAK = Maksutov, NEW = Newtonian; UV = Ultra Violet light; Seeing on the Standard ALPO Scale (from 0 = worst to 10 = perfect); Transparency = the limiting naked-eye stellar magnitude.*

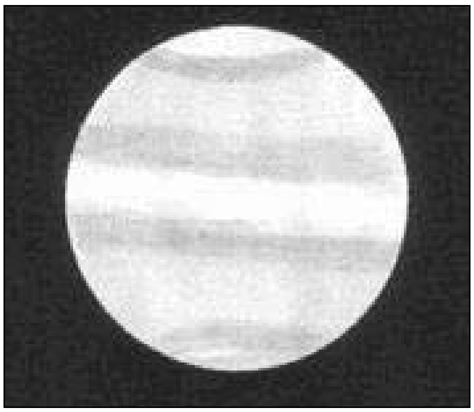


Illustration 001: 2010 Feb11 1500 UT, Carl Roussell, Hamilton, Ontario, Canada, 15.2 cm (6.0 in.) REF, Drawing @ 200-400X Integrated Light, W25, W58, W47 filters , Seeing 4.0, Transparency (slight haze), Phase (k) = 0.992, Apparent Diameter = 9.8", Drawing depicts banded dusky markings, cusp caps, and cusp bands.

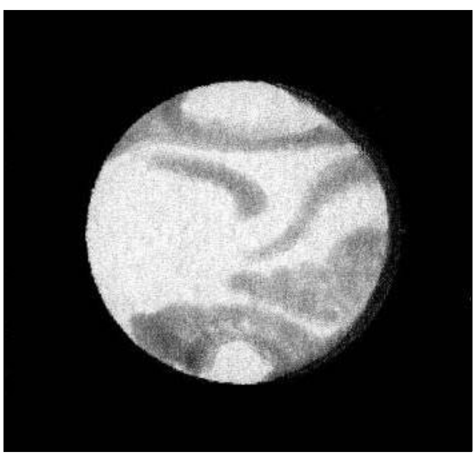


Illustration 002: 2010 Mar09 11:12UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 280X Integrated Light, Seeing 4.0 (interpolated), Transparency (not specified), Phase (k) = 0.973, Apparent Diameter = 10.1", Drawing shows amorphous and irregular dusky features, cusp caps, and cusp bands.

this report are, at the very least, quite rational.

The dusky markings of Venus' atmosphere are always troublesome to detect using normal visual observing methods, and this well-known characteristic of the planet is generally independent of the experience of the observer. When color filters and variable-density polarizers are utilized as a routine practice, however, views of cloud phenomena on Venus at visual wavelengths are often measurably improved. Without neglecting vital routine visual work, the ALPO Venus Section urges observers to try their hand at digital imaging of Venus at UV and IR wavelengths. The morphology of features captured at UV and IR wavelengths is frequently quite different from what is seen at visual regions of the spectrum, particularly atmospheric radial dusky patterns (in the UV) and the appearance of the dark hemisphere (in IR). Similarities do occasionally occur, though, between images taken at UV wavelengths and drawings made with blue and violet filters. The more of these that the ALPO Venus Section receives during an observing season, the more interesting are the comparisons of what can or cannot be detected visually versus what is captured by digital imagers at different wavelengths.

Figure 4 illustrates that in 7.2% of the observations submitted this apparition the dazzlingly bright disc of Venus was considered as being completely devoid of atmospheric features. When dusky features were seen or suspected, or imaged, on the brilliant disc of Venus, the highest percentage was "Amorphous Dusky Markings" (84.4%), followed closely by "Banded Dusky Markings" (83.3%), "Irregular Dusky Markings" (49.3%), and "Radial Dusky Markings" (2.2%) [See Illustrations 001, 002, 004, 006, 007, 009, and 013]. The latter category typically was more apparent in UV images [See Illustration No. 011].

Terminator shading was reported in 94.2% of the observations, as shown in *Figure 4*. Terminator shading normally extended from one cusp of Venus to the other, and the dusky shading was progressively lighter in tone (higher intensity) from the region of the terminator toward the bright planetary limb. Many observers described this upward gradation in brightness as ending in the Bright Limb Band. A considerable number of drawings at visual wavelengths

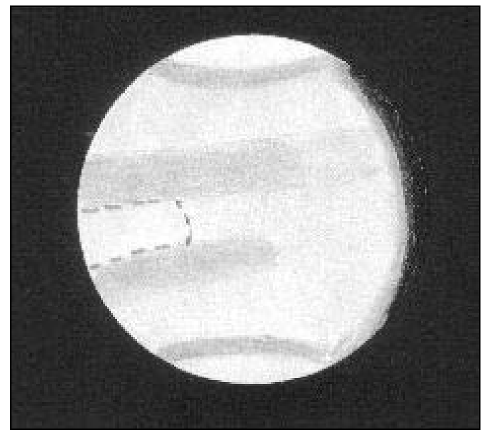


Illustration 003: 2010 Mar24 14:25 UT, Carl Roussell, Hamilton, Ontario, Canada, 15.2 cm (6.0 in.) REF, Drawing @ 200-400X Integrated Light, W25, W58, W47 filters , Seeing 5.0, Transparency (slight haze), Phase (k) = 0.956, Apparent Diameter = 10.4", Drawing depicts banded dusky markings, bright regions exclusive of the cusps, cusp caps, and cusp bands.

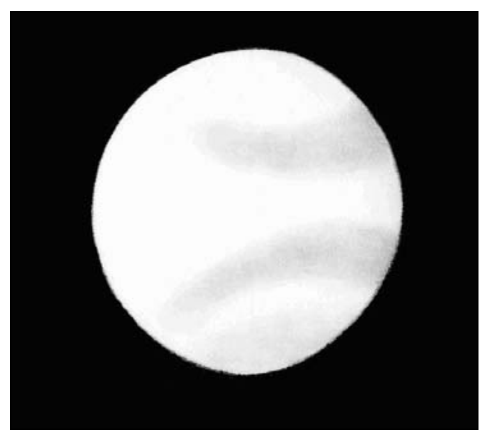


Illustration 004: 2010 Mar26 17:45 UT, Mario Frassati, Crescentino, Italy , 20.3 cm (8.0 in.) SCT, Drawing @ 160X W80A blue filter, Seeing 5.0 (interpolated), Transparency (not specified), Phase (k) = 0.953, Apparent Diameter = 10.4", Banded and amorphous dusky features are depicted on this superb sketch.

Figure 4

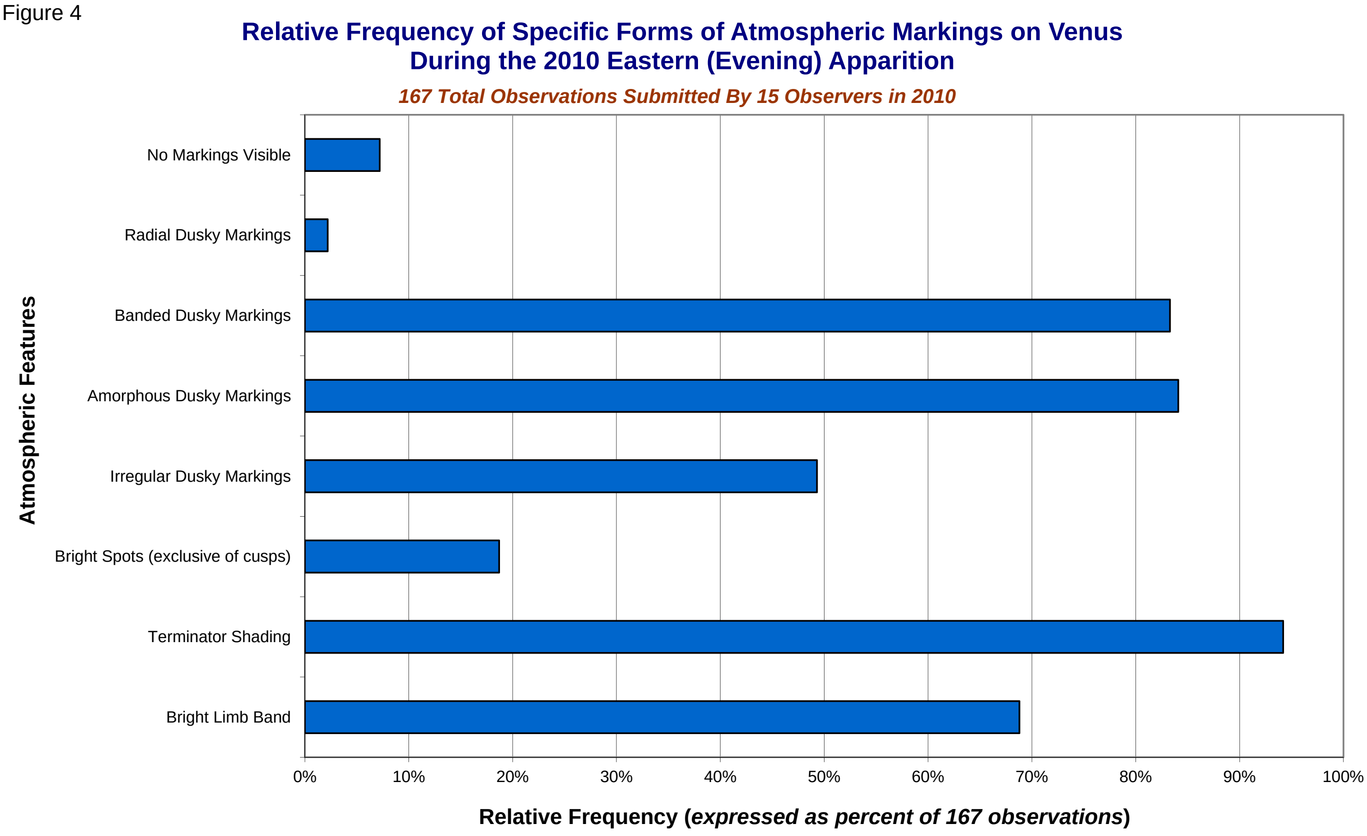
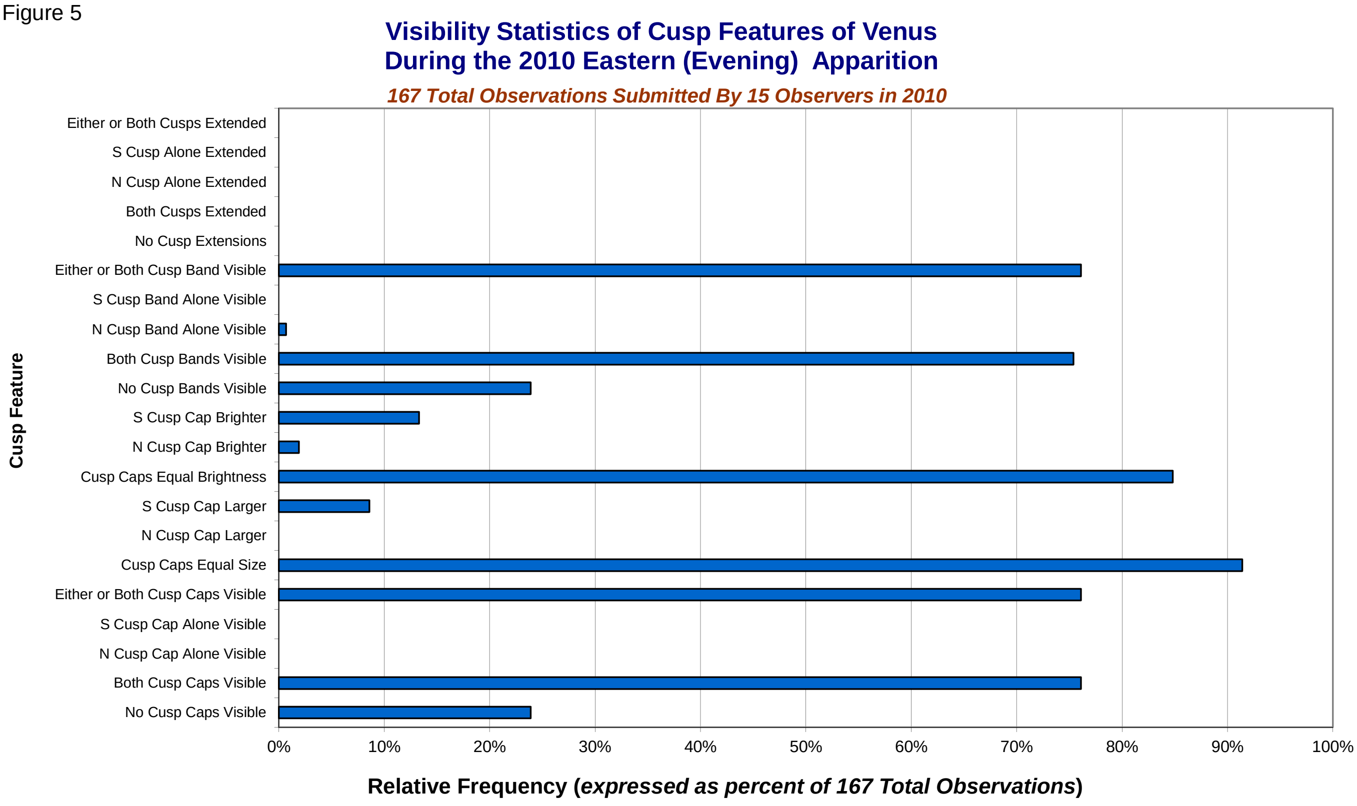


Figure 5



showed terminator shading [See Illustration 023], but it was most obvious on many UV images [See Illustration 012].

The mean numerical relative intensity for all of the dusky features on Venus this apparition averaged about 8.5. The ALPO Scale of Conspicuousness (a numerical sequence from 0.0 for "definitely not seen" up to 10.0 for "definitely seen") was used regularly, and the dusky markings in Figure 4 had a mean conspicuousness of ~3.6 throughout the apparition, suggesting that the atmospheric features on Venus were within the range from very indistinct impressions to fairly strong indications of their actual presence.

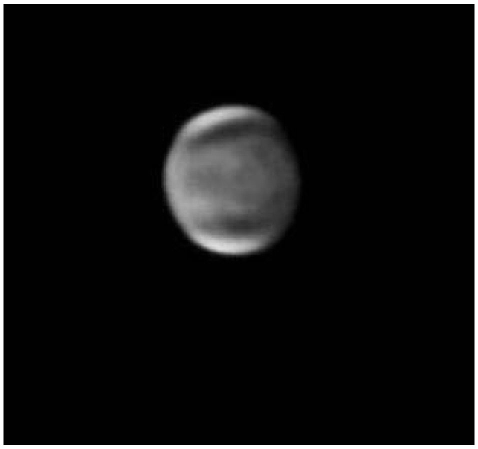


Illustration 005: 2010 Mar29 16:30 UT, Daniele Gasparri, Perugia, Italy, 23.5 cm (9.25 in.) CAS, Digital Image using Schott BG38 and W47 filters, Seeing 4.0, Transparency (not specified), Phase (k) = 0.949, Apparent Diameter = 10.5”, UV image depicts amorphous dusky markings, bright cusp caps, and dark cusp bands.

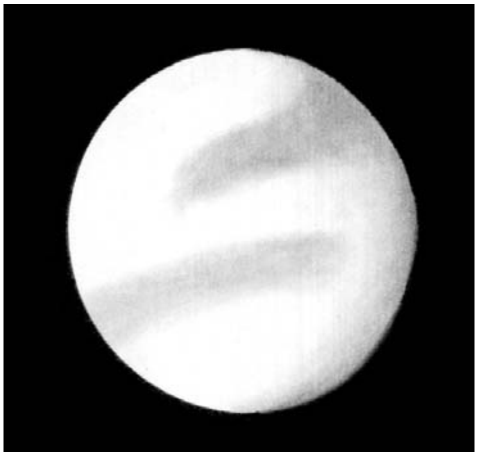


Illustration 006: 2010 Apr05 18:15 UT, Mario Frassati, Crescentino, Italy , 20.3 cm (8.0 in.) SCT, Drawing @ 160X W80A blue filter, Seeing 5.0 (interpolated), Transparency (not specified), Phase (k) = 0.938, Apparent Diameter = 10.6”, Banded dusky features and terminator shading is quite apparent in the drawing.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusps, were seen or suspected in only 18.1% of the submitted observations and images. For example, consider the image taken by David Arditti of a white region near the limb of Venus on July 9th at 19:30 UT at 355nm in the near-UV [See Illustration 016] as well as a similar image of a white spot along the S limb by Toshihiko Ikemura on July 18th at 10:15 UT at 360nm [See Illustration 017]. A subsequent image of Venus by Toshihiko Ikemura on July 22nd at 10:58 UT at 360nm shows a bright feature on the S limb but not as prominent as the feature he imaged on July 18th [See Illustration 018]. A drawing submitted on March 24th at 14:25 UT by Carl Roussell [See Illustration 003] and another by Detlev Niechoy at 15:22 UT on August 14, 2010 [See Illustration 019] called attention to bright spots. When visual observers detect such bright areas, it is standard practice for to denote them on drawings by using dotted lines to surround them.

Observers regularly used color filter techniques when viewing Venus, and when results were compared with studies in Integrated Light, it was evident that color filters and variable-density polarizers improved the visibility of otherwise indefinite atmospheric markings on Venus.

The Bright Limb Band

Figure 4 illustrates that slightly more than two-thirds of the submitted observations (68.8%) this apparition referred to a very conspicuous "Bright Limb Band" on the illuminated hemisphere of Venus. When the Bright Limb Band was visible or imaged, it appeared as a continuous, brilliant arc running from cusp to cusp 41.1% of the time, and interrupted or only marginally visible along the limb of Venus in 58.9% of the positive reports. The bright limb band was more likely to be incomplete in

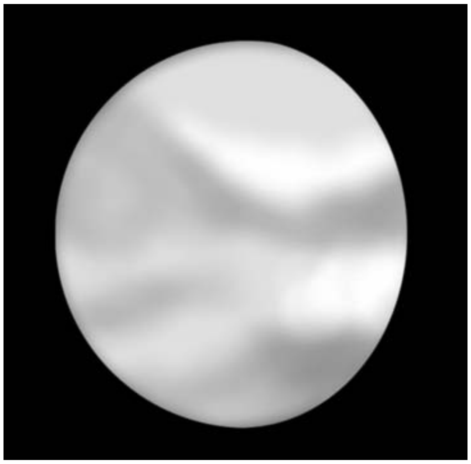


Illustration 007: 2010 Apr07 19:10 UT, Peter Grego, Cornwall, UK, 20.3 cm (8.0 in.) SCT, Drawing @ 250X Integrated Light (no filter), Seeing 6.0 (interpolated), Transparency (not specified), Phase (k) = 0.935, Apparent Diameter = 10.7”, Superb drawing showing banded and amorphous dusky features in good seeing conditions.

Illustration 008: 2010 Apr20 1930 UT, Paul G. Abel, Leichester, UK, 20.3 cm (8.0 in.) NEW, Drawing @ 133X Integrated Light (no filter), Seeing 4.0 (interpolated), Transparency (good; not numerically estimated), Phase (k) = 0.911, Apparent Diameter = 11.0”, Bright limb band, complete from cusp to cusp, banded and amorphous dusky markings, and cusp caps are visible in this drawing.

UV images than those captured in the visible spectrum as well as submitted drawings. The mean numerical intensity of the Bright Limb Band was 9.8,

Illustration 009: 2010 Apr07 19:10 UT, Peter Grego, Cornwall, UK, 20.3 cm (8.0 in.) SCT, Drawing @ 250X Integrated Light (no filter), Seeing 5.0 (interpolated), Transparency (not specified), Phase (k) = 0.881, Apparent Diameter = 11.6”, Nice drawing showing banded and amorphous dusky features in fair seeing conditions.

seemingly a bit more obvious when color filters or variable-density polarizers were used. This very bright feature, usually reported by visual observers this apparition, was also seen on a fairly large number of digital images of Venus received [See Illustration 008 and 020].

Terminator Irregularities

The terminator is the geometric curve that separates the brilliant sunlit and dark hemispheres of Venus. A deformed or asymmetric terminator was reported in 47.8% of the observations. Amorphous, banded, and irregular dusky atmospheric markings often seemed to merge with the terminator shading, possibly contributing to some of the reported incidences of irregularities. Filter techniques usually improved the visibility of terminator asymmetries and associated dusky atmospheric features. Bright features adjacent to the terminator can occasionally take the form of bulges, while darker markings may appear as wispy hollows [See Illustration 014].

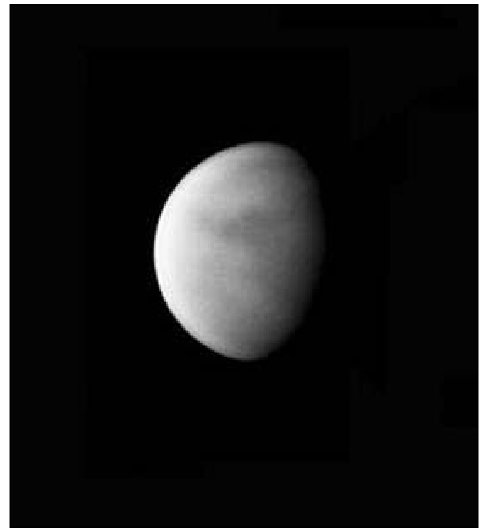


Illustration 011: 2010 May22 22:08 UT, Brian Combs, Buena Vista, GA, 35.6 cm (14.0 in.) SCT, Digital Image with UV filter, Seeing (not specified), Transparency (not specified), Phase (k) = 0.835, Apparent Diameter = 12.4”, In addition to banded dusky features, V-shaped radial dusky marking are quite obvious in this detailed UV image; cusp caps and cusp bands are also visible as well as bright limb band.

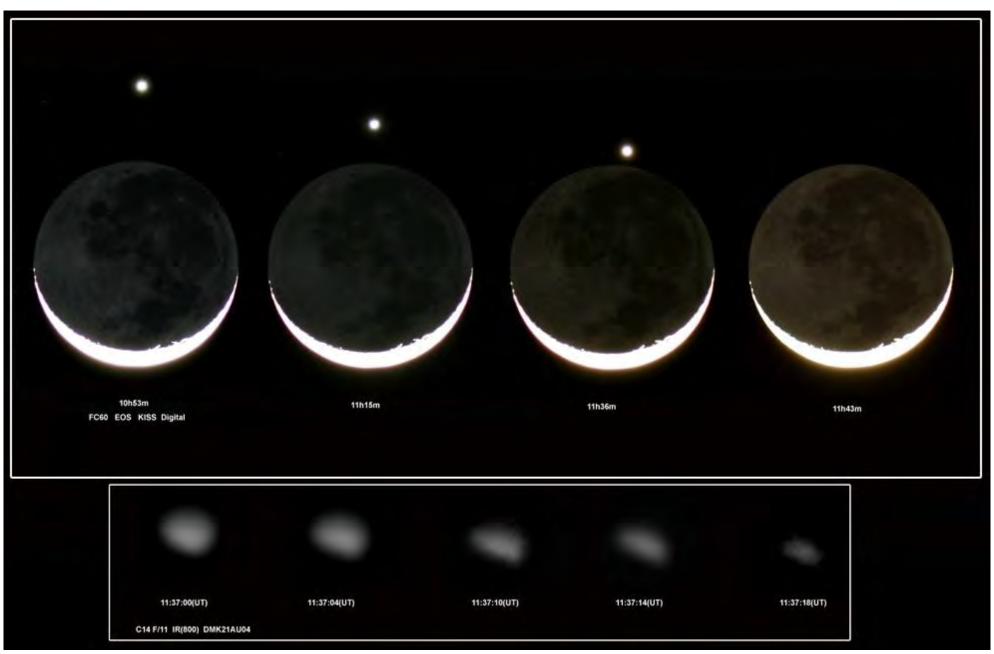


Illustration 010: 2010 May16 10:53-11:43 UT, Tomio Akutsu, Cebu City, Philippines, Top Images taken with FC60 EOS KISS Digital Camera, Bottom Images taken with 35.6 cm (14.0 in.) SCT, Integrated Light (no filter) and IR filter, Seeing 6.5, Transparency 5.0, Phase (k) = 0.853 , Apparent Diameter = 12.1”, Beautiful occultation of Venus. Ingress (disappearance) sequences of Venus behind the Moon (with obvious Earthshine in top images), since egress (reappearance) of the planet was not observable from observer’s location in Cebu City.

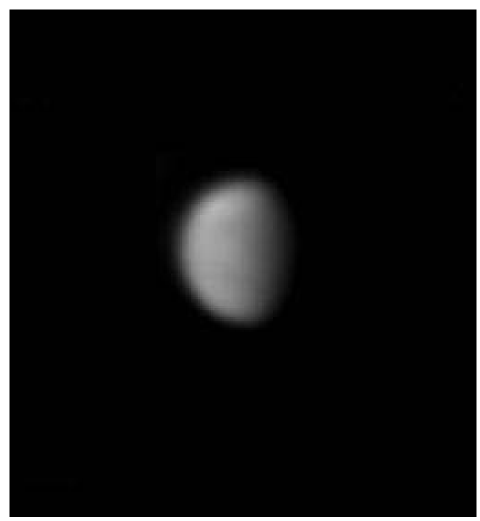


Illustration 012: 2010 May23 18:39 UT, David Arditti, Middlesex, UK, 35.6 cm (14.0 in.) SCT, Digital image with Astrodon-Schuler UV filter, Seeing (not specified), Transparency (not specified), Phase (k) = 0.833, Apparent Diameter = 12.5”, Cusp caps and cusp bands, along with terminator shading, and banded dusky markings appear in this image.

Cusps, Cusp-Caps, and Cusp-Bands

When the *phase coefficient*, **k**, is between 0.1 and 0.8 (the phase

Illustration 013: 2010 Jun10 00:30 UT Carlos Hernandez, Miami, FL, 22.9 cm (9.0 in.) MAK , Drawing @ 295X employing W23A (light red) and W38A (light blue) filters, Seeing 5.5, Transparency 4.5, Phase (k) = 0.781, Apparent Diameter = 13.6", Cusp caps and cusp bands, the bright limb band from cusp to cusp, irregular and amorphous dusky markings are all apparent in this superb drawing.

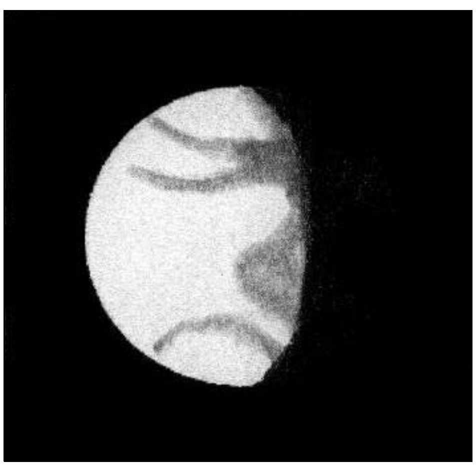


Illustration 014: 2010 Mar09 11:12 UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 225X W25 (red) filter, Seeing 4.0 (interpolated), Transparency (not specified), Phase (k) = 0.776, Apparent Diameter = 13.7", Drawing shows irregular and banded dusky features, cusp caps, and cusp bands, as well as a slightly deformed terminator.

coefficient is the fraction of the disc that is illuminated), atmospheric features on Venus with the greatest contrast and overall prominence are consistently sighted at or near the planet's cusps, bordered sometimes by dusky cusp-bands. *Figure 5* shows the visibility statistics for Venusian cusp features for this apparition.

When the northern and southern cusp-caps of Venus were reported this observing season, *Figure 5* graphically shows that these features were equal in size the majority (91.4%) of the time and in brightness in 84.8% of the observations. Also, there were several instances when the southern and northern cusp-caps were larger and brighter than each other. Both cusp-caps were visible in 76.1% of the observational reports, and their mean relative intensity averaged 9.8 during the observing season. Dusky cusp-bands were detected flanking the bright cusp-caps in 75.4% of the observations when cusp-caps were visible. When seen, the cusp-bands displayed a mean relative intensity of about 7.4 (see *Figure 5*) [See Illustrations 005 and 015].

Cusp Extensions

There were no instances during the 2010 Eastern (Evening) Apparition when cusp extensions were reported in integrated light or with color filters beyond the 180° expected from simple geometry (see Figure 5). Experience has shown that cusp extensions are notoriously troublesome to image because the sunlit regions of Venus are overwhelmingly brighter than faint cusp extensions, but observers are still encouraged to try to record these features using digital imagers in upcoming apparitions. Nevertheless, images of Venus at visual wavelengths are always striking [See Illustration 021].

Estimates of Dichotomy

A discrepancy between predicted and observed dates of dichotomy (half-phase) is often referred to as the "Schröter Effect" on Venus. The predicted half-phase occurs when k = 0.500, and the phase angle, i, between the Sun and the Earth as seen from Venus equals 90°. Although theoretical dichotomy occurred on August 17th at 17.64h UT, visual dichotomy estimates were not submitted during this apparition.

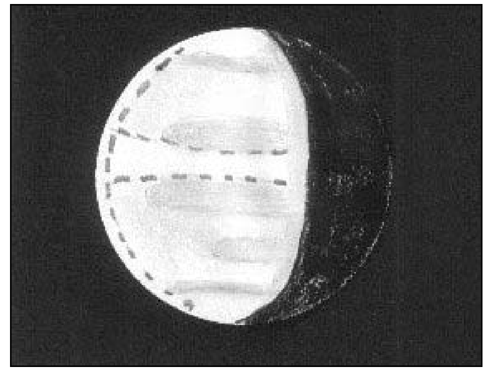


Illustration 015: 2010 Jun21 16:05 UT, Carl Roussell, Hamilton, Ontario, Canada, 15.2 cm (6.0 in.) REF, Drawing @ 200-400X Integrated Light, W25, W58, W47 filters , Seeing 5.0, Transparency (slight haze), Phase (k) = 0.742, Apparent Diameter = 14.6", Drawing depicts banded dusky markings, bright regions exclusive of the cusps, cusp caps, and cusp bands; bright limb band is visible cusp to cusp.

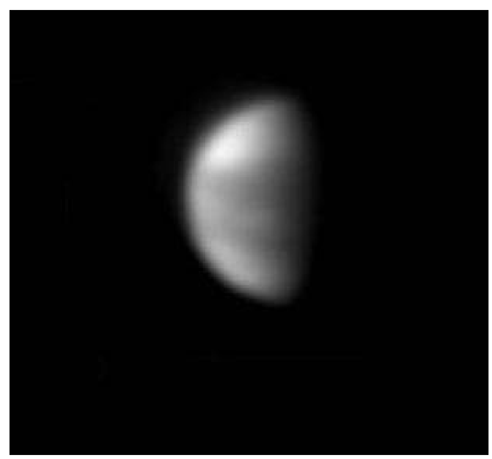


Illustration 016: 2010 Jul09 18:30 UT, David Arditti, Middlesex, UK, 35.6 cm (14.0 in.) SCT, Digital image with Astrodon-Schuler UV filter 355nm, Seeing (not specified), Transparency (not specified), Phase (k) = 0.675, Apparent Diameter = 16.5", Aside from cusp caps and cusp bands, terminator shading, and banded dusky markings, there is a rather brilliant bright spot along the S limb of Venus in this UV image.

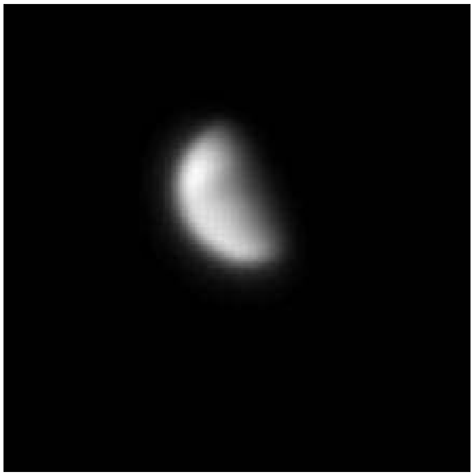


Illustration 017: 2010 Jul18 10:15 UT, Toshihiko Ikemura, Osaka, Japan, 38.0 cm (15.0 in.) NEW, Digital image with 360nm UV filter, Seeing (not specified), Transparency (not specified), Phase (k) = 0.640, Apparent Diameter = 17.7", Banded dusky markings and a bright spot along the S limb of Venus appear in the UV image.

Illustration 018: 2010 Jul22 10:58 UT, Toshihiko Ikemura, Osaka, Japan, 38.0 cm (15.0 in.) NEW, Digital image with 360nm UV filter, Seeing (not specified), Transparency (not specified), Phase (k) = 0.623, Apparent Diameter = 18.3", Amorphous dusky markings and a bright spot along the S limb of Venus appear in the UV image (feature does not appear as prominent as that captured on July 18th).

Dark Hemisphere Phenomena and Ashen Light Observations

The Ashen Light, reported the first time by G. Riccioli in 1643, is an extremely elusive, faint illumination of Venus' dark hemisphere. Some observers describe the Ashen Light as resembling Earthshine on the dark portion of the Moon, but the origin of the latter is clearly not the same. It is natural to presuppose that Venus should ideally be viewed against a totally dark sky for the Ashen Light to be detectable, but such circumstances occur only when the planet is very low in the sky where poor seeing adversely affects viewing. The substantial glare from Venus in contrast with the surrounding dark sky is a further complication. Nevertheless, the ALPO Venus Section continues to receive reports from experienced observers, viewing the planet in twilight, who are convinced they have seen the Ashen Light, and so the controversy continues. This apparition only one observer, Detlev Niechoy of Germany, submitted reports of the Ashen Light during early to mid-October 2010 using a 20.3 cm (8.0 in.) SCT in Integrated Light (no filter) and a variety of color filters [See Illustration 022]. There were no other visual reports or digital images of the Ashen Light contributed to the ALPO Venus Section during the 2001 Eastern (Evening) Apparition. Venus observers are encouraged to monitor the dark side of Venus using digital imagers to try to capture any illumination that may be present on the planet, ideally as part of a cooperative simultaneous observing endeavor with visual observers.

Since the instrumentation and methodology are not really complicated, the ALPO Venus Section also encourages observers to pursue systematic imaging of the planet in the near-IR. At these wavelengths the hot surface of the planet becomes quite apparent, and occasionally mottlings show up in such images, which are attributed to the presence of cooler dark higher-elevation terrain and warmer

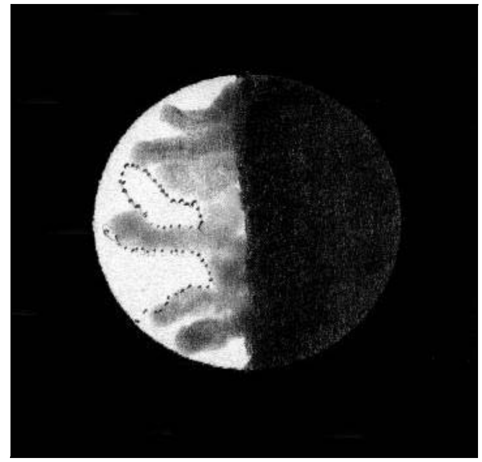


Illustration 019: 2010 Aug14 15:22 UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 82X Integrated Light (no filter), Seeing 3.0 (interpolated), Transparency (not specified), Phase (k) = 0.515, Apparent Diameter = 22.9", Drawing shows irregular and banded dusky features, cusp caps, and cusp bands, as well as a bright regions on the disk of Venus; terminator appears nearly straight in this drawing (dichotomy or 0.500 phase predicted on August 17th).

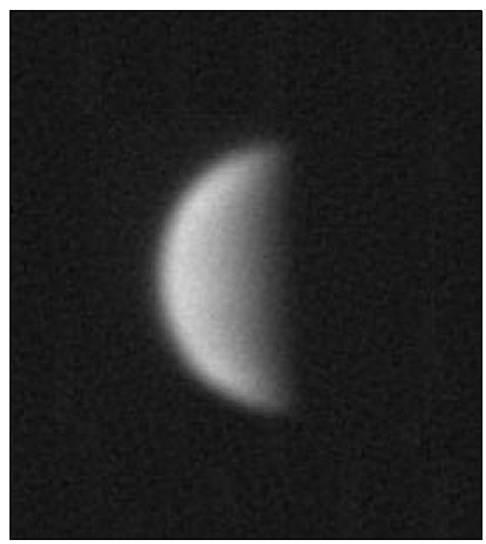


Illustration 020: 2010 Aug17 10:09 UT, Toshihiko Ikemura, Osaka, Japan, 38.0 cm (15.0 in.) NEW, Digital image with 350nm UV filter, Seeing (not specified), Transparency (not specified), Phase (k) = 0.501, Apparent Diameter = 23.6", Vague amorphous dusky markings and the bright limb band is obvious in this UV image on the date of theoretical dichotomy.

bright lower surface areas in the IR. There were no such images submitted this apparition.

There were no reports of the dark hemisphere of Venus allegedly appeared *darker* than the background sky, a phenomenon that is probably nothing more than a curious contrast effect.

Illustration 021: 2010 Oct04 07:08 UT, Maurice Collins, Palmerston North, NZ, 20.3 cm (8.0 in.) SCT, Digital image in Integrated Light (no filter), Seeing (not specified), Transparency (not specified), Phase (k) = 0.165, Apparent Diameter = 47.0”, Image of the beautiful crescent of Venus with no indication of extension of cusps.

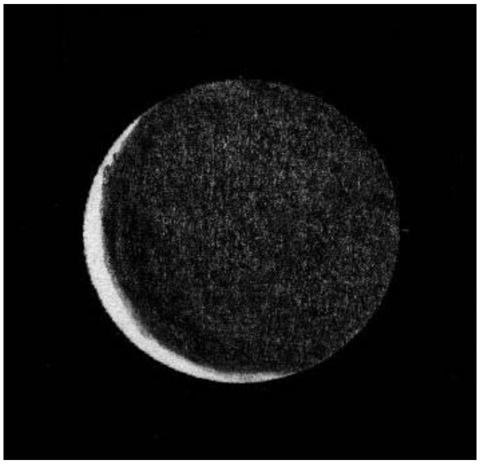


Illustration 022: 2010 Oct10 13:18 UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 82X Integrated Light (no filter), Seeing 3.0 (interpolated), Transparency (not specified), Phase (k) = 0.109, Apparent Diameter = 51.8”, Observer was convinced that the Ashen Light, albeit very subtle, was visible in this drawing made in poor seeing.

Simultaneous Observations

The atmospheric features and phenomena of Venus are elusive, and it not unusual for two observers looking at Venus at the same time to derive somewhat different impressions of what is seen. Our challenge is to establish which features are real on any given date of observation, and the only way to build confidence in any database is to increase observational coverage on the same date and at the same time. Therefore, the ideal scenario would be to have simultaneous observational coverage throughout any apparition. Simultaneous observations are defined as independent, systematic, and standardized studies of Venus carried out by a large group of observers using the same techniques, similar equipment, and identical observing forms to record what is seen. While this standardized approach emphasizes a thorough visual coverage of Venus, it is also intended to stimulate routine digital imaging of the planet at visual and various other wavelengths, such as infrared and ultraviolet. By these exhaustive efforts, we would hope to be able to at least partially answer some of the questions that persist about the existence and patterns of atmospheric phenomena on Venus.

Amateur-Professional Cooperative Programs

Following its climb to a new orbit after its daring aero-braking experiment in mid-2014, the European Space Agency’s Venus Express (VEX) spacecraft resumed observations of Venus for at least a few more months due to extension of the VEX mission through the end of December 2014.

By early 2015, however, ESA’s Venus Express had completed its final descent into the atmosphere of the planet, bringing an absolutely fantastic and successful scientific endeavor to an end.

Despite the fate of the Venus Express (VEX) spacecraft which started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in May 2006, ALPO observers who have not yet sent their images to the ALPO Venus Section and the VEX website (see below) should do so immediately. These data are important and will continue to be analyzed for several years to come as a result of this Professional-Amateur (Pro-Am) effort. Regular Venus program activities (including drawings of Venus in Integrated Light and with color filters of known transmission) have been also valuable throughout the period that VEX was observing the planet. The VEX website is

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

Lunar Occultation of Venus in 2010

Tomio Akutsu, observing from the Philippines, witnessed the beginning of the spectacular occultation of Venus by the thin crescent Moon on May 16, 2010. His images, captured between 10:53 UT and 11:43 UT on May 16th, showed only the ingress (disappearance)

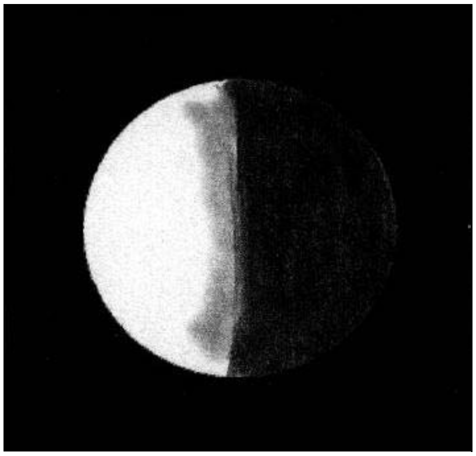


Illustration 023: 2010 Jul04 19:59 UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 225X W47 (violet) filter, Seeing 4.0 (interpolated), Transparency (not specified), Phase (k) = 0.694, Apparent Diameter = 15.9”, Although no other dusky features were apparent to the observer in this drawing, terminator shading was particularly obvious.

of Venus behind the Moon, since egress (reappearance) of the planet was not observable from his location [See Illustration 010]. These were the only images of the event submitted to the ALPO Venus Section.

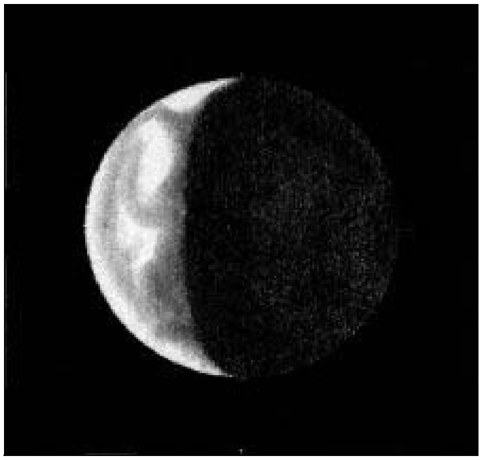


Illustration 024: 2010 Sep06 19:59 UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 290X W15 (deep yellow) filter, Seeing 3.0 (interpolated), Transparency (not specified), Phase (k) = 0.383, Apparent Diameter = 30.8", Amorphous, irregular, and banded dusky features were apparent to the observer in this drawing of the crescent Venus; terminator shading is obvious as well as cusp-caps and cusp-bands.

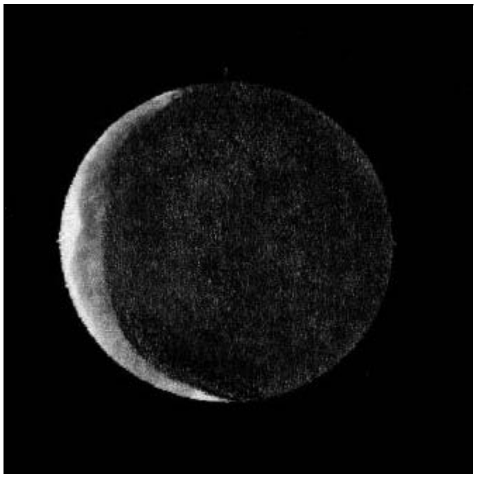


Illustration 025: 2010 Sep22 15:29 UT, Detlev Niechoy, Göttingen, Germany, 20.3 cm (8.0 in.) SCT, Drawing @ 290X W25 (red) filter, Seeing 3.5 (interpolated), Transparency (not specified), Phase (k) = 0.266, Apparent Diameter = 39.2", Amorphous dusky features were depicted in this drawing of the crescent Venus; terminator shading and irregularities are visible.

Conclusions

Analysis of ALPO observations of Venus during the 2010 Eastern (Evening) Apparition showed that vague shadings on the disc of the planet were periodically apparent to visual observers who utilized standardized filter techniques to help reveal the notoriously elusive atmospheric features. Indeed, it is often very difficult to be sure visually what is authentic and what is merely illusory at visual wavelengths in the atmosphere of Venus. Increased confidence in visual results is improving as more and more program participants are attempting simultaneous observations.

Readers and potential observers should realize that well-executed drawings of Venus are still a vital part of our overall program as we strive to improve the opportunity for confirmation of highly elusive atmospheric phenomena, to introduce more objectivity, and to standardize observational techniques and methodology. It is especially good to see that Venus observers worldwide are contributing digital images of the planet at visual, near-UV, and near-IR wavelengths. It is also meaningful when several observers working independently, with some using visual methods at the same time others are employing digital imaging, to produce comparable results. For example, atmospheric banded features and radial ("spoke") patterns depicted on drawings often look strikingly similar to those captured with digital imagers at the same date and time.

Many of our best UV images have been sought after by the professional community, and cooperative involvement of amateurs and professionals on common projects took another step forward with the establishment of the Venus Amateur Observing Project (VAOP) in 2006 coincident with the Venus Express (VEX) mission, which continues at least through 2014.

Active international cooperation by individuals making regular systematic, simultaneous observations of Venus remain our main objective, and the ALPO Venus Section encourages interested readers to join us in our many projects and challenges in the coming years.

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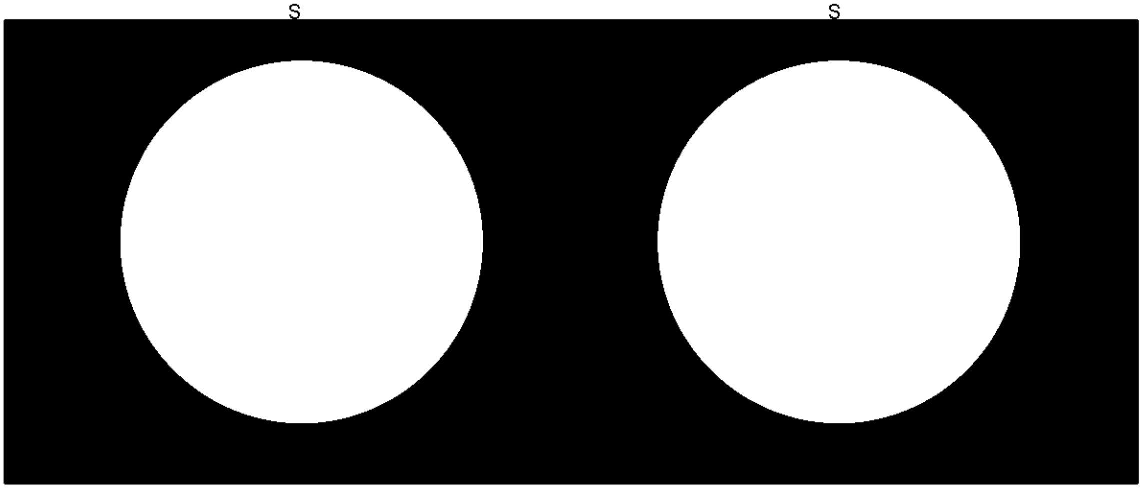
Association of Lunar and Planetary Observers (A.L.P.O.): Venus Section

A.L.P.O. Visual Observation of Venus

Drawing Blank — *Intensity Estimates Blank*

S S

p  f

N (*all coordinates are IAU*) N

Observer________________________________Location____

UT Date ______________ UT Start ________________ UT End ________________ D = ___________″ k_m = ___________ k_c = ____________

m_v = ____________ Instrument ____ Magnification(s) ______________ x_{min} ______________ x_{max}

Filter(s) IL(none) ___________ f_1 ___________ f_2 ___________ f_3 ____________ Seeing ________________ Transparency ________________

Sky Illumination (*check one*): [ ] Daylight [ ] Twilight [ ] Moonlight [ ] Dark Sky

Dark Hemisphere (*check one*):
[ ] No dark hemisphere illumination [ ] Dark hemisphere illumination suspected
[ ] Dark hemisphere illumination [ ] Dark hemisphere darker than sky

Bright Limb Band (*check one*):
[ ] Limb Band not visible
[ ] Limb Band visible (complete cusp to cusp)
[ ] Limb Band visible (incomplete cusp to cusp)

Terminator (*check one*):
[ ] Terminator geometrically regular (no deformations visible)
[ ] Terminator geometrically irregular (deformations visible)

Terminator Shading (*check one*):
[ ] Terminator shading not visible
[ ] Terminator shading visible

Atmospheric Features (*check, as applicable*):
[ ] No markings seen or suspected [ ] Radial dusky markings visible
[ ] Amorphous dusky markings visible [ ] Banded dusky markings visible
[ ] Irregular dusky markings visible [ ] Bright spots or regions visible (exclusive of cusp regions)

Cusp-Caps and Cusp-Bands (*check, as applicable*):
[ ] Neither N or S Cusp-Cap visible [ ] N and S Cusp-Caps both visible
[ ] N Cusp-Cap alone visible [ ] S Cusp-Cap alone visible
[ ] N and S Cusp-Caps equally bright [ ] N and S Cusp-Caps equal size
[ ] N Cusp-Cap brighter [ ] N Cusp-Cap larger
[ ] S Cusp-Cap brighter [ ] S Cusp-Cap larger
[ ] Neither N or S Cusp-Band visible [ ] N and S Cusp-Bands both visible
[ ] N Cusp-Band alone visible [ ] S Cusp-Band alone visible

Cusp Extensions (*check, as applicable*):
[ ] No Cusp extensions visible [ ] N Cusp extended (angle = ______°)
[ ] S Cusp extended (angle = ______°)

Conspicuousness of Atmospheric Features (*check one*):
[ ] 0.0 (nothing seen or suspected) [ ] 3.0 (indefinite, vague detail)
[ ] 5.0 (suspected detail, but indefinite) [ ] 7.0 (detail strongly suspected)
[ ] 10.0 (detail definitely visible)

IMPORTANT: Depict morphology of atmospheric detail, as well as the intensity of features, on the appropriate blanks at the tope of this form. Attach to this form all supporting descriptive information, and please do not write on the back of this sheet. The intensity scale is the *Standard A.L.P.O. Intensity Scale*, where 0.0 = completely black ⇔ 10.0 = very brightest features, and intermediate values are assigned along the scale to account for observed intensity of features.

Feature Story:

A Small Lunar Dome Complex Blanketed by Ejecta in Euclides-J region? A Spectral and Morphometric Analysis

By Charles Galdies
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A short note about the author appears on the last page of this paper.

Online Readers

Left-click your mouse on the e-mail address in blue text to contact the author of this article and any of the additional information sources in blue text at the end of this paper for more information.

Introduction

Mare Cognitum (which is the area chosen in 1964 by the Ranger program to gather the first high resolution imaging of the Moon) is located in the second ring of Oceanus Procellarum. To the northwest of the mare is the Montes Riphaeus mountain range which dates back some 4 billion years and which is, in turn, the likely remains of a very large crater rim that was not completely buried by the lava flood.

To the west of M. Raphaeus is the prominent Copernican-era crater Euclides (Latitude -7.40085°, Longitude -29.56347°), which is a 12-km circular, bowl-shaped crater with steep-slopes surrounded with bright ejecta and with a height/width ratio of 0.055 (using GLD 100 elevation data).

Euclides crater and its surrounding area is an interesting, yet somewhat overlooked lunar region. A number of low-lying domes have been documented, notably dome "470" which lies to the east of Euclides crater, some 21 geodetic km away [footnote 1]. Lunar domes are circular features of varying diameter and have a gentle slope, rising in elevation a few hundred meters to the midpoint. These are structures of volcanic origin that, at the time of eruption, are typically viscous, possibly silica-rich lava, erupting from localized vents having low effusion rates. Domes and associated volcanic features yield information about the volcanic history of the Moon (Stopar et al. 2009). Some of the domes may also show a small craterlet or vent at the peak.

Terrestrial observations of domes and related features (such as cones [footnote 2]) represents a particular challenge, in that they are usually difficult to identify due to their low height, thus requiring particularly low-Sun illumination angles in order to be detected and studied.

Visual observation techniques of such volcanic features can obviously be supplemented by the acquisition of CCD images, which can undergo subsequent processing and geometric

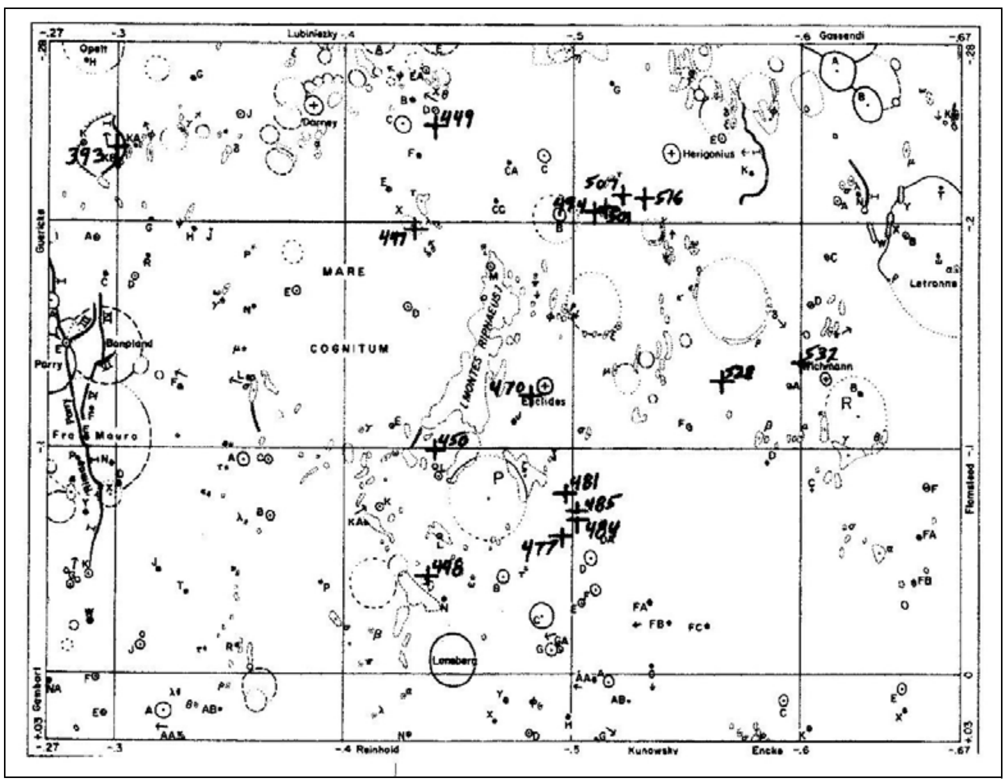


Figure 1. Lunar map of the Euclides region and its environ showing the location of domes reported by several lunar observers, in need of further verification. (Source: BAA).

Footnotes:

1) http://target.lroc.asu.edu/qm3d/o2w_3d_055734235_46_11_41_39_0/
2) Such as Isis-Osiris; http://target.lroc.asu.edu/qm3d/o2w_3d_748971396_46_11_41_39_0/

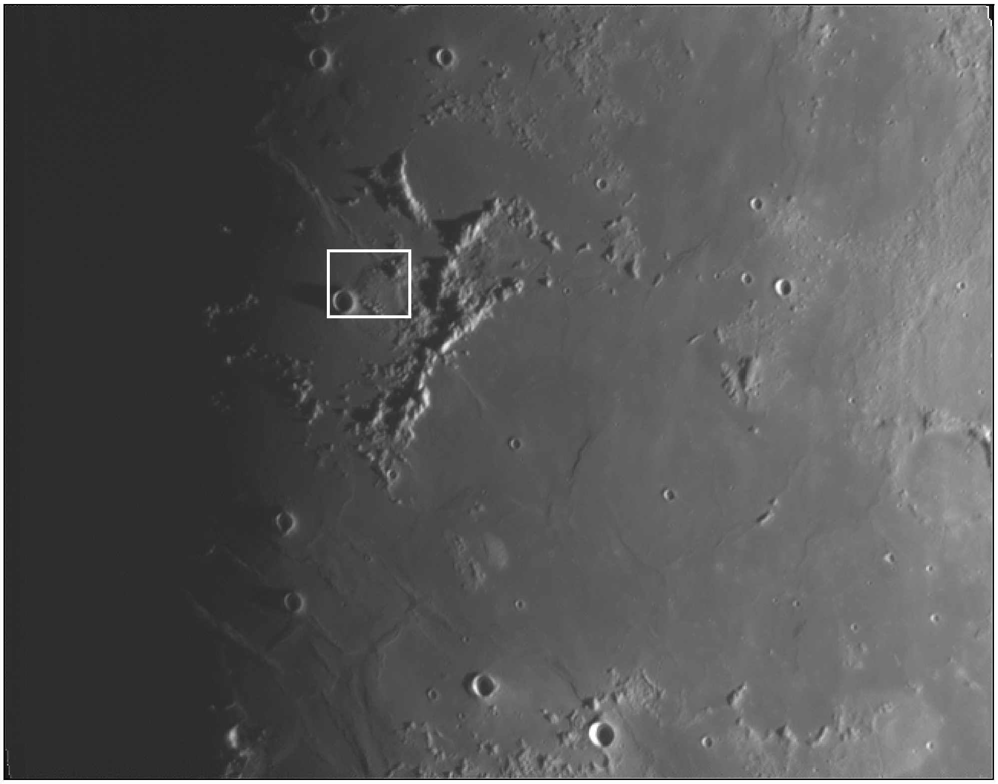
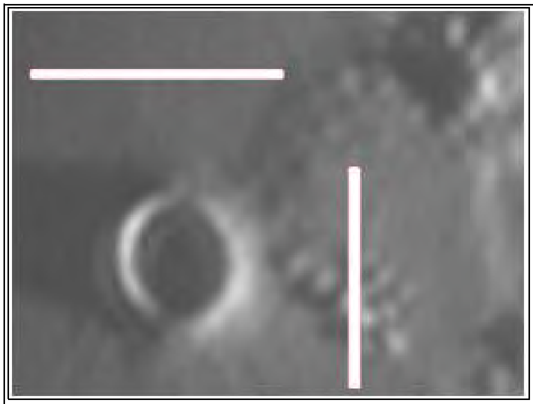


Photo 1. CCD image showing an overview of Mare Cognitum. The white solid frame indicates the region of interest. Image taken on May 30, 2012 at 19:56 UT with a 203 mm SCT and DMK21AU04 camera at f/10 using a red filter (Znith Observatory Malta; *http://znith-observatory.blogspot.com*).

transformations to produce their 3-dimensional models, thus facilitating their identification even with modest amateur telescopic equipment. In addition to visual and photographic low-Sun-angle observations, spectrometry in the ultraviolet and visible electromagnetic spectrum can provide evidence of their mineralogical features against a known background of lunar surface, which according to Papike et al. (1991), is composed mainly of plagioclase, pyroxene, olivine, silica, ilmenite (Iron Titanium Oxide), mare and highland glass.

Spectrometric observations are one of the most elaborate optical remote sensing techniques used by many lunar investigators, and has been carried out as a quantitative tool for the understanding of the chemical and mineralogy examination of the lunar surface (Wohler et al. 2011). This is made possible because UVVIS electromagnetic radiances are associated with silicate absorption bands.

Before the provision of the Clementine satellite data [footnote 3] (which among the wide-ranging sensors included a UV/Visible Camera, a Near-Infrared Camera, a Long-Wavelength Infrared Camera and a High-Resolution Camera), the mineral composition of the lunar surface was principally obtained using Earth-based telescopes having high spectral resolution (allowing minerals to be identified with high accuracy) at the expense of low spatial resolution (2-10 km). This meant that lunar geological studies were focused on the regional rather than global scale. In 1994, the Clementine UVVIS camera acquired global multispectral images with pixel resolution of 100-300 m, for five spectral channels (Eliason et al. 1999) at 415, 750, 900, 950 and 1,000 nm wavelengths. For the first time, the acquisition of such data enabled the mapping of the global lunar mineral distribution (Nozette et al. 1995) on a global scale.



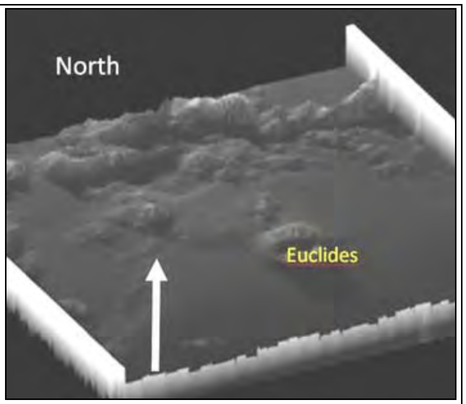


Photo 2a. (Left) CCD image showing the area of interest where the white lines converge. Image taken on May 30, 2012 at 19:56 UT using a 200 mm SCT and DMK21AU04 camera at f/10 using a red filter (Znith Observatory Malta; http://znith-observatory.blogspot.com

Photo 2b. (Right) 3-D profile of the CCD image based on reflectance DN number of image showing the elevated lava platform featuring possible domical features.

Footnote:

3) The Clementine Mission [Nozette et al., 1995], officially designated as the Deep Space Program Science Experiment (DSPSE), was launched on 1994-01-25 aboard a Titan IIG rocket from Vandenburg Air Force Base in California. The mission included two months of systematic lunar mapping (1994-02-26 through 1994-04-21). The UVVIS mosaic was created using the Clementine EDR Image Archive. Further information can be obtained from the PDS Imaging Node or the Lunar and Planetary Institute.

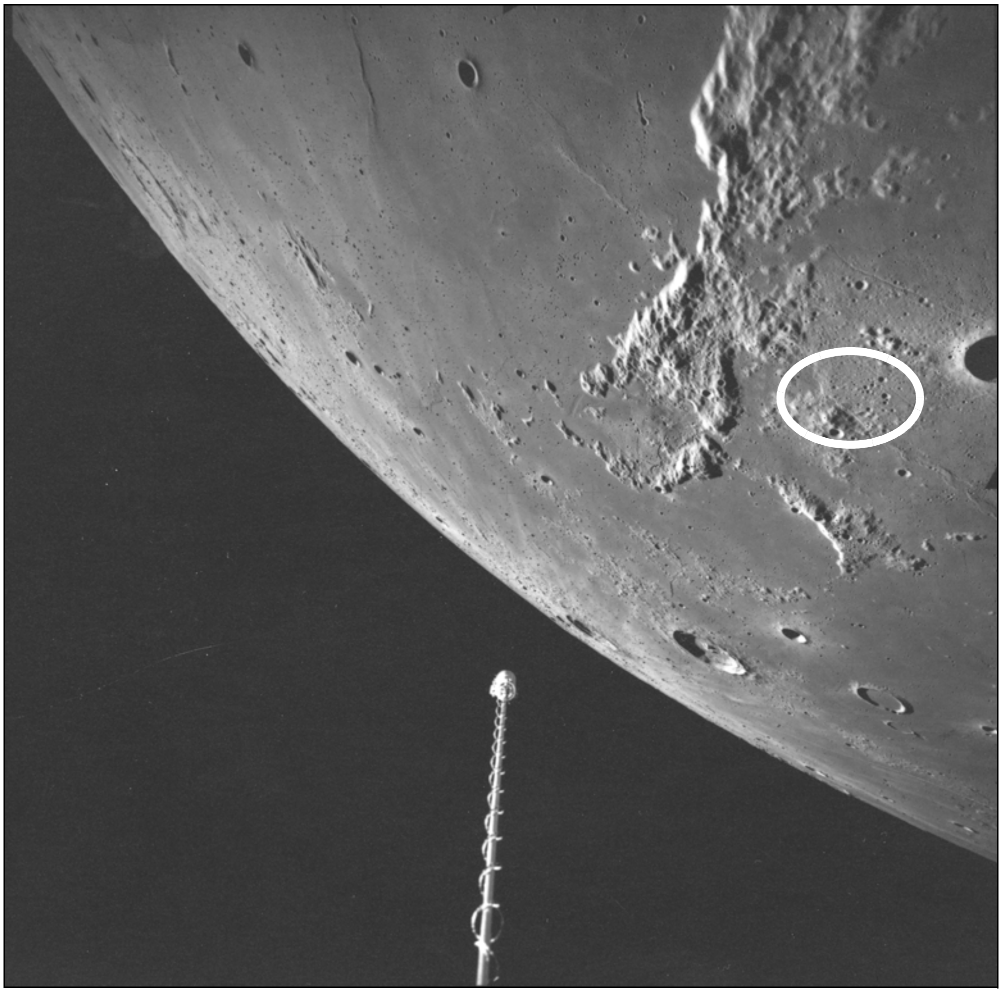


Photo 3. An Apollo image showing low profile dome-like features to the north of Euclides crater (inset). Source: *http://www.lpi.usra.edu/resources/apollo/images/print/AS16/M/2517.jpg*

Calibration algorithms for Clementine data were derived primarily by Lucey (2004) and Lawrence et al. (2005) based on Apollo lunar samples. For these samples the chemical determination was used and their albedo values were found at the sampling sites against Clementine images having a ground pixel resolution of 100 m. These algorithms enabled the calculation of percentage weight of FeO and TiO_2 from the radiances collected at the 5 wavebands (Shkuratov et al., 2011) and such estimates allowed the distinction among different types of lunar surface materials. Lunar remote sensing algorithms are now being used by investigators to retrieve mineral distributions (Cahill et al. 2009) where color ratios R_{415}/R_{750} and R_{950}/R_{750} are used as diagnostic absorption bands in reflectance spectra to allow the identification of mafic minerals.

Aim of the Study

The Euclides region is surrounded by several domes (Fig. 1). A cursory investigation using LROC data shows that "Euclides 3" could possibly be a complex dome system residing some 15 km to the east of Euclides crater (Kapral & Garfinkle, 2005).

Of particular interest is an unexplored area residing some 33.4 geodetic km away from the central floor of Euclides, in the NE direction, precisely at latitude -6.62° and longitude -29.89°. In this area lies a small group of dome-like structures situated on an elevated basaltic platform. This topographic feature was detected by telescopic observation and CCD imagery carried out by the author on May 30, 2012 at 19:56 UT (photos 1, 2a and 2b). One hypothesis is that these features represent a series of mounds made up of a collection of undifferentiated crater materials or ejecta (denoted as "***EI?c***"), as described by USGS (1965). According to USGS (1965), (I-458; LAC-76; Geology of the moon in the M. Raphaeus region), the area of interest (AOI) consists of "predominantly crushed rock and great blocks derived mainly from the region Mare Imbrium. This layer forms a coating probably ranging from a few meters to about 500 meters in thickness, and has a heterogeneous composition."

This hypothesis is tested against an alternative one in that the area shows the presence of domes that are partly covered by these ejecta.

An Apollo image (Photo 3) shows these low-profile features to the north of Euclides crater (encircled in white).

Method and Measurement

Geographic Setting

A subset of this AOI covers a cartographic width of approximately 10.74 geodetic km and is situated between Euclides-J and Euclides (Photo 4). The LROC NAC high-resolution image (0.5 m/pixel) laid over the WAC Global Morphological basemap (100 meters/pixel) is available at *http://bit.ly/1rtQC5O*

Telescopic CCD Images

For each of the observations, the local solar altitude and the Sun's selenographic colongitude were calculated using the LTVT software package (Mosher and Bondo, 2006) which requires a calibration of the image by identifying the precise selenographic coordinates of some landmarks on the image. This calibration was performed based on a standard list of control points.

The morphometry of the dome-like feature residing in the AOI subset,

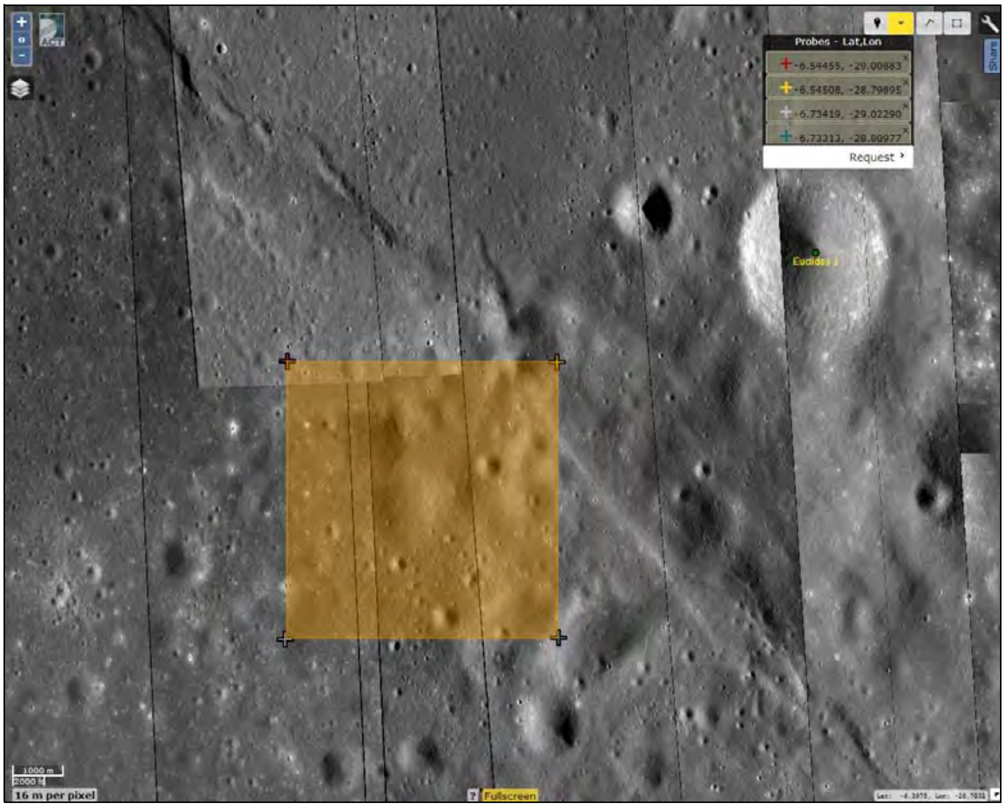


Photo 4. This subset AOI lies within the lunar coordinates shown at the top right hand corner. http://bit.ly/1zXZepg

including slope, height and diameter, was calculated and further refined using GLD100 (Global Lunar DTM 100 m topographic model) elevation model (NAC-derived DTMs are included, where available) produced by Scholten et al. (2012).

Spectrometry

The UVVIS spectrum based on Clementine imagery at wavelengths of 415, 750, 900 and 950 nm were downloaded from the LPI Clementine Mapping Project (http://www.lpi.usra.edu/lunar/tools/clementine/) for an area that covered the AOI subset: South = -10°; North = 10°; West = -40° and East = -20° to produce a simple cylindrical output map projection at a projected scale of 303 pixels per degree.

The reflectance RAW values were derived based on the calibrated and normalized Clementine UVVIS reflectance data as provided by Eliasson et al. (1999). The extracted Clementine UVVIS data were reprocessed in terms of R415/R750 and R950/R750 color ratios for the AOI. Contour analysis was applied to denote spatial distribution of albedo.

The R415/R750 color ratio was used as a measure for the TiO_2 content of mature basaltic soils (Charette et al. 1974). However, one has to keep in mind that for many lunar regions, the relation between the R415/R750 color ratio and TiO_2 content displays a significant scatter (Gillis and Lucey, 2005). On the other hand, the R950/R750 color ratio is related to the strength of the mafic absorption band, representing a measure of the FeO content of the soil (Lucey et al. 1998).

FeO and TiO_2 (% wt) data were also downloaded from the LPI Clementine Mapping Project. The algorithms used to produce these data are according to Lucey et al. (1995). Contour analysis was applied to denote spatial distribution of FeO and TiO_2 (% wt).

It is interesting to note that Blewett et al. (1997) found excellent linear correlations between spectral Fe and Ti parameters from Clementine mission and the average FeO and TiO_2 contents of soils sampled at the Apollo 15, 16 and 17 landing sites. Blewett et al. (1997) based their investigations on the method used by Lucey et al. (1995) to derive FeO abundance from reflectance spectrometry modelling. More detailed analysis are included in Bletwett et al. (1997).

A number of spectrometric data points were analyzed within the Euclides region at different mineralogical sites as defined by USGS (1965), including maria region (M), ejecta deposits (E), enclosed ejecta (EnE), as well as crater walls (CW) (Fig. 2). This was carried out in order to better define the characteristic spectrometric response from various areas in the Clementine data representing the main mineralogical classes within the Euclides region.

Image Processing

Unsupervised classification was used as the statistical method to aggregate digital number pixels into surface mineralogical categories (or classes). The methodological concept here is that values within a given lunar soil cover type should have similar measurements (i.e., have similar DN levels), whereas data in different classes should be statistically well separated (Lillesand and Kiefer, 1994). In doing so, image processing can determine and map out spectrally separable classes.

The Iterative Self-Organizing Data Analysis Technique (ISODATA) method was used. The ISODATA algorithm merges clusters together based on a separation distance in multispectral feature space defined by a maximum standard deviation of 2 and a minimum distance between class means of 1 in order to separate two close clusters from each other. The maximum number of classes was set to 10. This method made a large number of iterations through the dataset until the specified results were

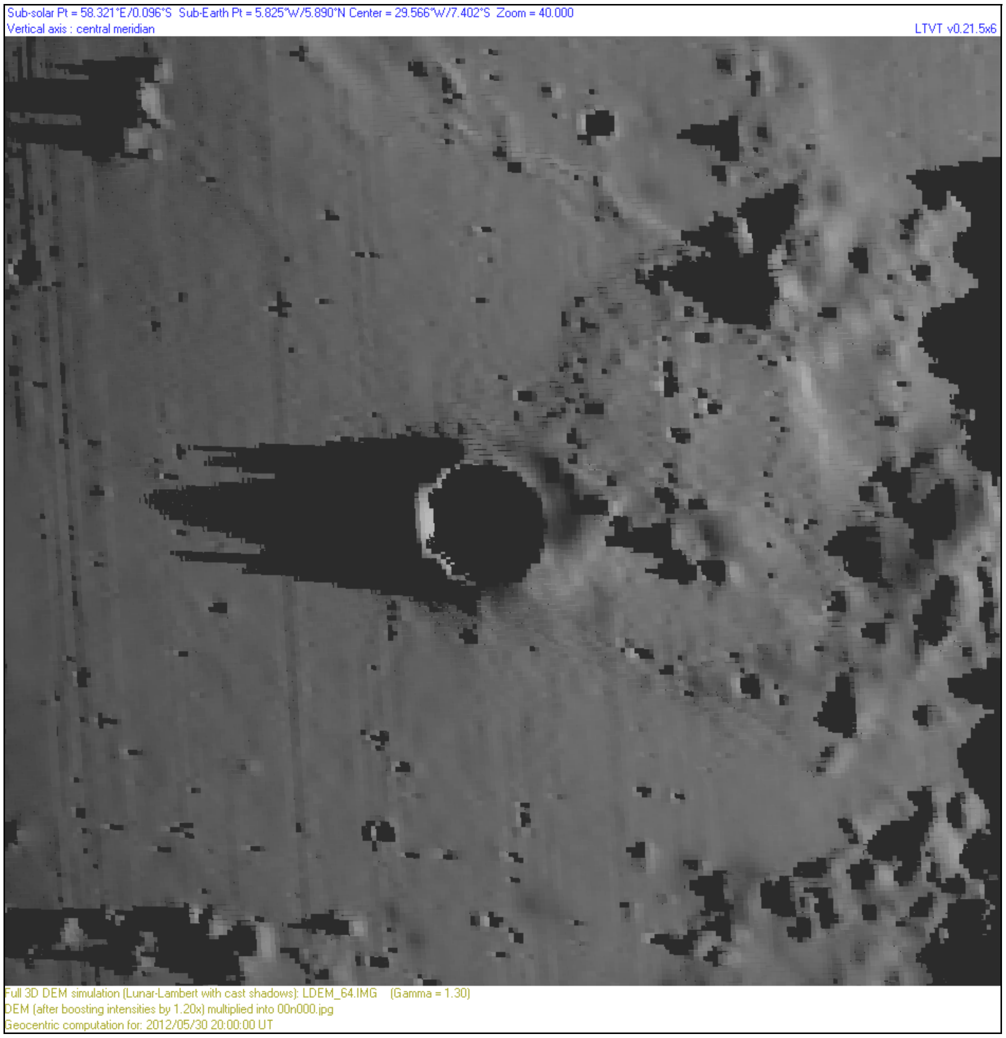


Photo 5. The information below shows the selenographic information at the time of CCD image capture (North is at top).
[Sub-solar Pt=58.321E/0.096S Sub-Earth Pt=5.825° West/5.890° North, Center=29.566° W/7.402° South Zoom=40.000 Vertical axis: central meridian.]

obtained. Thus, UVVIS Clementine 750 nm band was classified to derive 10 spectrally different classes based on the individual relationship of every collocated pixel value in the original albedo image.

Similarly, the FeO abundance image (% wt) was classified to derive congruent spectral classes based on the degree of FeO abundance as originally processed using the algorithm developed by Lucey et al. (2000). The resulting classified map represented the major terrain geology according to the FeO abundance.

Unsupervised classification can also be considered as a highly sensitive technique that is efficient in identifying the main clusters from the FeO abundance image. Clustering techniques might also provide equally good and possibly more accurate classification results, but were not explored in this study.

It is important to note that the identity of the final classes can only be ascertained by comparing the final maps with *in situ* or accurate secondary sources of information (although their presence remains doubtful) in order to determine the absolute typology of each of the spectral classes. Once this is made available then this classification approach provides a complementary rapid means of producing high-quality lunar soil cover data.

Results and Discussion

The Geological Setting from Spectrometric Results

The lunar stratigraphy of the AOI can be described by the superposition and chemistry of the most recent crater materials. The impact which formed Euclides crater, for example, has excavated and spread underlying crustal and possibly mantle material. This ejecta material has of course different chemical composition from that of the surface basaltic layer.

It is interesting to note that the Clementine UVVIS spectral data for the small AOI subset covering a single possible dome feature in the Euclides-J region (figs. 3a-d) revealed a low average value of the UVVIS color ratio of R415/R750 = 0.61, indicating a low TiO_2 content, and an average weak mafic absorption with R950/R750 = 1.04, suggesting a high soil maturity (Table 1). Using the Lucey et al. (2000) algorithm, the FeO Abundance (% weight) over the AOI subset, shows a value of around 12-13% wt while TiO_2 abundance shows a value of around 2.6%. Information related to the difference in spectrometric data between ***Dm*** and ***M*** classes suggest a slightly different material over the dome region, which is most probably due to crustal ejecta from neighboring Euclides, giving it a close range of values to ones observed over ***E***, ***EnC*** and ***CW*** areas (Table 1). Results suggest the presence of ejecta overlaying the dome that might be altering the spectral parameters of the original chemical composition.

Spectrometrically, similar dome features have been observed by other investigators near the Milichus/Tobias Mayer regions (Table 2), over which USGS (1965) describes the presence of recently exposed crushed rock derived in part from primary rayed craters (LAC 58). These domes result from both effusive and intrusive volcanic processes as classified by Wohler and Lena (2014).

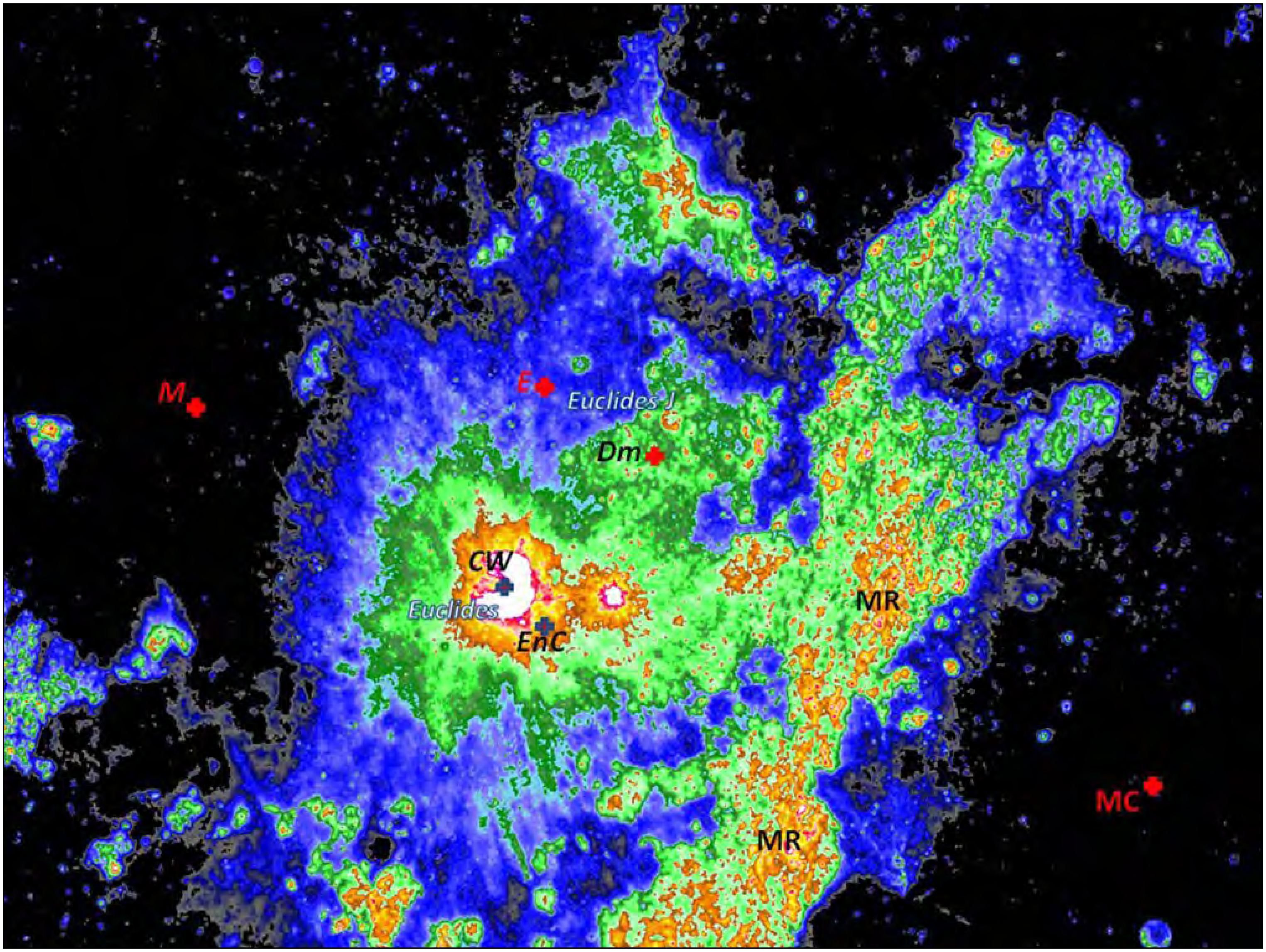


Figure 2. Classified albedo map based on the reflectance at 750 nm over the Euclides region (Mare Cognitum (MC), Montes Raphaeus (MR), Euclides and Euclides-J). The resolution of the data is 303 pixels per degree. A number of sampling points were selected to derive mineralogical characteristics as shown in Table 1.

Lunar Soil Mapping of the Euclides Region

Figure 4 (a) shows a classified map derived by unsupervised classification which includes the main R950 albedo spectrometric classes of the Euclides region, and which includes the AOI subset. When compared to the corresponding albedo image (using the UVVIS 950 nm band - Fig. 4b), it can be noticed that the AOI subset where the domical feature is found, forms part of the light-green-colored class which spectrometrically is different from either the light blue or orange-colored classes, both of which are statistically closer to the ejecta seen next to the walls of Euclides crater. This means that the light green color has a higher basaltic composition, and therefore lies somewhere in between the two extreme classes, i.e., between the basaltic, maria surface (dark blue) with little ejecta coverage, and the exposed mantle/ crustal material situated within and around Euclides crater itself (orange and red-colored classes).

Moreover, the present digital image classification method for the Euclides region on the basis of FeO abundance by weight has produced a map that is similar to, but is spatially richer (in terms of mineralogical distribution based on FeO abundance) than the published geological map made available by the United States Geological Survey (1995-1969; figures 5A-C). The classification of the lunar surface into homogenous, discrete classes based on the statistical distribution of FeO abundance seems to provide an improved map product. This new spatial map shows that the AOI subset is definitively within the 11.5-13.2% wt region, roughly equivalent to

Table 1. Spectrometric Results Derived Over the AOI from Clementine UVVIS Data (See Fig. 2 for geo-location of codes.)

Code	Image x	Image y	R_{415}/R_{750}	R_{950}/R_{750}	FeO abundance (% wt)	TiO_2 abundance (% wt)
M	2546.67	4934.3	0.61	1.02	17.96	6.20
Dm	***3380.47***	***5026.33***	***0.61***	***1.04***	***13.20***	***2.60***
E	3277.09	4931.35	0.62	1.01	15.39	3.77
EnC	3297.79	5309.87	0.63	0.99	13.13	2.10
CW	3194.29	5224.11	0.68	0.89	11.53	1.18

the "***If***=ejecta blanket" type as defined by USGS (1965). This study confirms that the "***If***" region is, in fact, made up of three statistically distinct classes in terms of FeO abundance, i.e., classes 2 to 5 (11.49-13.17; 13.17-14.41; 14.41-15.65 and 15.65-16.81% wt). One must keep in mind that this categorization is based purely on spectral and statistical information that may not necessarily correspond to the informational categories of interest. The resulting classification maps should be checked using ground truth information and field validation surveys whenever possible.

Morphometric Properties

The morphometry of the most prominent dome feature identified within the AOI subset, which caused an identifiable shadow cast from the terrestrial CCD observations, were derived using GLD100 data from LROC database.

Results show that the dome feature reaches up to 112 m, with an approximate flank slope of 4.9°. The dome volume *V* was computed by integrating the data provided in Fig. 6, assuming a circular feature of 2 km in diameter. A rough quantitative measure for the shape of the dome is equivalent to 0.3 form factor (Lena et al., 2009), which is equivalent to a conical shape. The volume amounts to 0.13 km^3. A digital elevation map of the area including this feature is shown in Fig. 7. A possible dome classification for this feature, based on the one used by Westfall (1964) would be *DW/1a/6h/8j*.

In morphometric terms, a similar dome structure is located on the floor of the crater Stevinus (32.760°S; 53.739°E) which is some 2.3 km in diameter (Fig. 8). Using GLD100 data, the dome has a height of 103 m (NAC frame M113603383L) - *http://bit.ly/1oL4uYD*

Conclusion

The rapid growth of image acquisition technology is leading to a large amount of planetary remotely sensed images now available for astronomy research in both the professional and amateur domains. The use of such imagery for terrain and soil classification is instrumental to study the geologic evolution of moons and planets. This study focuses on lunar image classification to understand lunar mineralogy using images collected by the Clementine mission.

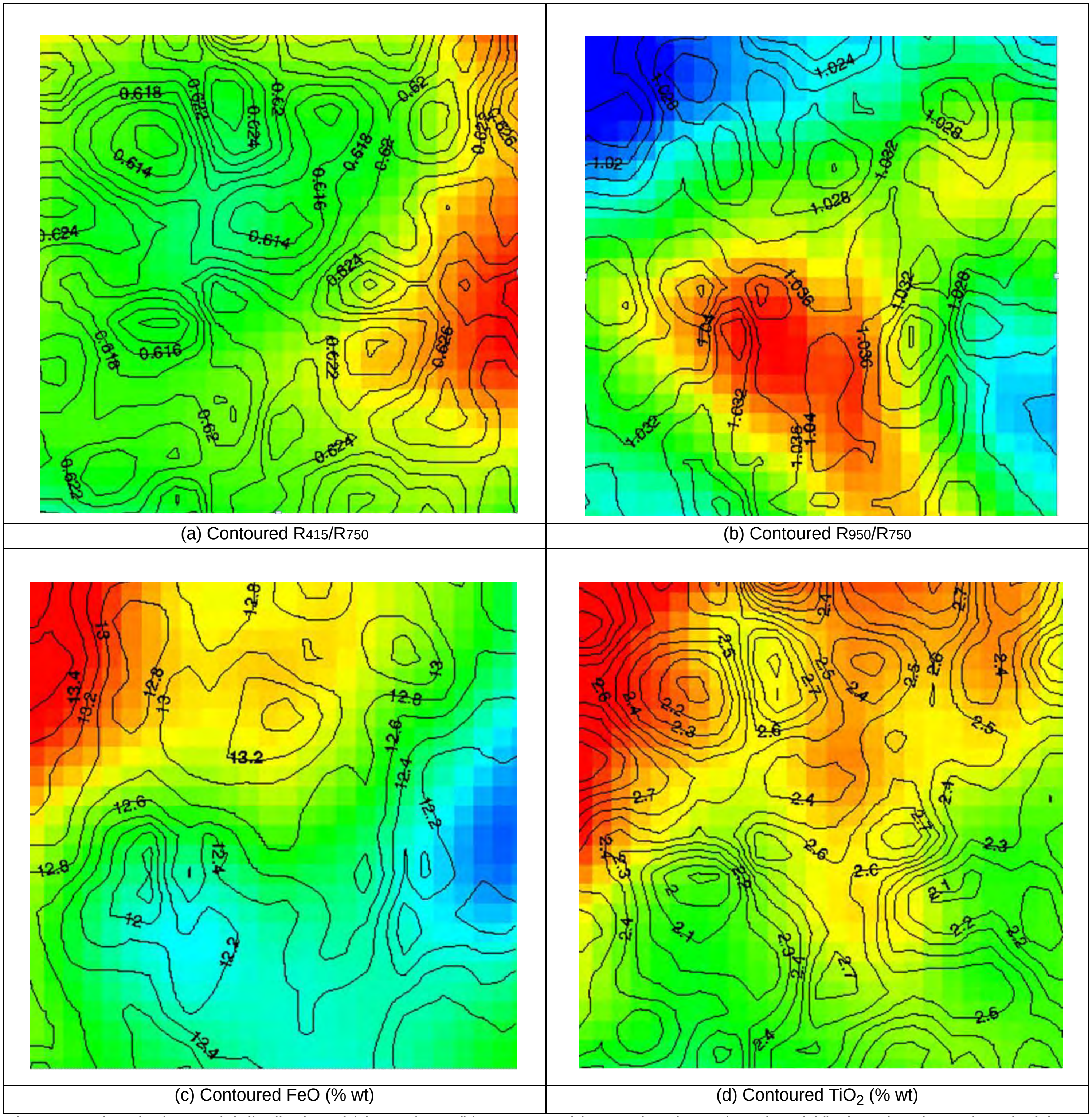
Lunar geologic classification is particularly challenging because the shapes and colors of each type of terrain depend on the spatial location, while the

Table 2. Comparative spectrometric results showing similar attributes between the dome structure under investigation in Euclides-J region and other domes as documented by Wohler and Lena (2014; Latest revision: April 25, 2011) (The nomenclature of Eucl Dm as Euclides-9 is given as a continuation in accordance with Kapral and Garfinkle, 2005.)

ID	long [°]	lat [°]	R_{415}/R_{750}	R_{950}/R_{750}	Name
Eucl Dm	**-28.90**	**-6.63**	**0.61**	**1.04**	**Euclides-9 (proposed name by this study)**
Effusive domes near Milichius/Tobias Mayer					
M1	-31.58	12.76	0.61	1.04	Tobias Mayer
M14	-32.13	12.76	0.61	1.04	Tobias Mayer
Candidate intrusive domes					
M13	-31.53	11.68	0.61	1.04	Milichius

brightness and shadow caused by the angle of sunlight can significantly change the appearance of lunar features.

Meanwhile, studies of lunar domes and related volcanic features continue to provide us with clues into the interior and evolution of the Moon as well as the composition of the lunar crust. The methodology presented in this study has the potential to provide new insight into the distribution of volcanic features, in



(a) Contoured R415/R750 | (b) Contoured R950/R750

(c) Contoured FeO (% wt) | (d) Contoured TiO_2 (% wt)

Figures 3 a thru d. The spatial distribution of (a) R415/R750 (b) R950/R750, (c) FeO abundance (% wt) and (d) TiO_2 abundance (% wt) of the subset AOI (see Photo 4). Color scheme used is dependent on each of the respective DN variations and is not normalized.

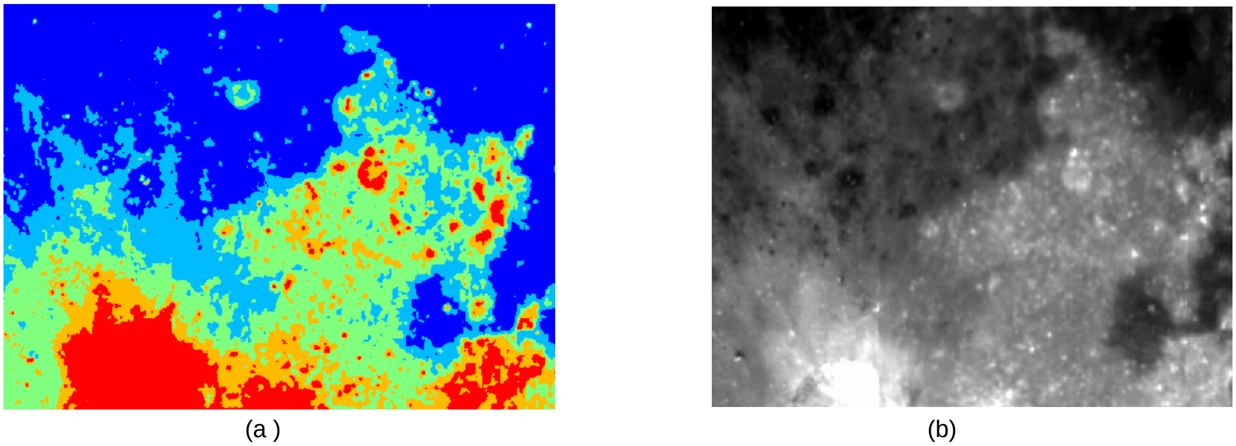


Figure 4 (a). Classified map of the AOI subset (boxed) based on R950 albedo. Figure 4 (b) Raw R950 albedo. The color scheme (digital version of this article) used for (a) is dependent on the classes identified based on each DN raw value.

otherwise overlooked regions of the lunar surface. Finding these small features using traditional terrestrial telescopic techniques, coupled with new online research tools such as LROC Act React Quick Map demonstrate the ability to amalgamate with the latest technological developments that bring within reach planetary information to whoever is interested to discover and further understand the lunar geological surface.

This study makes use of an automatic image classification system with the following conclusions.

1. This study is strongly suggestive of the presence of volcanic structures close to Euclides-J crater, and thus adds to the already identified similar features in the Euclides region, as reported by other lunar observers.

2. Present results place the basalt within the AOI subset in the low-Ti category (1-5 wt% TiO_2). Multispectral Clementine data indicate that the AOI subset has an Fe content between 12 and 14%wt. The low-Ti category points at relatively old basalts compared to more recent ones that tend to become progressively Ti-richer (i.e., from 2-3 to 4-5 wt% TiO_2).

3. The AOI subset is definitively within the 11.5-13.2% wt FeO which is geographically resides over the "***If=ejecta blanket***" soil type as defined by USGS (1965). This "***If"*** region is, in fact, made up of three classes in terms of FeO abundance, i.e., classes 2 to 5 (11.49-13.17; 13.17-14.41; 14.41-15.65 and 15.65-16.81 FeO % wt).

4. Spectrometrically, similar dome features have been observed by other investigators near the Milichus/ Tobias Mayer regions. These domes describe both effusive and intrusive volcanic processes.

5. In morphometric terms, a similar dome structure is observed from LROC data located on the floor of the crater Stevinus (32.760°S; 53.739°E) and is some 2.3 km in diameter. Using GLD100 data, the dome has a height of 103 m (NAC frame M113603383L). This dome exhibits similar relatively high FeO and TiO_2% abundance.

6. A possible classification for this feature would be *DW/1a/6h/8j*. The proposed name for this dome is Euclides-9.

7. Image classification detail is presented which is considered to be effective to discriminate between different classes of varying FeO abundance. This approach can be used to effectively map out other regions of the Moon.

8. This study presents higher resolution mapping of the lunar soil geology for the euclides region which is more spatially informative than the current mapping information available by USGS.

Acknowledgements

LROC images, topographic charts and 3D visualization reproduced by courtesy of the LROC Website, School of Earth and Space Exploration, Arizona State University at *http://lroc.sese.asu.edu/index.html*

Clementine Multispectral Images courtesy of the USGS PSD Imaging Node at: *http://www.mapaplanet.org/*

The Lunar and Planetary Institute Geologic Atlas of the Moon at:

http://astrogeology.usgs.gov/tools/map

U.S. Geological Survey; Department of the Interior/USGS

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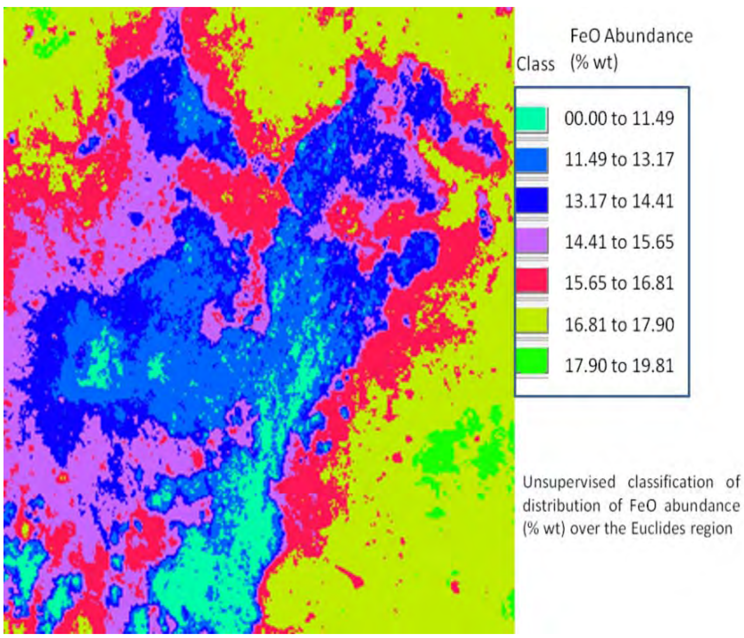

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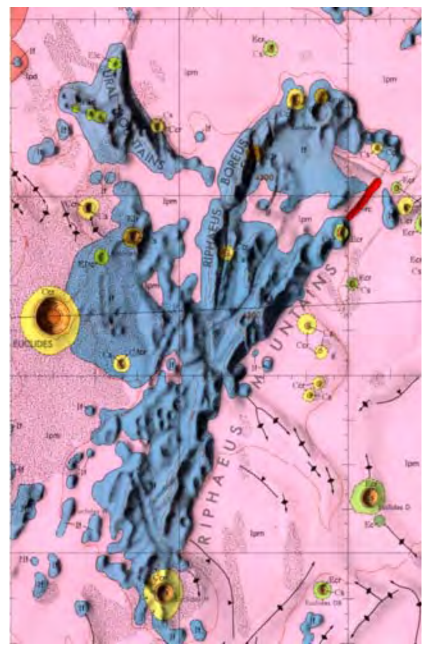

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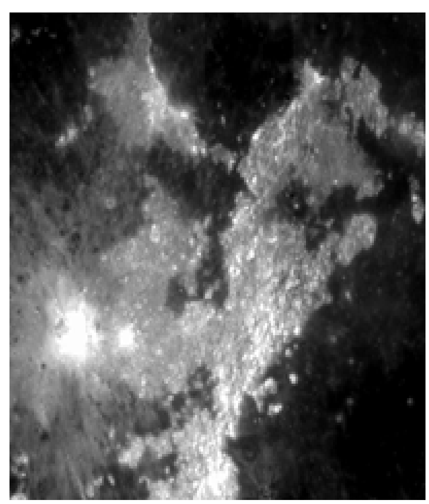

(c)

Figure 5a. Additional geological classes as detected by the Iterative Self-Organizing Data Analysis Technique (ISODATA) method. Insets (black outlines) show detection of additional categories compared to USGS (1965).

Figure 5b. Sub-sample of the lunar soil map published by USGS (1965)

Figure 5c. Grayscale albedo image derived from UVVIS Clementine mission (using the 950nm band) showing general albedo pattern over the Euclides region.

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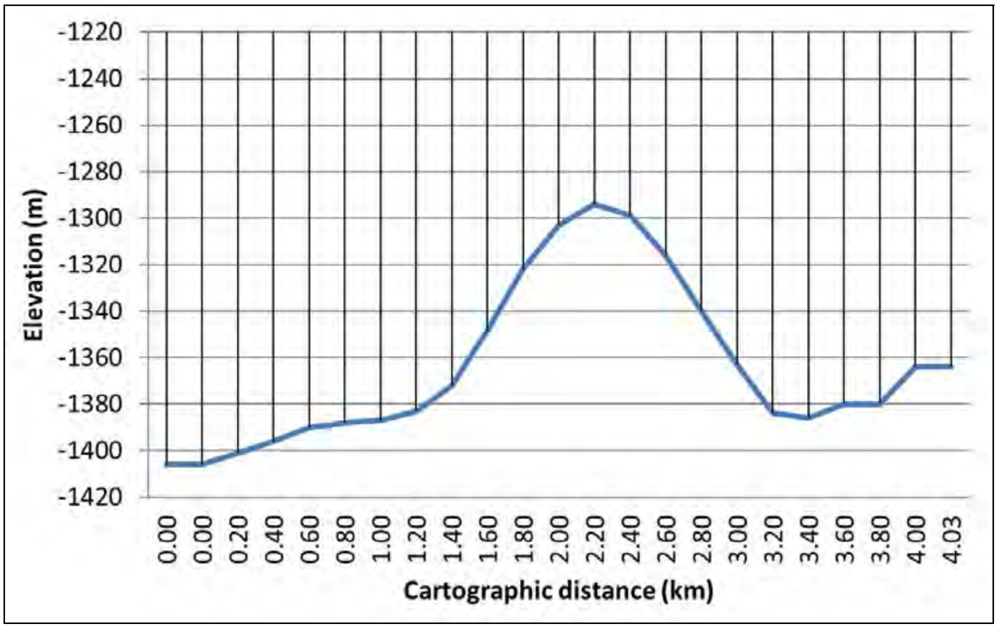

Figure 6. Cross section of the dome based on data derived from GLD100 data from LROC database.

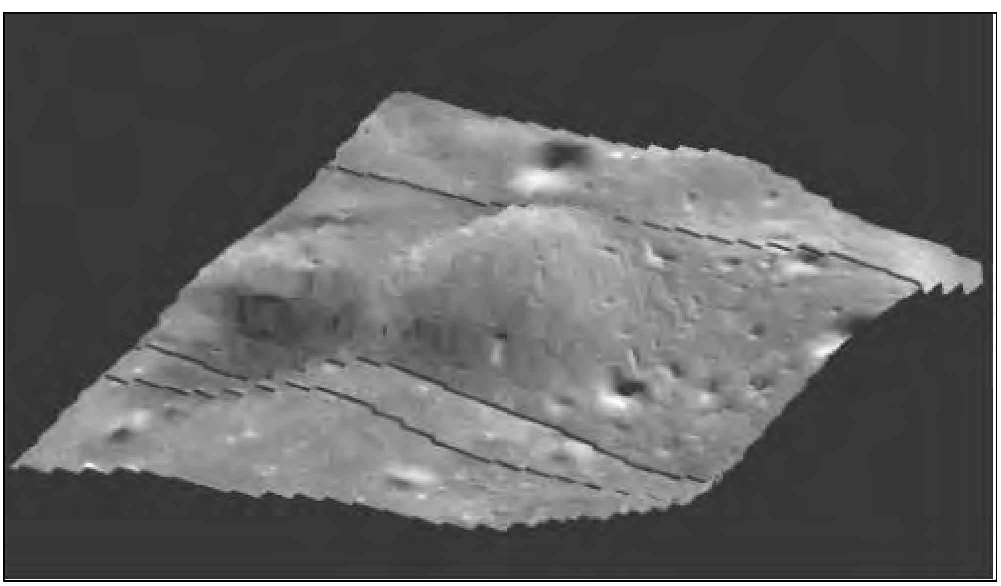

Figure 7. The dome-shaped structure found within the AOI subset has a diameter of 2 km and height of 112 m. Source: ACT-REACT.

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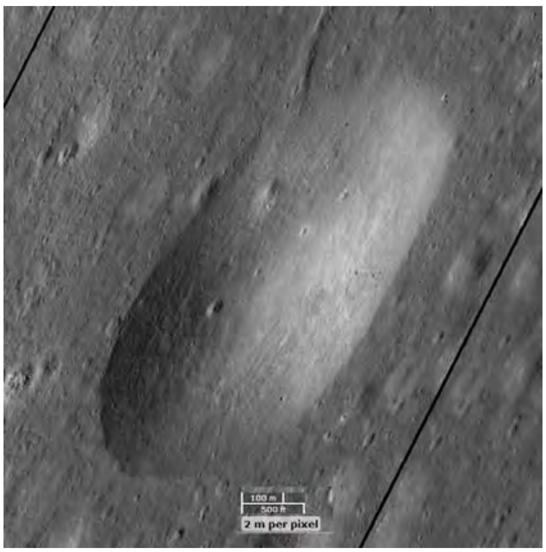
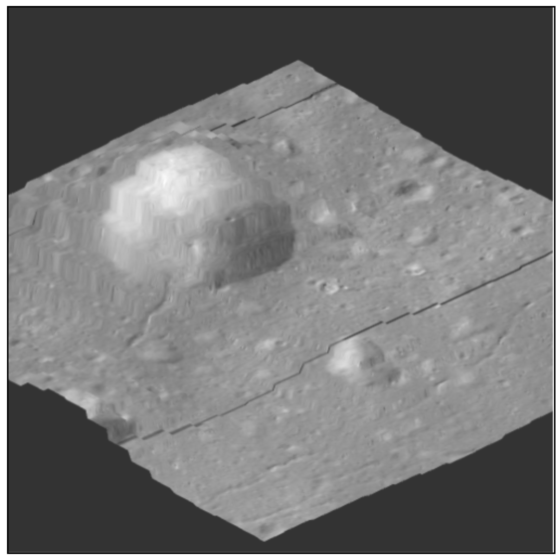


(a)



(b)

Figure 8 (a). A dome with similar morphometric structure is located on the floor of the crater Stevinus (32.760°S; 53.739°E), (b) 3D visualization. Source: ACT-REACT Quick Map.

Dr Charles Galdies teaches Earth Systems at the University of Malta. He has received his Ph.D. in Remote Sensing and GIS from Durham University (UK) in 2005. He studied ways to improve small-scale weather and ocean forecasting in the central Mediterranean region using novel remote sensing observations of the ocean and atmosphere. Having been inspired by Sagan's Cosmos TV series, Charles has been an avid amateur astronomer since childhood. He maintains his astronomy blog *http://znith-observatory.blogspot.com/* on which he documents his visual and digital observations made from his rooftop observatory which houses a C14 SCT.

ALPO Lunar Dome Observation Form

Submit electronically (attach images and scanned drawings to e-mail) to:
wayne.bailey@alpo-astronomy.org
or via regular mail to:
Wayne Bailey
17 Autumn Lane
Sewell, NJ 08080

Observers Name:	**Last:**					**First:**				
Date: (UD)	**Month:**			**Day:**				**Year:**		
Time: (UT)	**(UT) Hours:**					**(UT) Minutes:**				
Colongitude:										
Region Observed:										
Telescope:	**Size (Inches or Cm.):**					**Type:**				
Eyepieces Used:									**Filters:**	
Seeing (Circle)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Transparency:										
Type of Observation (list details):	**Visual:**					**Photographic:**				

Domes Observed (Positionss)

Xi	Eta	OR	Lunar Long.	Lunar Lat.

Notes: (**Include Observer Location (City, State, and Country) Here**; Use back if necessary):

Feature Story: ALPO Observations of Saturn During the 2011 - 2012 Apparition

By Julius L. Benton, Jr.,
Coordinator, ALPO Saturn Section
E-mail: jlbaina@msn.com

This paper includes a gallery of Saturn images submitted by a number of observers.

Please note that when a visual observer records or suspects a specific feature on Saturn, it is important to secure future observations quickly if we wish to obtain the period of rotation. For this purpose we encourage observers to use these facts: In System I (EZ plus NEB or SEB), 7 rotations are accomplished in close to 3 Earth-days, while in System II (rest of planet), 9 rotations require close to 4 such days.

A complete set of Saturn Observing Forms are available for downloading at *http://www.alpo-astronomy.org/publications/ALPO Section Publications/SaturnReportForms - All.pdf*

See the ALPO Resources Section, ALPO Observing Section Publications of this Journal for hardcopy availability.

Abstract

The ALPO Saturn Section received a cumulative total of 348 visual observations and digital images for the 2011-12 apparition for the period from November 12, 2011 through September 9, 2012. These observations were contributed by 41 observers located in Australia, Brazil, Canada, China, France, Germany, Greece, Japan, Philippines, Poland, Puerto Rico, Slovenia, Spain, United Kingdom, and United States. Instruments employed to carry out the observations ranged in aperture from 15.2 cm (6.0 in.) up to 45.0 cm (17.7 in.). Throughout the 2011-12 apparition observers regularly imaged the complex morphological remnants of the brilliant white storm in Saturn's North Tropical Zone (NTrZ) that emerged in December 2010, faded in overall prominence but still encircling the globe and occupying the region between Saturnigraphic latitude +35° and +45°. In addition, one or more recurring small white spots were imaged in the North North Temperate Zone (NNTeZ) largely between April 8,

Table 1: Geocentric Phenomena in Universal Time (UT) for Saturn During the 2011-2012 Apparition

Conjunction		2011	Oct	13^{d}
Opposition		2012	Apr	15^{d}
Conjunction		2012	Oct	25^{d}
Opposition Data				
Visual Magnitude		+0.2		
Constellation		Virgo		
B		+13.7°		
B'		+13.9°		
Globe	Equatorial Diameter	19.0"		
	Polar Diameter	16.9"		
Rings	Major Axis	44.0"		
	Minor Axis	10.2"		

All Readers

Your comments, questions, etc., about this report are appreciated. Please send them to: *ken.poshedly@alpo-astronomy.org* for publication in the next Journal.

Online Features

Left-click your mouse on:

• The author's e-mail address in blue text to contact the author of this article.
• The references in blue text to jump to source material or information about that source material (Internet connection must be ON).

Observing Scales

Standard ALPO Scale of Intensity:
0.0 = Completely black
10.0 = Very brightest features
Intermediate values are assigned along the scale to account for observed intensity of features
Ring B has been adopted (for most apparitions) as the standard on the numerical sequence. The outer third is the brightest part of Ring B, and it has been assigned a constant intensity of 8.0 in integrated light (no filter). All other features on the globe and in the rings are estimated using this standard of reference.

ALPO Scale of Seeing Conditions:
0 = Worst
10 = Perfect

Scale of Transparency Conditions:
Magnitude of the faintest star visible near Saturn when allowing for daylight and twilight

IAU directions are used in all instances (so that Saturn rotates from west to east).

Table 2: Contributing Observers, 2011-2012 Apparition of Saturn

	Observer	Location	No. of Observations	Telescopes Used
1.	Abel, Paul G.	Leichester, UK	7	20.3 cm (8.0 in.) NEW
2.	Akutsu, Tomio	Cebu City, Philippines	4	35.6 cm (14.0 in.) SCT
3.	Arditti, David	Middlesex, UK	2	35.6 cm (14.0 in.) SCT
4.	Barry, Trevor	Broken Hill, Australia	36	40.6 cm (16.0 in.) NEW
5.	Benton, Julius L.	Wilmington Island, GA	51	15.2 cm (6.0 in.) REF
6.	Borges, Fabricio	Cariaccia, Brazil	2	20.3 cm (8.0 in.) NEW
7.	Chang, Daniel	Hong Kong, China	8	23.5 cm (9.25 in.) SCT
8.	Chavez, Rolando	Powder Springs, GA	1	35.6 cm (14.0 in.) SCT
9.	Combs, Brian	Buena Vista, GA	6	35.6 cm (14.0 in.) SCT
10.	da Silva, Vlamir	San Paolo, Brazil	17	20.3 cm (8.0 in.) SCT
11.	Delcroix, Marc	Tournefeuille, France	7	25.4 cm (10.0 in.) SCT
12.	Falcon, Israel	Las Palmas, Canary Islands	1	28.0 cm (11.0 in.) SCT
13.	Go, Christopher	Cebu City, Philippines	9	28.0 cm (11.0 in.) SCT
14.	Grego, Peter	Cornwall, UK	1	20.3 cm (8.0 in.) SCT
15.	Hill, Rik	Tucson, AZ	5 1	20.3 cm (8.0 in.) MAK 35.6 cm (14.0 in.) SCT
16.	Ikemura, Toshihiko	Osaka, Japan	4	38.0 cm (15.0 in.) NEW
17.	Jaeschke, Wayne	West Chester, PA	7	35.6 cm (14.0 in.) SCT
18.	Jakiel, Richard	Douglasville, GA	4	30.5 cm (12.0 in.) SCT
19.	Kardasis, Manos	Athens, Greece	1	28.0 cm (11.0 in.) SCT
20.	Kinne, Richard	E. Somerville, MA	2	15.2 cm (6.0 in.) NEW
21.	Kowollik, Silvia	Ludwigsburg, Germany	1	20.3 cm (8.0 in.) NEW
22.	Malinski, Piotr	Warsaw, Poland	3	20.3 cm (8.0 in.) SCT
23.	Maxson, Paul	Phoenix, AZ	48	35.6 cm. (14.0 in.) SCT
24.	Melillo, Frank J.	Holtsville, NY	4	25.4 cm (10.0 in.) SCT
25.	Melka, Jim	St. Louis, MO	7	45.0 cm (17.7 in.) NEW
26.	Morales, Efrain	Aquadilla, Puerto Rico	3	30.5 cm (12.0 in.) SCT
27.	Niechoy, Detlev	Göttingen, Germany	17	20.3 cm (8.0 in.) SCT
28.	Parker, Donald C.	Coral Gables, FL	5	40.6 cm (16.0 in.) NEW
29.	Peach, Damian	Norfolk, UK	8	35.6 cm (14.0 in.) SCT
30.	Pellier, Christophe	Bruz, France	2	25.4 cm. (10.0 in.) NEW
31.	Phillips, Jim	Charleston, SC	2	25.4 cm (10.0 in.) REF
32.	Phillips, Michael A.	Swift Creek, NC	1	35.6 cm (14.0 in.) NEW
33.	Rosolina, Michael	Friars Hill, WV	1	35.6 cm (14.0 in.) SCT
34.	Roussell, Carl	Hamilton, ON, Canada	3	15.2 cm (6.0 in.) REF
35.	Sanchez, Jesus	Grand Canaria, Spain	2	23.5 cm (9.25 in.) SCT
36.	Sharp, Ian	West Sussex, UK	4	28.0 cm (11.0 in.) SCT
37.	Smrekar, Matic	Krim, Slovenia	1	25.4 cm (10.0 in.) NEW
38.	Sweetman, Michael E.	Tucson, AZ	14	15.2 cm (6.0 in.) MAK

Table 2: Contributing Observers, 2011-2012 Apparition of Saturn (Continued)

39.	Walker, Gary	Macon, GA	2	20.3 cm (10.0 in.) REF
40.	Wesley, Anthony	Murrumbateman, Australia	8	36.8 cm (14.5 in.) NEW
41.	Willems, Freddy	Waipahu, HI	36	35.6 cm (14.0 in.) SCT
	TOTAL OBSERVATIONS		348	
	TOTAL OBSERVERS		41	

Instrumentation Abbreviations:
NEW = Newtonian, SCT = Schmidt-Cassegrain, MAK= Maksutov-Cassegrain, REF = Refractor

2012 and July 23, 2012, and sporadic, ill-defined white ovals were imaged in the northern half of the Equatorial Zone (EZn). in the North Equatorial Belt Zone (NEBZ) and North Temperate Zone (NTeZ). Dark spots, generally referred to as "barges" by observers, were imaged in the North Temperate Belt (NTeB). ALPO observers continued to support our aggressive Pro-Am imaging campaign in various wavelengths, including routine valuable participation by visual observers, as we monitor activity on Saturn's globe and submit results to Cassini scientists. The inclination of Saturn's ring system toward Earth, ***B,*** *attained a maximum value of +15.1° on February 3, 2012, and therefore, more of the planet's Northern Hemisphere and North face of the rings were seen to advantage during 2011-12. A summary of visual observations and digital images of Saturn contributed during the apparition are discussed, including the results of continuing efforts to image the curious bi-colored aspect and azimuthal brightness asymmetries of the rings. Accompanying the report are references, drawings, photographs, digital images, graphs, and tables.*

Introduction

This report is derived from an analysis of 348 visual observations, descriptive notes, and digital images contributed to the ALPO Saturn Section by 41 observers from November 12, 2011 through September 9, 2012, referred to hereinafter as the 2011-12 "observing season" or apparition of Saturn. Examples of submitted drawings and images are included with this report, integrated as much as practicable with topics discussed in the text, with times and dates all given in Universal Time (UT).

Table 1 provides geocentric data in Universal Time (UT) for the 2011-12 apparition. The numerical value of B, or the Saturnicentric latitude of the Earth referred to the ring plane (+ when north), ranged between the extremes of +15.1° (February 3, 2012) and +12.5° (June 19, 2012). The value of B', the saturnicentric latitude of the Sun, varied from +11.9° (November 12, 2011) to +15.7° (September 8, 2012).

Table 2 lists the 41 individuals who submitted 348 reports to the ALPO Saturn Section this apparition, along with their observing sites, number of observations, telescope aperture, and type of instrument. *Figure 1* is a histogram showing the distribution of observations by month, where it can be seen that 41.1% were made prior to opposition, 0.9% at opposition (April 15, 2012), and 58.0% thereafter. Although there usually is a tendency for observers to view Saturn more frequently around the date of opposition when the planet is well-placed high in the evening sky, coverage favored a wider span of time around opposition during the 2011-12 apparition (92.8% of all observations took place from early January through late July 2012). As always, to get the best overall coverage, observers are encouraged to start viewing and imaging Saturn as soon as the planet becomes visible in the eastern sky before sunrise right after conjunction. Our goal is to carry out consistent observational surveillance of the planet for as much of its mean synodic period of 378^d as possible (this period refers to the elapsed time from one conjunction of Saturn with the Sun to the next, which is slightly longer than a terrestrial year).

Figure 2 and *Figure 3* show the ALPO Saturn Section observer base and the international distribution of all observations submitted during the apparition. The United States accounted for 41.5% of the participating observers and 56.6% of the submitted observations. With 58.5% of all observers residing in Australia, Brazil, Canada, China, France, Germany, Greece, Japan, Philippines, Poland, Puerto Rico, Slovenia, Spain, and the United Kingdom, whose total contributions represented 43.4% of the observations, international cooperation remained strong this observing season.

Figure 4 graphs the number of observations this apparition by instrument type. Roughly two-fifths (38.5%) of all observations were made with telescopes of classical design (refractors and Newtonians). Classical designs with superb optics and precise collimation frequently produce high-resolution images with excellent contrast, perhaps the reason why they have often been the instruments of choice for visual studies of the Moon and planets. In recent apparitions, however, since a variety of adapters have become readily available to attach digital imagers to them, employment of comparatively compact and portable Schmidt-Cassegrains and Maksutov-Cassegrains has been growing. It has been established repeatedly that such instruments outfitted with quality well-collimated optics produce very fine images of Saturn.

Telescopes with apertures of 15.2 cm (6.0 in.) through 45.0 cm (17.7 in.) were used for all of the observations contributed this apparition. Readers are reminded, however, that there are many historical examples where smaller instruments of good quality have been successfully utilized for quite a few of our Saturn observing programs.

The ALPO Saturn Section greatly appreciates all of the descriptive reports, digital images, visual drawings, and supporting data submitted by the observers listed in *Table 2* for the 2011-12 apparition. Without such dedicated observers, this report would have been impossible. Those aspiring to join us in our numerous Saturn observing programs using visual methods (e.g., drawings, intensity and latitude estimates, CM transit timings) as well as digital imaging techniques are encouraged to do so in upcoming observing seasons as we strive to maintain the international flavor of our endeavors. All methods of recording observations are crucial to the success of our programs, whether there is a preference for sketching Saturn at the eyepiece or simply writing descriptive reports, making visual numerical relative intensity or latitude estimates, or pursuing routine digital imaging. It should be noted that, in recent years, too few experienced observers are making routine visual numerical relative intensity estimates, which are desperately needed for maintaining data that allow for a continued comparative analysis of belt, zone, and ring component brightness fluctuations over many apparitions. The Saturn Section, therefore, appeals to observers to set aside a few minutes while at the telescope to record intensity estimates (visual photometry) in integrated light and with standard color filters. The ALPO Saturn Section is always pleased to receive observations from novices, and the author will be delighted to offer assistance as one becomes acquainted with our programs.

The Globe of Saturn

The 348 observations submitted to the ALPO Saturn Section during 2011-12

Figure 1

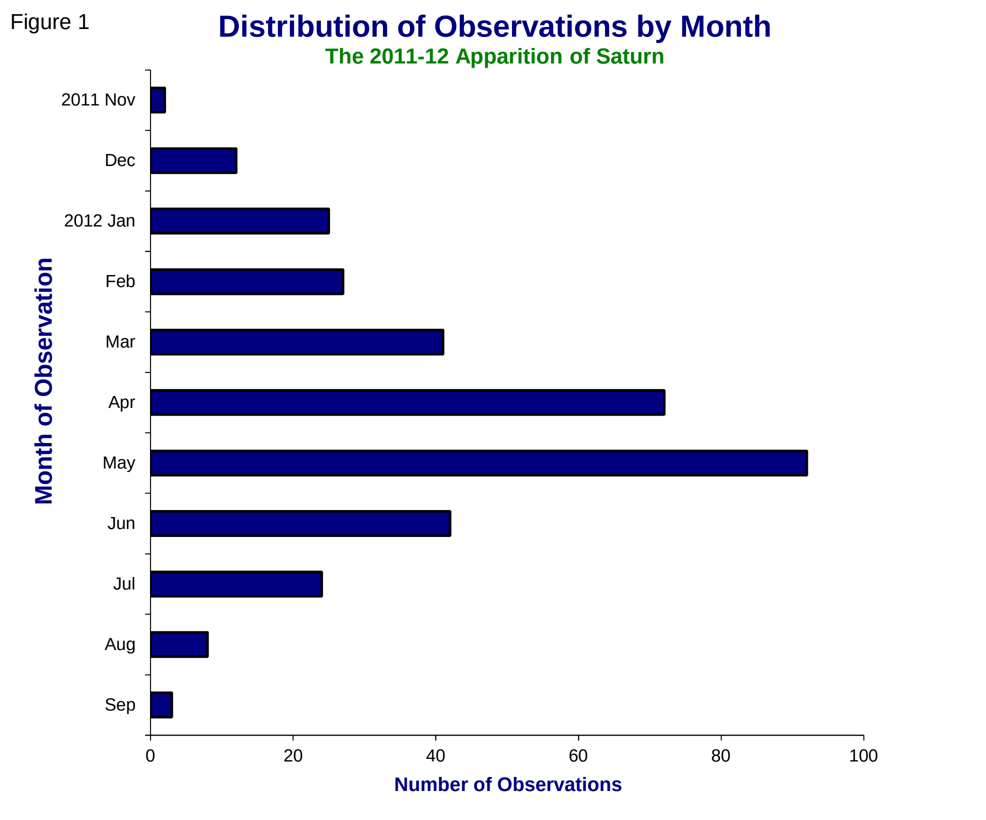


Figure 2

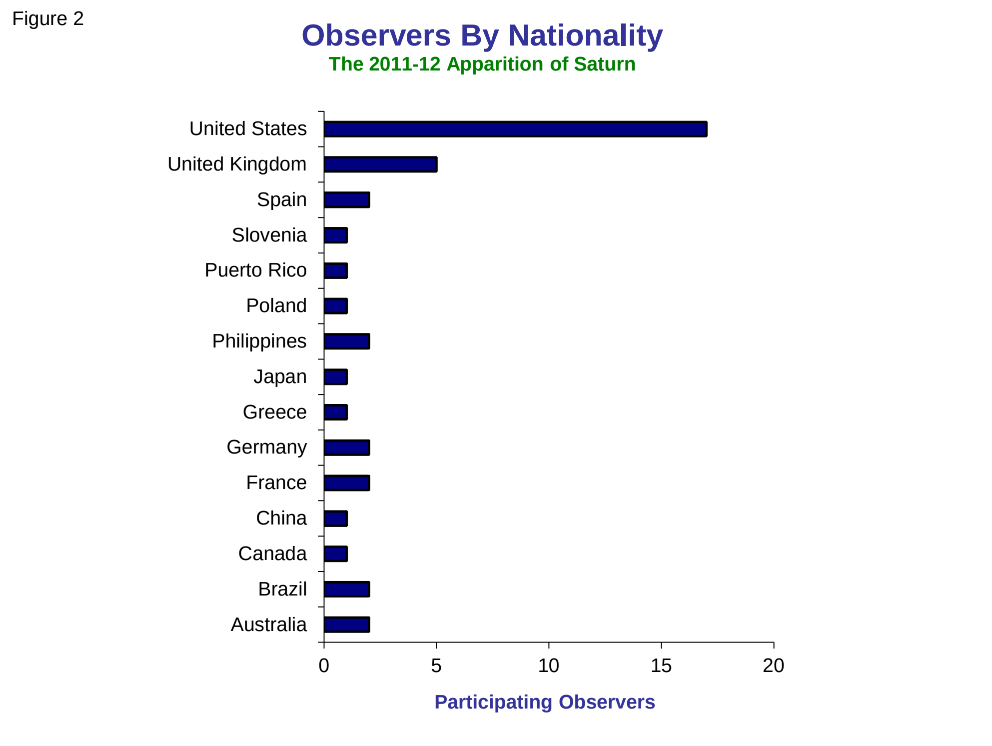


Table 3: Visual Numerical Relative Intensity Estimates and Colors for the 2011-12 Apparition of Saturn

Globe/Ring Feature	# Estimates	2011-12 Mean Intensity & Standard Error	Intensity Difference Since 2010-11	Mean Derived Color
Zones				
SPR	6	4.50 ± 0.09	+2.30	Dull Gray
STrZ	5	7.02 ± 0.18	+1.90	Light Yellowish-White
EZn	21	7.77 ± 0.11	+0.60	Bright Yellowish-White
NEBZ	4	4.98 ± 0.19	-----	Yellowish-Gray
NTrZ	11	6.53 ± 0.13	-0.50	Bright Yellowish-White
NTeZ	7	6.21 ± 0.22	+0.50	Yellowish-White
NPR	21	2.67 ± 0.27	+0.20	Dark Gray
Belts				
Globe S of Rings	13	5.62 ± 0.13	+0.20	Light Yellowish-Gray
SEBs	6	3.98 ± 0.18	-0.10	Grayish-Brown
NEBw (whole)	15	4.07 ± 0.10	+0.40	Dull Yellowish-Brown
NEBs	6	3.25 ± 0.24	-----	Dark Grayish-Brown
NEBn	6	2.73 ± 0.15	-----	Dark Grayish-Brown
NTeB	5	4.42 ± 0.23	-0.10	Light Grayish-Brown
Globe N of Rings	12	5.42 ± 0.10	+0.3	Yellowish-Gray
Rings				
A (whole)	20	5.34 ± 0.18	-1.20	Grayish-White
A0 or B10	6	0.00 ± 0.00	0.00	Black
B (outer 1/3)	21	8.00 ± 0.00 **STD**	0.00	Brilliant White
B (inner 2/3)	21	6.20 ± 0.09	-1.30	Yellowish-White
Ring C (ansae)	9	1.12 ± 0.18	-1.50	Very Dark Gray
Crape Band	2	3.00 ± 0.00	-----	Dull Gray
Sh G or R	2	0.00 ± 0.00	0.00	Black shadow

Notes:
For nomenclature see text and Figure 5. A letter with a digit (e.g. A0 or B10) refers to a location in the ring specified in terms of units of tenths of the distance from the inner edge to the outer edge. Visual numerical relative intensity estimates (visual surface photometry) are based upon the ALPO Intensity Scale, where 0.0 denotes complete black (shadow) and 10.0 refers to the most brilliant condition (very brightest Solar System objects). The adopted scale for Saturn uses a reference standard of 8.0 for the outer third of Ring B, which appears to remain stable in intensity for most ring inclinations. All other features on the Globe or in the rings are compared systematically using this scale, described in the Saturn Handbook, which is issued by the ALPO Saturn Section. The "Intensity Difference Since 2010-11" is in the same sense of the 2010-11 value subtracted from the 2011-12 value, "+" denoting an increase (brightening) and "" indicating a decrease (darkening). When the apparent change is less than about 3 times the standard error, it is probably not statistically significant.

were used to prepare this report. Drawings, digital images, tables, and graphs are included so readers can refer to them as they study the content of this report. For drawings or images utilized as examples of the more notable features or phenomena occurring within Saturn's belts and zones, contributors are identified in the text along with dates and times of those specific observations for easy reference back to the relevant tables that list instrumentation employed, seeing, transparency, CM data, and so forth. In addition, captions associated with illustrations provide useful information.

With the numerical value of B (the Saturnicentric latitude of the Earth referred to the ring plane) attaining a maximum value of +15.1° during 2011-

12, opportunities for studying regions of the planet's northern hemisphere (e.g., NEB, NTrZ, NTeZ, NPR, and NPC) have steadily improved each observing season now that the Earth is north of the rings as they increase their tilt toward our line of sight. Most of the features of the southern hemisphere are increasing hidden from view by the rings as they cross in front of the globe, so the inclination of the rings during 2011-12 was such that only a few features south of the rings, such as the STrZ and SPR, could be seen.

Small fluctuations in intensity of Saturn's atmospheric features (see *Table 3*) may simply be due to the varying inclination of the planet's rotational axis relative to the Earth and Sun, although photometric work in past years has shown that tiny oscillations of roughly 0.10 in the visual magnitude of Saturn likely happens over the span of a decade or so. Transient and longer-lasting atmospheric features seen or imaged in various belts and zones on the globe may also play a role in what appear to be subtle brightness variations. Regular photoelectric photometry of Saturn, in conjunction with carefully-executed visual numerical relative intensity estimates, is strongly encouraged.

The intensity scale routinely employed by Saturn observers is the standard *ALPO Standard Numerical Relative Intensity Scale*, where 0.0 denotes a total black condition (e.g., complete black shadow) and 10.0 is the maximum brightness of a feature or phenomenon (e.g., an unusually bright EZ or dazzling white spot). This numerical scale is normalized by setting the outer third of Ring B at a "standard" intensity of 8.0. The arithmetic sign of an intensity change is determined by subtracting a feature's 2010-11 intensity from its 2011-12 value. Suspected variances of 0.10 mean intensity points are usually insignificant, while reported changes in intensity that do not equal or exceed roughly three times the standard error are probably not important.

It is important to evaluate digital images of Saturn contributed by ALPO observers using different apertures and filter techniques. Our goal is to understand the level of detail seen and how it compares with visual impressions of the globe and rings, including any correlation with spacecraft imaging and results from professional observatories. So, in addition to routine visual studies, such as drawings and visual numerical relative intensity estimates, Saturn observers

Figure 3

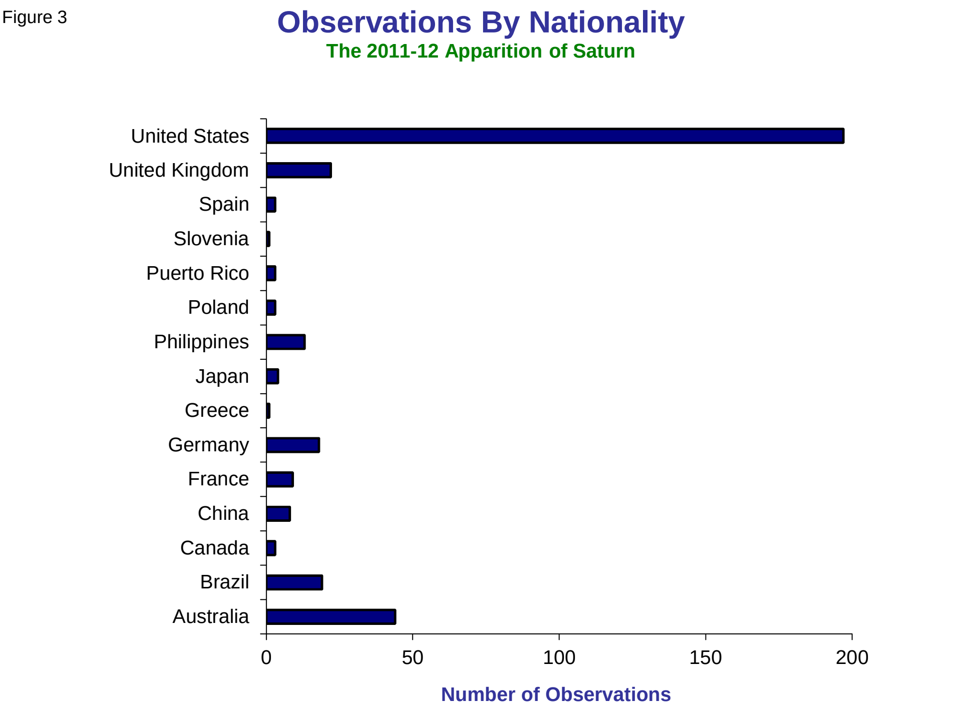
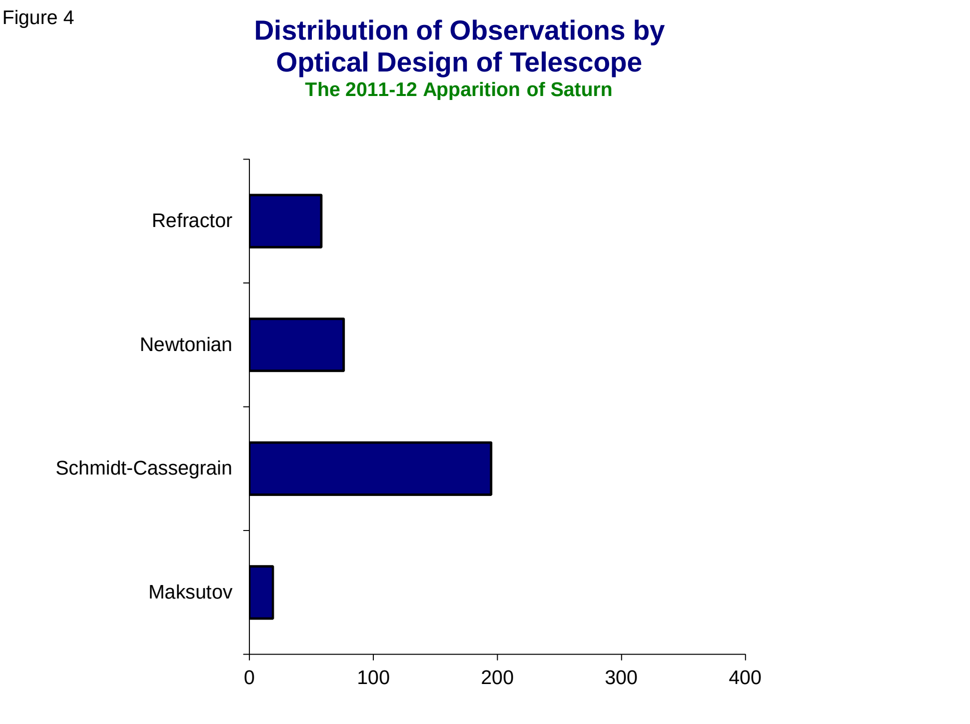


Figure 4



should systematically image the planet every possible clear night to try to document individual features on the globe and in the rings, their motion and morphology (including changes in intensity and hue), to serve as comparative input with images taken by professional ground-based observatories and spacecraft monitoring Saturn at close range. Furthermore, comparing images taken over several apparitions for a given hemisphere of the planet's globe provides information on long-term seasonal changes suspected by observers using visual numerical relative intensity estimates. Images and systematic visual observations by amateurs are being relied upon for providing initial alerts of interesting large-scale features on Saturn that professionals may not already know about but can subsequently examine with considerably larger and more specialized instrumentation.

Particles in Saturn's atmosphere reflect different wavelengths of light in very distinct ways, which causes some belts and zones to appear especially prominent, while others look very dark, so imaging the planet with a series of color filters may help shed light on the dynamics, structure, and composition of its atmosphere. In the UV and IR regions of the electromagnetic spectrum, it is possible to determine additional properties as well as the sizes of aerosols present in different atmospheric layers not otherwise accessible at visual wavelengths, as well as useful data about the cloud-covered satellite Titan. UV wavelengths shorter than 320nm are effectively blocked by the Earth's stratospheric ozone (O_3), while CO_2 and H_2O-vapor molecules absorb in the IR region beyond 727nm. The human eye is insensitive to UV light short of 320nm and can detect only about 1.0% at 690nm and 0.01% at 750nm in the IR (beyond 750nm visual sensitivity is essentially zero). Although most of the reflected light from Saturn reaching terrestrial observers is in the form of visible light, some UV and IR wavelengths that lie on either side and in close proximity to the visual region

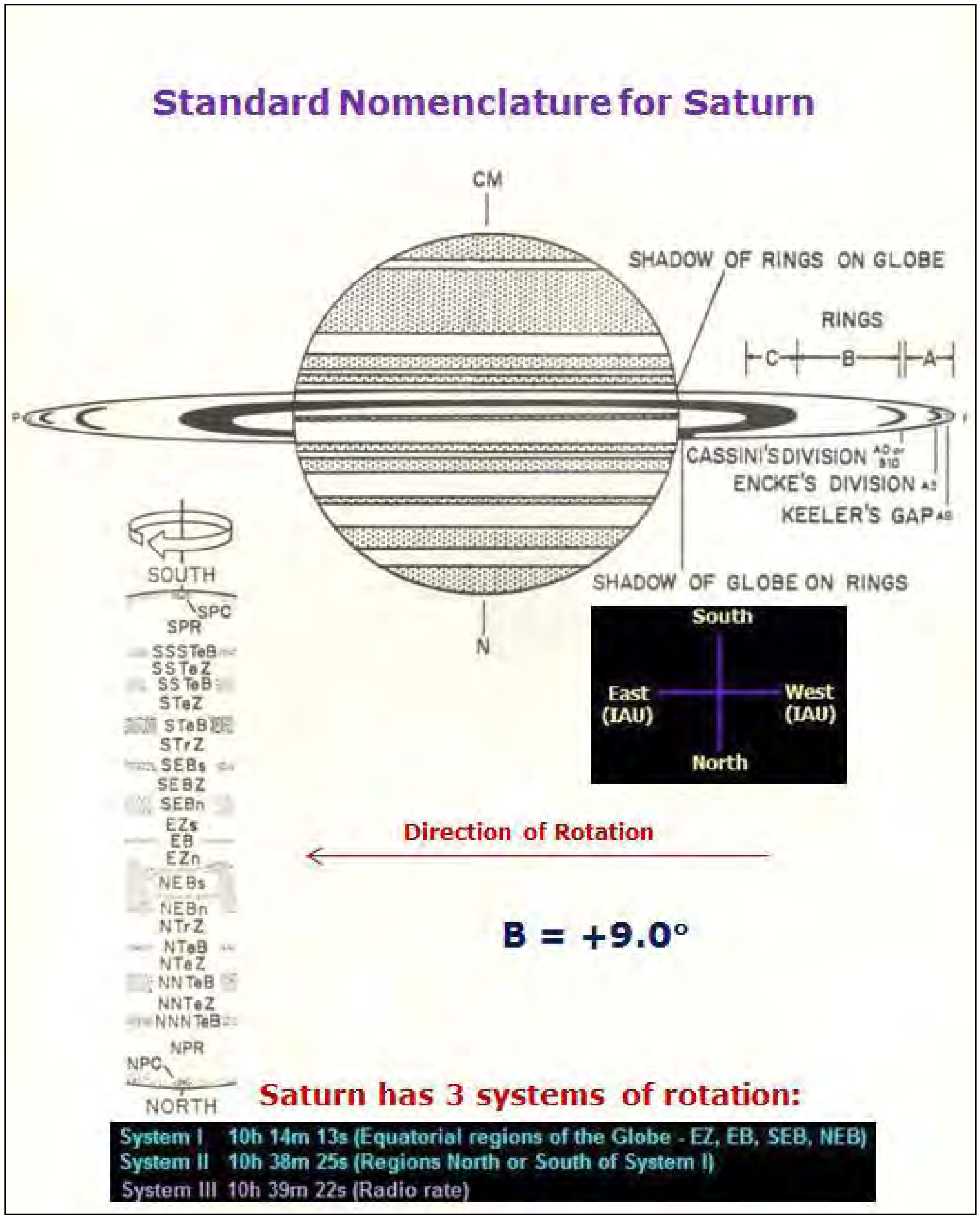


Figure 5. Saturn nomenclature, where A = Ring A, B = Band or Ring B or saturnicentric latitude of Earth, C = Ring C or Cap, E = Equatorial, f = following (celestial east), G = Globe, n = north component, N = North, p = preceding (celestial west), P = Polar, R = Ring(s) or Region, s = south component, S = South, Te = Temperate, Tr = Tropical, Z = Zone. The ring Ansae (not labeled) are the easternmost and westernmost protrusions of the Ring System. Note that "Gap" is also called "Division" or "Complex." South is at the top in this inverted view, similar to the orientation seen through an inverting telescope in Earth's Northern Hemisphere.

penetrate to the Earth's surface, and imaging Saturn in these near-IR and near-UV bands has provided some remarkable results in the past. The effects of absorption and scattering of light by the planet's atmospheric gases and clouds at various heights and with different thicknesses are often evident. Indeed, such images sometimes show differential light absorption by particles with dissimilar hues intermixed with Saturn's white NH_3 clouds.

In the forthcoming paragraphs, our discussion of features on Saturn's globe will proceed in the usual south-to-north order (traditional astronomical inverted and reversed view). For clarity, the relative positions of major belts and zones can be identified by referring to the nomenclature diagram shown in *Figure 5*. If no reference is made to a global feature in this report, the area was not reported by observers during the 2011-12 apparition. It has been customary in past Saturn apparition reports to compare the brightness and morphology of atmospheric features between observing seasons, and this practice continues as much as possible so readers are aware of very subtle, but nonetheless recognizable, variations that may be occurring seasonally on the planet.

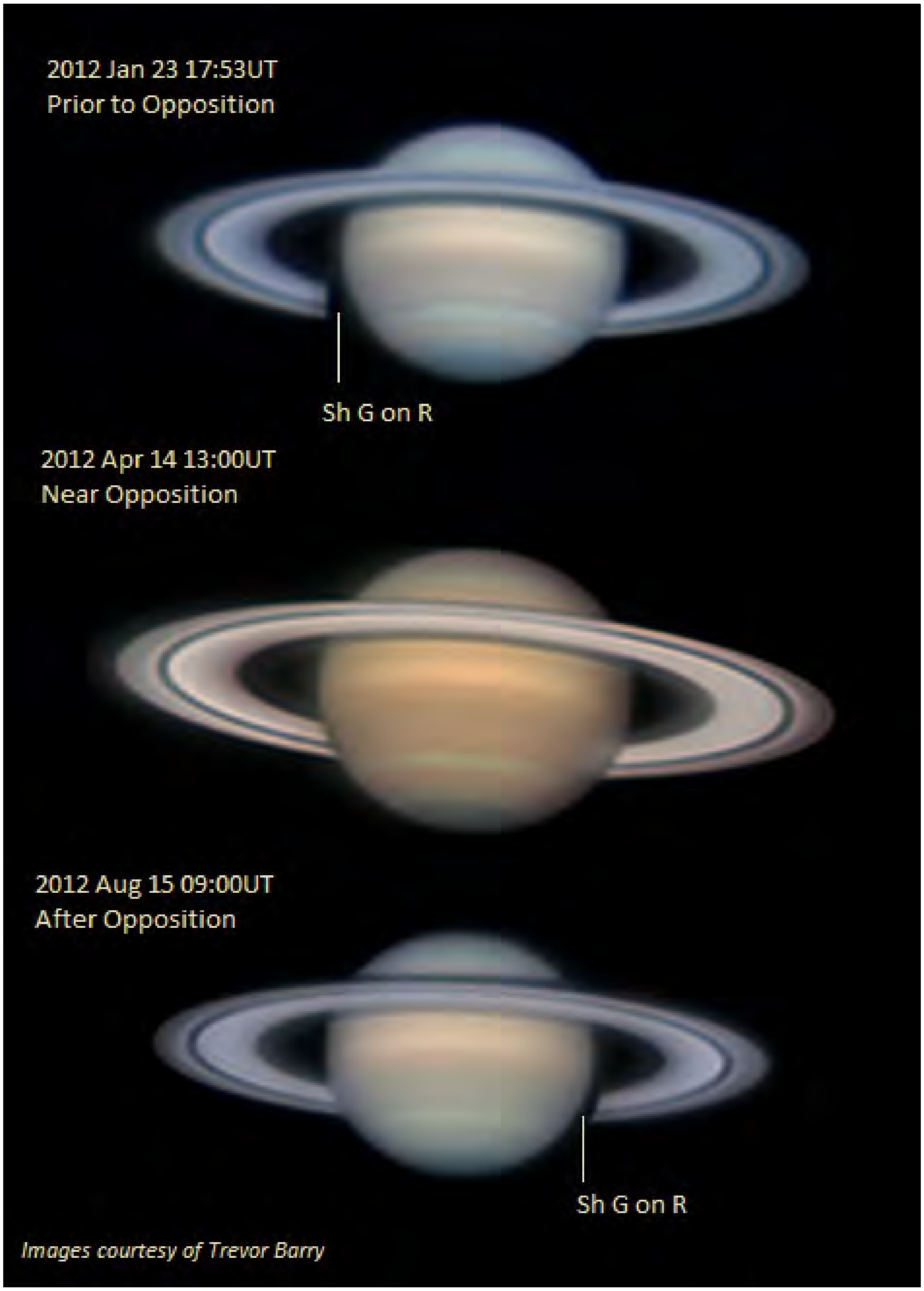


Figure 6. Three images digital images furnished by Christopher Go showing the position of the shadow of the globe on Saturn's rings on March 05, 2011 at 17:17 UT (before opposition), April 04, 2011 15:40 UT (at opposition), and May 21, 2011 at 12:41 UT (after opposition).

South Polar Region (SPR). Visual numerical relative intensity estimates submitted during the 2011-12 apparition suggested that the dull gray SPR may have been brighter since 2010-11 (increase in mean visual intensity of +2.30), but due to the increased tilt of the southern polar region away from our line of sight during 2011-12, only extreme peripheral areas of the SPR were observable. The South Polar Cap (SPC) was hidden from our view this apparition. No drawings by visual observers or digital images revealed any discrete activity in the SPR during the apparition. The normally dark gray South Polar Belt (SPB) encircling the SPR was not reported by visual observers during the apparition nor was it readily apparent on digital images received.

South South Temperate Zone (SSTeZ). The SSTeZ was not reported by visual observers during this observing season, thus no visual numerical relative intensity estimates were contributed. The SSTeZ was also very hard to discern on any digital images submitted in 2011-12.

South South Temperate Belt (SSTeB). The SSTeB, typically light gray in appearance, was not described by visual observers during 2011-12 and only marginally detectable in a few high-resolution digital images.

South Temperate Zone (STeZ). The often yellowish-white STeZ was not reported by visual observers making visual numerical relative intensity estimates in 2011-12, but it was sometimes noticeable on a few digital images submitted, showing a rather uniform intensity across the globe of Saturn with no reported activity [refer to Illustration No. 001].

South Temperate Belt (STeB). Despite the appearance of a light grayish-brown STeB on many of the images submitted during 2011-12, visual observers did not call attention to this feature or make visual numerical relative intensity estimates during the apparition. High-resolution digital images showed this dusky feature during the apparition as devoid of discrete activity [refer to Illustration No. 002].

General Caption Note for Illustrations 1-38. *B = saturnicentric latitude of the Earth; B' = saturnicentric latitude of the Sun; CMI, CMII and CMIII = central meridians in longitude Systems I, II and III; IL = integrated light; S = Seeing on the Standard ALPO Scale (from 0 = worst to 10 = perfect); Tr = Transparency (the limiting naked-eye stellar magnitude). Telescope types as in Table 2; feature abbreviations are as in Figure 5. In all figures, south is at the top and IAU east is to the left.*

Illustration 001. 2012 April 09 1430UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW with RGB filters. S = not specified, Tr = not specified. CMI = 211.3°, CMII = 38.5°, CMIII = 326.8°, B = +13.9°, B´ = +13.9°. STeZ is captured revealed South of the rings.

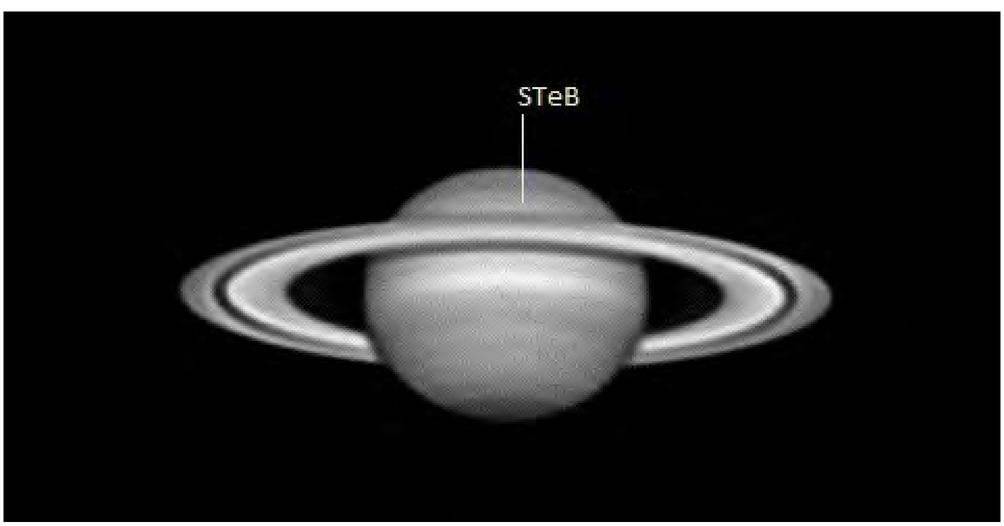


Illustration 002. 2012 April 13 04:34UT. Digital image by Gary Walker. 20.3 cm (10.0 in.) REF with Red filter. S = 5 Tr = variable. CMI = 359.3°, CMII = 70.7°, CMIII = 354.7°, B = +13.8°, B´ = +14.0°. Narrow STeB is just recognizable South of the rings as they cross the globe.

South Tropical Zone (STrZ). Visual observers described a light yellowish-white STrZ during the 2011-12, with limited visual numerical relative intensity estimates that suggested a possible brightening of this feature by +1.90 in mean intensity since the immediately preceding apparition. The STrZ was also fairly prominent on several digital images contributed during the observing season, seen just beyond the south edge of where the rings crossed the globe of Saturn. No activity was reported in this zone this apparition [refer to Illustration No. 003].

South Equatorial Belt (SEB). In studying submitted observations of Saturn during 2011-12, what visual observers were occasionally reporting as the SEB was just the SEBs, since where the rings crossed in front of the globe the SEBn was hidden from our view, coupled with the projected shadow of the rings on the globe adding complications after mid-April 2012. Furthermore, the grayish-brown SEBs was equally difficult to distinguish on digital images also because of the presence of the rings crossing the globe and the aforementioned projected ring shadow. Nevertheless, a few visual observers provided visual numerical relative intensity estimates of the feature they believed to be the SEBs, whereby little change in mean intensity since 2010-11 was derived (negligible intensity difference of only -0.1) [refer to Illustration No. 004].

Equatorial Zone (EZ). With the numerical value of **B** ranging between the extremes of +12.5° and +15.1° this apparition, it was the northern half of the Equatorial Zone (EZn) that could be seen and imaged to advantage. Based on intensity estimates and digital imaging, the bright yellowish-white Equatorial Zone (EZn) was slightly brighter by +0.6 mean intensity points since 2010-11 and easily the brightest zone on Saturn's globe in 2011-12 [refer to Illustration No. 005]. On April 21, 2012 at

23:26UT Damian Peach submitted a detailed RGB image of a bright elongated white spot within the EZn approaching the CM [refer to Illustration No. 006]. Subsequent images of the same or similar features in the EZn were imaged on three occasions by Trevor Barry at red wavelengths, the first on July 15, 2012 at 08:54UT, the second on July 19, 2012 at 09:10UT, and the last one at 08:58UT on August 15, 2012 [refer to Illustrations No. 007 thru 009]. The features in all three images were very faint, somewhat diffuse, and difficult to discern. There were no specific reports of white spot activity in the EZn during the observing season by visual observers, although the impression was that the EZn appeared slightly more prominent after opposition (both visually and on digital images), presumably due to the aforementioned white features. Visual numerical relative intensity estimates of the very narrow Equatorial Band (EB) were lacking during 2011-12, but it was apparent on several drawings in integrated light and quite obvious on several digital images submitted during the observing season. [refer to Illustration No. 010].

Illustration 003. 2012 April 27 212:40UT. Digital image by Piotr Malinski. 20.3 cm (10.0 in.) SCT with RGB filters S and Tr not specified. CMI = 182.0°, CMII = 138.2°, CMIII = 44.5°, B = +13.4°, B´ = +14.2°. Light yellowish-white STrZ is visible South of where the rings cross the globe.

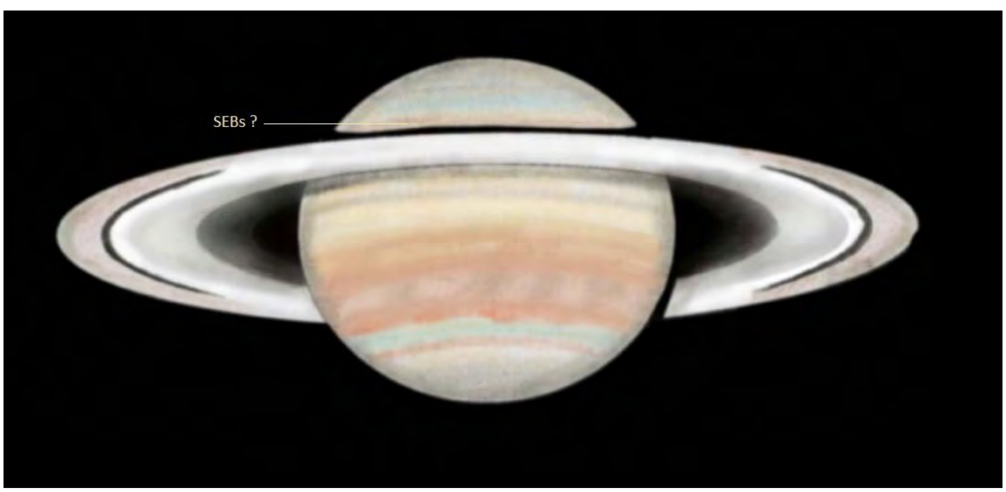


Illustration 004. 2012 May 12 23:46UT Excellent detailed drawing by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 6.0 (interpolated), Tr = not specified. CMI = 321.0°, CMII = 149.9°, CMIII = 37.9°, B = +13.0°, B´ = +14.4°. The dull SEBs is barely visible on the disk of Saturn just south of the rings. Note remnants of the NTrZ storm that occurred in 2010-11 as well as other details in Saturn's northern hemisphere.

North Equatorial Belt (NEB). The rather broad and dull yellowish-brown NEB considered as a whole feature was frequently reported by visual observers and imaged regularly much of the 2011-12 apparition. While the overwhelming consensus visually was that the NEB appeared singular during much the observing season, it usually displayed a steady lighter-to-darker northward gradation in intensity across its fairly broad width, consistent with its form on most digital images. Nevertheless, a few visual observers in 2011-12 described the NEB as being differentiated into the NEBs and NEBn with the lighter NEBZ situated in between, also occasionally obvious on digital images. Accompanying descriptive reports and visual numerical relative intensity estimates revealed that the NEBn was -0.5 darker than the NEBs, with a faintly detectable yellowish-gray NEBZ separating them. Activity in the NEB was infrequently seen during the apparition by a few visual observers. For example, consider a drawing showing subtle phenomena such as dark irregular areas in the NEBn and lighter splotches in the NEBZ made in good seeing by Paul G. Abel on May 12, 2012 at 23:46UT [refer to Illustration No. 011].

North Tropical Zone (NTrZ). Visual observers described a bright yellowish-white NTrZ that seemed slightly dimmer in 2011-12 by a factor of -0.5 in mean intensity since the immediately preceding apparition and it was quite apparent on images captured in good seeing conditions throughout the observing season.

To digress briefly, observers will recall the sudden appearance of the brilliant white spot in the NTrZ last apparition detected initially on December 5, 2010 by the radio and plasma wave instrument aboard *Cassini* as a Saturn Electrostatic Discharge (SED) caused by atmospheric lightning flashes. At the request of the *Cassini* team, amateur astronomers worldwide started contributing images, the first arriving five days later on December 10, 2010, followed by myriad images almost daily from ALPO and other observers worldwide. These images helped *Cassini* scientists track the storm as it developed over time between Saturnigraphic latitude +35° and +45°. For instance, the bright white storm first emerged at Saturnigraphic latitude +35°, spanning 1,300km (800mi) North to South in latitude and 2,500km (1,600mi) East to West in longitude, showing rapid growth with obvious morphological changes over the next several months. By December 24, 2010, the storm had widened by 10,000km (6000mi) and extended nearly a third of the way around the globe, a distance of 100,000km (62,000mi) longitudinally. Then by early February 2011, it had enlarged in latitudinal extent to some 15,000km (9,000mi) at about +43° and the feature's "tail" had longitudinally encircled the entire planet! Thereafter, and for the remainder of the 2010-11 apparition, a steady flood of excellent amateur images, combined with *Cassini* results, confirmed that the massive NTrZ storm had evolved significantly in morphological complexity analogous to features so common on Jupiter. Also, imaging at different wavelengths helped illustrate corresponding variability in the appearance of the NTrZ storm.

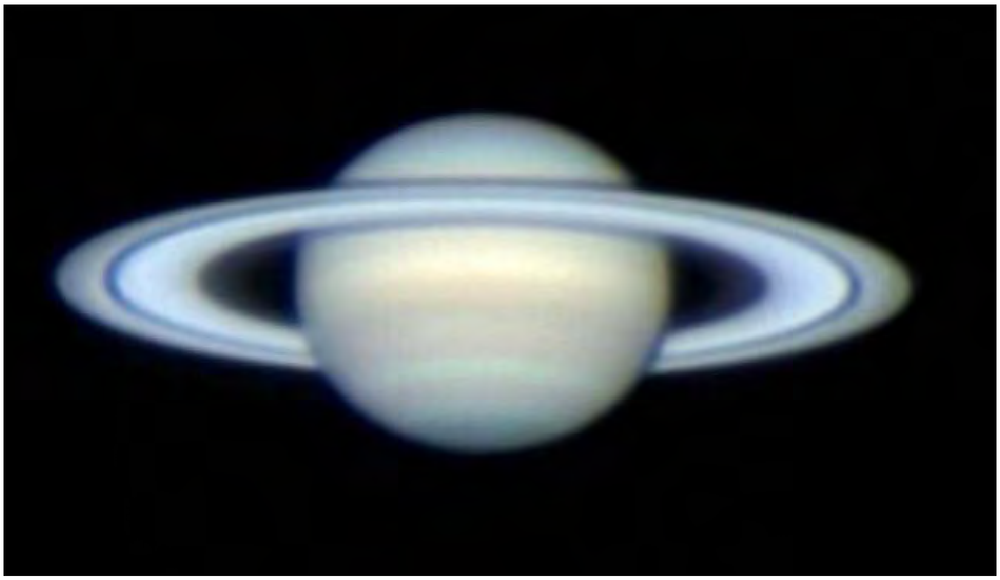


Illustration 005. 2012 April 30 04:46UT. Digital image by Michael A. Phillips. 35.6 cm (14.0 in.) NEW and RGB filters. S = 3.0, Tr = 2.0. CMI = 320.5°, CMII = 202.6°, CMIII = 106.0°, B = +8.5°, B´ = +8.8°. The bright EZn is prominent across the globe of Saturn in fair seeing.

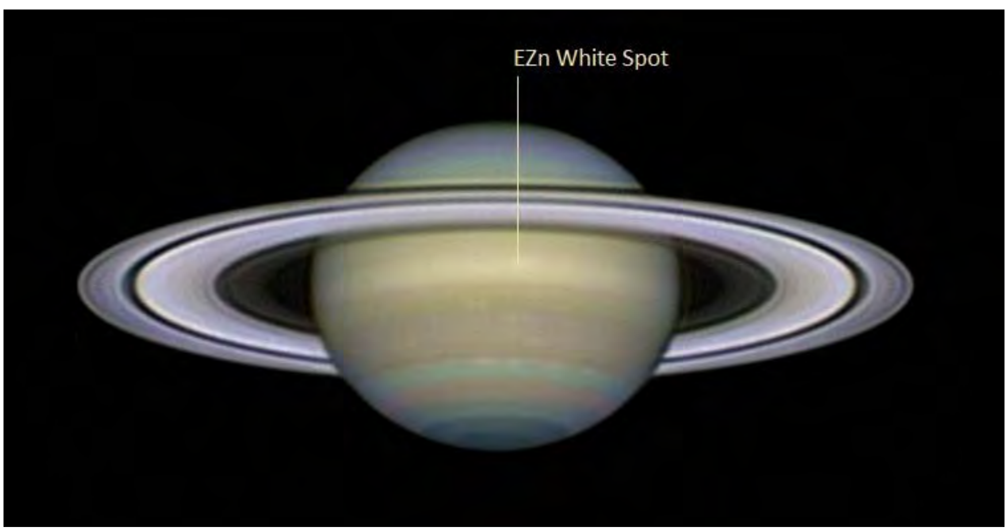


Illustration 006. 2012 April 21 23:26UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 218.0°, CMII = 5.7°, CMIII = 279.0°, B = +13.6°, B´ = +14.1°. A bright somewhat elongated white spot within the EZn approaching the CM is shown here. Remnants of the NTrZ storm encircling the globe of Saturn back in 2010-11 are visible as well as other discrete details on the globe and in the rings.

It is important to note that white spots like the NTrZ storm of 2010-11 originate as columns of material suddenly emerge through the upper NH_3-ice cloud layer, then start spreading out quite dramatically in latitude and longitude. Over time, darker substances upwelling from greater depths within Saturn's atmosphere start to intermix with lighter material creating complex eddies, as seen in many of the images from *Cassini* as well as those contributed by ALPO observers in 2010-11.

Returning to our discussion for 2011-12, ALPO Saturn observers faithfully continued their ambitious campaign of imaging the planet to monitor activity in the NTrZ in the aftermath of the great white storm of 2010-11. Indeed, most of the images received during the observing season, as well as several full-disk drawings, clearly depicted numerous small white disturbances intermixed with dusky areas between Saturnigraphic latitude +35° and +45° where the now-fading storm had progressively widened and encircled the globe since 2010-11. Because of the considerable latitudinal spreading that occurred as the morphologically complex bright storm evolved with time, it became difficult to clearly ascertain sharp northern and southern boundaries of the broad NTrZ, which introduced some confusion in differentiating the actual NTrZ from nearby belts and zones of Saturn's northern hemisphere, in particular the NTeZ [refer to Illustrations No. 012 thru 017].

Illustration 007. 2012 July 15 08:54UT Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and red filter. S = 5.5, Tr not specified. CMI = 190.1°, CMII = 131.9°, CMIII = 303.6°, B = +12.8°, B´ = +15.1°. Careful scrutiny reveals an ill-defined white spot within the EZn enhanced at red wavelengths.

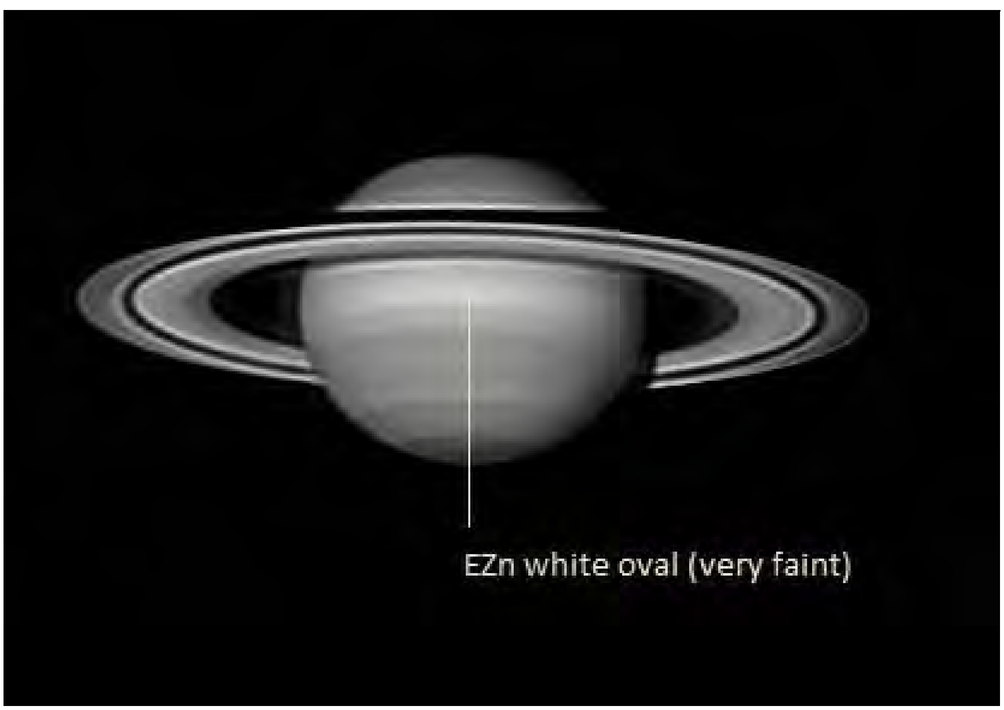


Illustration 008. 2012 July 19 09:10UT Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 6.5, Tr not specified. CMI = 336.2°, CMII = 148.5°, CMIII = 315.3°, B = +12.9°, B´ = +15.2°. Faint, diffuse EZn white spot is seen to better advantage in red wavelengths.

North Temperate Belt (NTeB). The light grayish-brown NTeB was reported only occasionally by visual observers during 2011-12, and in terms of estimated visual numerical relative intensity, it was virtually unchanged since 2010-11 (a difference of only -0.1 mean intensity points). On May 30, 2012 at 02:59UT Don Parker imaged a dark area or "barge" in the NTeB east of the CM [refer to Illustration No. 018], and on June 11, 2012 at 11:20UT Christopher Go captured an elongated dark feature on the CM [refer to Illustration No. 019]. Subsequent images of the dark barge were contributed by Don Parker just west of the CM on June 14, 2012 at 02:14UT [refer to Illustration No. 020], on the CM by Damian Peach at 20:51UT on June 19, 2012 [refer to Illustration No. 021] and finally by Anthony Wesley on August 12, 2012 at 09:07UT lying slightly east of the CM [refer to Illustration No. 022]. No visual observers called attention to this feature during the observing season.

North Temperate Zone (NTeZ). Visual observers making visual numerical relative intensity estimates reported that the yellowish-white NTeZ was slightly brighter in 2011-12 than in the previous apparition by +0.5 mean intensity points, yet slightly dimmer visually than the NTrZ by a mean factor of -0.32. The NTeZ was quite apparent on the majority of digital images contributed during the observing season, and in contrast with the aforementioned visual impressions, the NTeZ was more prominent that the NTrZ. The brighter appearance of the NTeZ, which showed some mottling in the best images submitted, was possibly due to latitudinal intrusion of the upwelling NH_3-ice cloud layer associated with the widening NTrZ storm of 2010-11, giving the NTeZ its greater prominence in 2011-12. Digital images by Christopher Go on June 11, 2012 at 11:20UT, by Don Parker on June 14, 2012 at 02:14UT, and Damian Peach on June 19, 2012 at 20:51UT all revealed a white spot in the NTeZ near the CM (together with the above-mentioned dark barge in the NTeB) [refer to Illustrations No. 019, 020, and 021]. Trevor Barry captured the NTeZ white spot on July 23, 2012 at 08:56UT near the CM [refer to Illustration No. 023], while Anthony Wesley reported the feature, looking somewhat more diffuse, on August 12, 2012 at 09:07UT [refer to Illustration No. 022].

Illustration 009. 2012 August 15 08:54UT Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 5.0, Tr not specified. CMI = 79.4°, CMII = 100.0°, CMIII = 234.3°, B = +13.6°, B´ = +15.5°. The rather diffuse EZn white spot, again difficult to discern, although but slightly easier to recognize in a red filter.

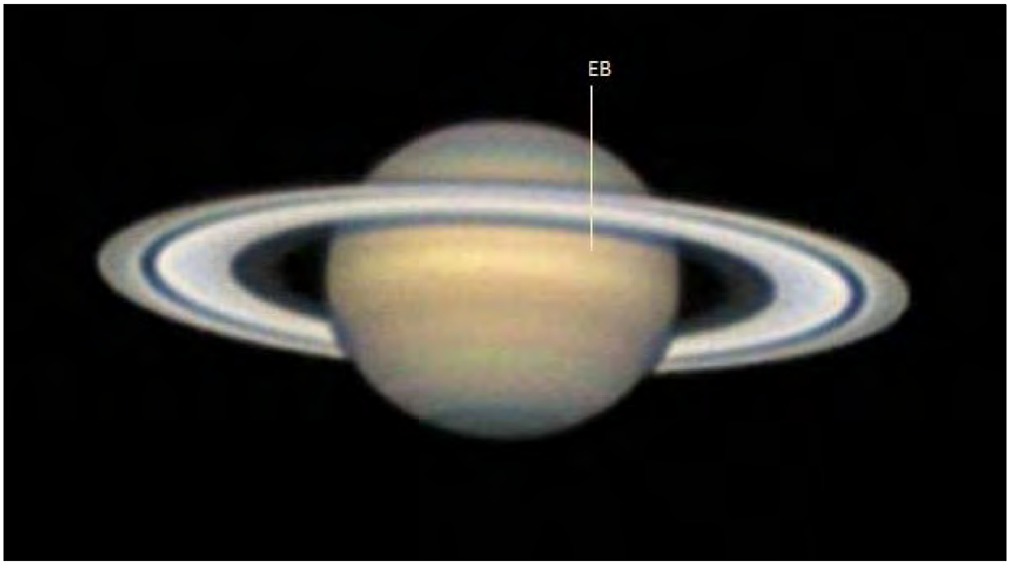


Illustration 010. 2012 April 20 03 :19UT. Digital image by Wayne Jaeschke. 35.6 cm (14.0 in.) SCT and RGB filters. S and Tr not specified. CMI = 105.9°, CMII = 312.9°, CMIII = 228.5°, B = +13.6°, B´ = +14.1°. The narrow greyish EB is easily visible across the globe of Saturn.

North North Temperate Belt (NNTeB). The dull gray NNTeB was difficult to detect even on the best images taken in good seeing conditions in 2011-12, and visual observers did not report it.

North North Temperate Zone (NNTeZ). During 2011-12 the usually dull yellowish-gray NNTeZ was not reported visually but was depicted on the best images taken with moderate-to-larger apertures during the observing season. From early April through late July 2012 several observers imaged recurring small white spots in the NNTeZ. For example, Brian Combs submitted an image of a small white feature in the NNTeZ near the CM at 06:19UT on April 8, 2012 [refer to Illustration No. 024] followed by near-simultaneous images of the NNTeZ white spot by Trevor Barry at 15:34UT and Christopher Go at 15:51UT on April 12, 2012 [refer to Illustrations No. 025 and 026]. Almost simultaneous images of a rather compact NNTeZ white spot were contributed by Anthony Wesley at 14:15UT (particularly prominent at red wavelengths) and by Christopher Go at 14:20UT on April 13, 2012 [refer to Illustrations No. 027 and 028]. Don Parker provided an image of the compact NNTeZ white spot in good seeing at 03:51UT on May 7, 2012 [refer to Illustration No. 029]. The last submitted image of the NNTeZ white spot, which had apparently faded in prominence, occurred on July 23, 2012 by Trevor Barry at 09:31UT at red wavelengths [refer to Illustration No. 030]. Visual observers did not submit reports of NNTeZ white spots during the 2011-12 apparition.

North Polar Region (NPR). The dark gray NPR was frequently reported by visual observers and evident on digital images contributed during the 2011-12 apparition, only a little bit lighter by +0.20 in mean intensity since 2010-11, and devoid of any recognizable activity by visual observers and those imaging Saturn [refer to Illustration No. 031]. Although visual observers did not report the NPB (North Polar Belt) in 2011-12, this narrow feature was usually recognizable on higher-definition images encircling the NPR [refer to Illustration No. 021]. The always intriguing North Polar hexagon was easily recognizable on many of the best images this apparition [refer to Illustration No. 034].

Shadow of the Globe on the Rings (Sh G on R). The Sh G on R was visible to observers as a geometrically regular black shadow on either side of opposition during 2011-12. Any apparent variation of this shadow from a totally black intensity (0.0) during a given observing season is purely a consequence of bad seeing conditions or the presence of extraneous light. Digital images revealed this feature as completely black. Readers are reminded that the globe of Saturn casts a shadow on the ring system to the left or IAU East prior to opposition, to the right or IAU West after opposition, and on neither side precisely at opposition (no shadow) as illustrated in *Figure 6* showing digital images furnished by Trevor Barry on January 23, 2012 at 17:53UT (before opposition), April 14, 2012 at 13:00UT (one day before opposition), and August 15, 2012 at 09:00UT (after opposition).

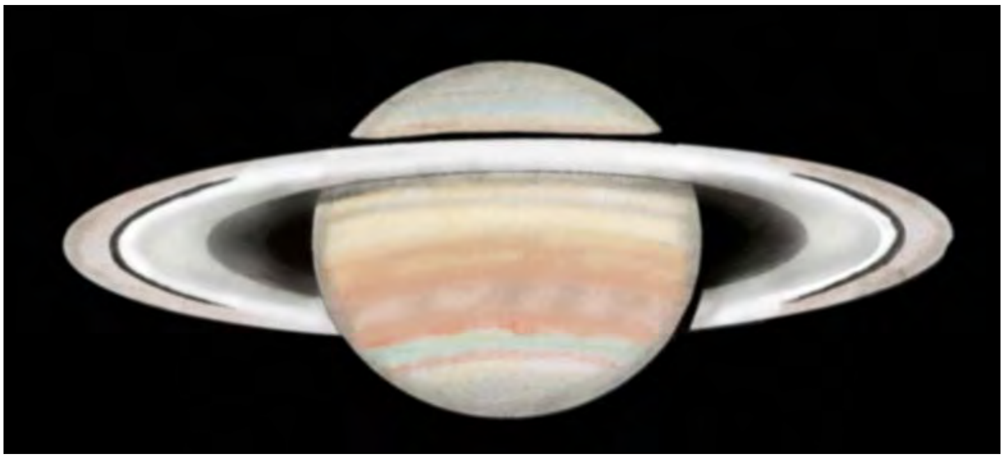


Illustration 011. 2011 May 12 23:46UT. Detailed sketch by Paul G. Abel. 20.3 cm (8.0 in.) NEW in Integrated Light (no filter) at 250X. S = 6.0 (interpolated), Tr not specified. CMI = 321.0°, CMII = 149.9°, CMIII = 37.9°, B = +13.0°, B´ = +14.4°. Impressive drawing showing subtle phenomena such as dark irregular areas in the NEBn and lighter splotches in the NEBZ made in good seeing.

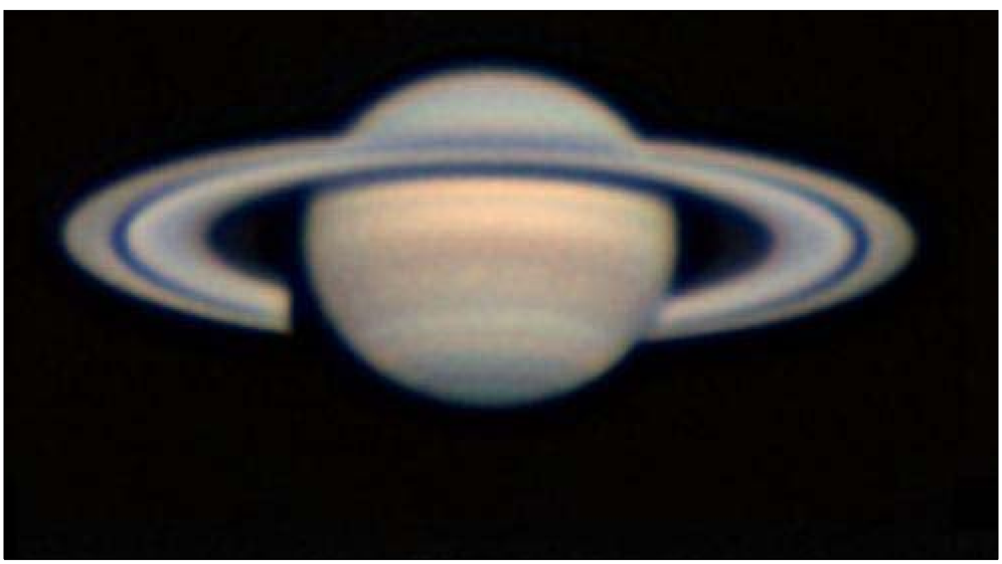


Illustration 012. 2011 December 30 13:50UT. Digital image by Paul Maxson. 36.8 cm (14.5 in.) SCT and RGB filters. S and Tr not specified. CMI = 226.1°, CMII = 76.7°, CMIII = 126.9°, B = +14.9°, B´ = +12.6°. Remnants of the massive NTrZ white storm of 2010-11 running across the globe are quite obvious.

Latitude Estimates of Features on the Globe. Observers did not submit latitude estimates of features on Saturn's globe during 2011-12. Readers are encouraged to try the simple visual technique developed by Walter Haas over 60 years ago to estimate latitudes, which involves determining as accurately as possible the fraction of the polar semidiameter of Saturn's globe subtended on the central meridian (CM) between the limb and the feature whose latitude is desired. As a control on the accuracy of this method, observers should include in their estimates the position on the CM of the projected ring edges and the shadow of the rings. The actual latitudes can then be calculated from the known values of B and B' and the dimensions of the rings, but this test cannot be effectively applied when B and B' are near their maximum attained numerical values. Experienced observers have used this visual convenient procedure for many years with very reliable results, especially since filar micrometers are virtually non-existent, and if available they tend to be very expensive, not to mention sometimes tedious to use. A detailed description of the technique can be found in the author's book entitled *Saturn and How To Observe It*, published by Springer and available from booksellers worldwide.

Saturn's Ring System

The discussion in this section pertains to visual studies of Saturn's ring system with the usual comparison of mean intensity data between apparitions, as well as interpretations of digital images of the rings contributed during 2011-12. With the ring tilt toward Earth in 2011-12 increasing to as much as +15.1°, the major ring components were increasingly easier for observers to see and image as the rings continued to progress toward their maximum inclination of +27° during the future 2016-17 apparition.

Ring A. The majority of visual observers agreed that the greyish-white Ring A, taken as a whole, appeared a bit dimmer in 2011-12 than in 2010-11 according to visual numerical relative intensity estimates (difference of -1.2 mean intensity points). Visual observers usually described Ring A as being rather homogeneous rather than being subdivided into inner and outer halves, but digital images of Saturn in 2011-12 often showed inner and outer halves of Ring A, with the inner half slightly brighter than the outer half (especially at red wavelengths). Visual observers occasionally reported the very dark gray Encke's division (A5) in 2011-12 when the rings were near their maximum tilt but offered no visual numerical relative intensity estimates, while a few of the best images occasionally revealed A5 near the ansae. There were hints of Keeler's gap (A8) on some images, but it was not described by visual observers [refer to Illustrations No. 032 and 033].

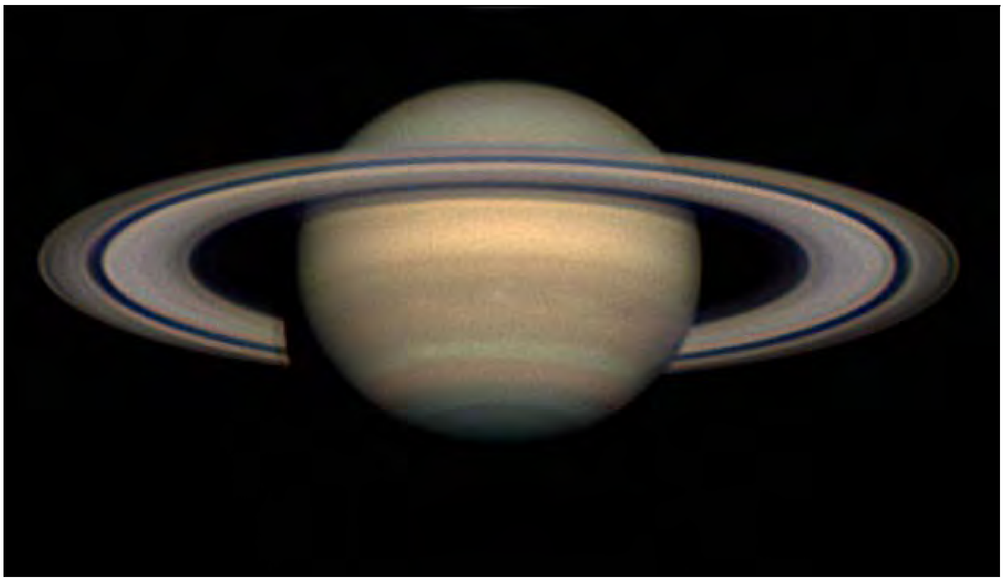


Illustration 013. 2012 February 23 19:00UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 6.5, Tr = 4.0. CMI = 47.5, CMII = 274.5°, CMIII = 258.1°, B = +15.0°, B´ = +13.4°. Numerous features appear within the NTrZ in the aftermath of the impressive storm in 2010-11.

Illustration 014. 2012 March 20 16:13UT Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW with RGB filters. S and Tr not specified. CMI = 303.9°, CMII = 54.8°, CMIII = 7.2°, B = +14.5°, B´ = +13.7°. Discrete light and dark atmospheric disturbances left behind by the 2010-11 storm within the NTrZ and adjacent regions in Saturn's northern hemisphere.

Ring B. The outer third of Ring B is the conventional standard of reference for the ALPO Saturn Visual Numerical Relative Intensity Scale, with an assigned value of 8.0. Under circumstances of greater ring tilt during the apparition, visual observers reported that the outer third of Ring B appeared brilliant white with no variation in intensity, and compared with other ring components and atmospheric phenomena of Saturn's globe, it was always the brightest intrinsic feature. The inner two-thirds of Ring B during this apparition, described as yellowish-white and uniform in intensity, displayed a somewhat duller intensity by a mean factor of -1.3 compared with the immediately preceding observing season. Digital images confirmed most visual impressions during 2011-12 [refer to Illustrations No. 033 and 034].

Cassini's Division (A0 or B10). Cassini's division (A0 or B10) was frequently reported by visual observers in 2011-12 but only a few visual numerical relative intensity estimates were contributed. It was described as a black gap at both ansae and usually traceable all the way around Saturn's ring system by visual observers (except where the globe blocked views of the rings). This was also true for most of the high-resolution images submitted. While a black Cassini's division was generally apparent on most digital images received during the 2011-12 observing season, any presumed deviation from a totally black intensity for Cassini's Division was a consequence of bad seeing, scattered light, or insufficient aperture. Minor divisions or "intensity minima" across the breadth of the ansae, such as B1, B2, B5, and B8, were captured on detailed digital images with larger apertures during the 2011-12 observing season [refer to Illustration No. 034]. It is interesting to note that the globe can be seen through Cassini's division (A0 or B10) in a number of the better images submitted this observing season [refer to Illustration No. 037].

Ring C. The very dark gray Ring C was usually apparent at the ansae on most digital images during 2011-12 and depicted on drawings made by visual observers. Visual numerical relative intensity estimates suggested that Ring C at the ansae was dimmer by -1.5 mean intensity points than it appeared in 2010-11. The Crape Band (merely Ring C in front of the globe of Saturn) was reported by visual observers and appeared dull gray in color and uniform in intensity [refer to Illustration No. 035], and it was generally visible on digital images [refer to Illustration No. 036]. Although mentioned in several visual reports, and noticed in a number of digital images, observers did not offer intensity estimates of the Crape Band during the observing season.

Illustration 015. 2012 March 15 07:23UT. Digital image by Brian Combs. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S and Tr not specified. CMI = 91.1, CMII = 15.4°, CMIII = 334.3°, B = +14.6°, B´ = +13.6°. Considerable detail is visible across the globe within the NTrZ subsequent to the bright storm of 2010-11.

Illustration 016. 2012 January 19 19:16UT. Digital image by Tomio Akutsu. 35.6 cm (14.0 in.) SCT with RGB filters. S = 7.0, Tr = 4.0. CMI = 23.8°, CMII = 301.1°, CMIII = 326.9°, B = +15.2°, B´ = +12.9°. Well-defined morphological features appear within the NTrZ following the 2010-11 storm.

Opposition Effect.

The Seeliger "opposition effect" was reported by a handful of observers on opposition date (April 15, 2012), which is a detectable brightening of Saturn's ring system within a very short interval on either side of opposition, typically when the phase angle between Sun, Saturn, and the Earth is <0.3°. This ring brightening is caused by coherent back-scattering of sunlight by the m-sized icy particles that make up the rings, which do so far more efficiently than the particles of Saturn's atmosphere. Anthony Wesley was among several observers whose images depicted this brightening of the rings during 2011-12, exemplified in his image on April 13, 2012 at 14:15UT roughly two days before opposition [refer to Illustration No. 027].

Shadow of the Rings on the Globe (Sh R on G). This shadow in 2011-12 was almost always described as a completely black feature where the rings crossed Saturn's globe. Those very few instances when the shadow appeared as grayish-black, a departure from an overall black (0.0) intensity, occurred for the same reason as previously noted in our discussion regarding the Sh G on R.

When B and B' are both positive, and the value of B is greater than that of B', the ring shadow (Sh R on G) is to the north of the projected rings, which happened prior to April 14, 2012 [refer to Illustration No. 037]. When B and B' are both positive, and the value of B is less than of B', the shadow of the rings on the globe (Sh R on G) is cast to their south, circumstances that occurred starting about April 14, 2011 through September 09, 2012 (the final observation received for the apparition) [refer to Illustration No. 038], and the Crape Band then is seen south of the projected Rings A and B. At times when the shadows of Ring A, Ring B, and Ring C projection are superimposed, it is often very troublesome to distinguish between them in ordinary apertures and seeing conditions, and the shadow of Ring C is a further complication.

Terby White Spot (TWS). The TWS is an apparent brightening of the rings immediately adjacent to the Sh G on R. There were only a few times when this feature was noticed by visual observers during 2011-12. It is just an artificial contrast effect, not a real feature of Saturn's rings, but might be beneficial to try to find any correlation that might exist between the visual numerical relative intensity of the TWS and the varying tilt of the rings, including its brightness and visibility using variable-density polarizers, color filters, and digital images.

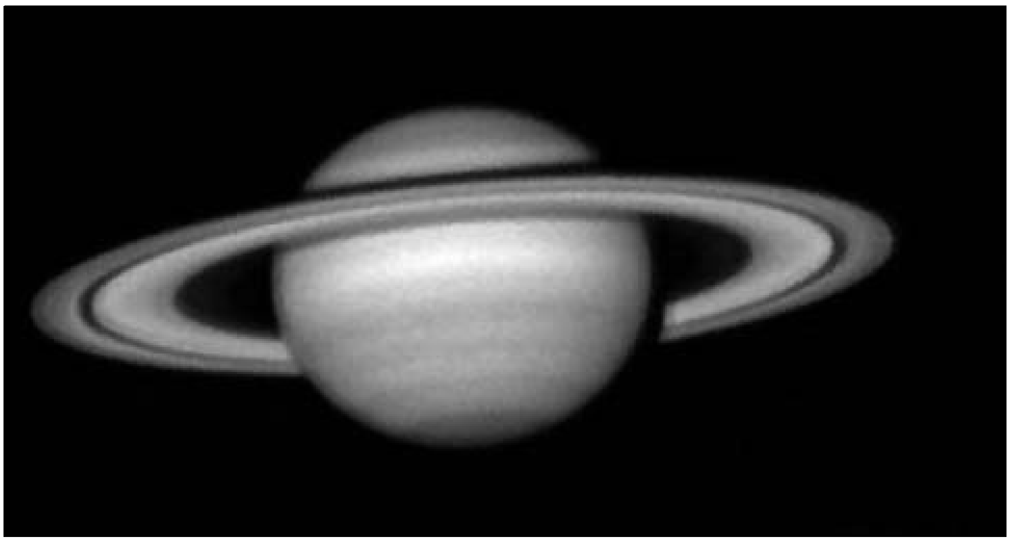


Illustration 017. 2012 June 12 06:40UT, Digital image by Freddy Willems. 35.6 cm (14.0 in.) SCT with Red filter. S and Tr not specified. CMI = 332.3°, CMII = 263.0°, CMIII = 114.5°, B = +12.6°, B´ = +14.7°. Remnants of the NTrZ white storm raging across the globe of Saturn in 2010-11 are quite apparent at red wavelengths.

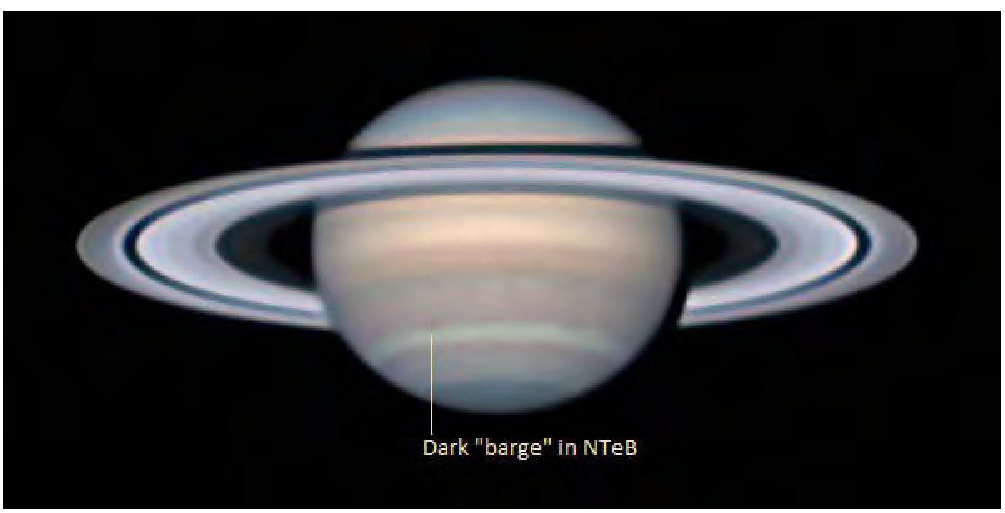


Illustration 018. 2012 May 30 02:58UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW with RGB filters. S = 6.5, Tr = 4.0. CMI = 26.7°, CMII = 22.2°, CMIII = 249.6°, B = +12.7°, B´ = +14.6°. Dark area or "barge" in the NTeB east of the CM in fair seeing conditions.

Bicolored Aspect of the Rings and Azimuthal Brightness Asymmetries. The bicolored aspect of the rings is an observed difference in coloration between the East and West ansae (IAU system) when systematically compared with alternating W47 (where W denotes the Wratten filter series), W38, or W80A (all blue filters) and W25 or W23A (red filters). There were no reports of this phenomenon in 2011-12, although in recent years observers have been systematically attempting to document the presence of the bicolored aspect of the rings using digital imagers. In the past, there have been rare instances when the phenomenon was allegedly photographed, and of particular importance would be images of the bicolored aspect at the same time it is sighted visually, especially when it occurs independent of similar effects on the globe of Saturn (which would be expected if atmospheric dispersion was a contributing factor). Such simultaneous visual observations cannot be stressed enough so that more objective confirmation of the bicolored aspect of the rings can occur.

Professional astronomers are well-acquainted with Earth-based sightings of azimuthal variations in the rings (initially confirmed by *Voyager* spacecraft), which probably is a consequence of light-scattering by denser-than-average clumps of particles orbiting in Ring A. ALPO Saturn observers are encouraged to try to image any azimuthal brightness asymmetries in Ring A, preferably at the same date that visual observers report it.

The Satellites of Saturn

Many of the planet's satellites show tiny fluctuations in visual magnitude as a result of their varying orbital positions relative to the planet and due to asymmetries in distribution of surface markings on a few. Despite close proximity sensing by spacecraft, the true nature and extent of all of the observed satellite brightness variations is not completely understood and merits further investigation.

Visual Magnitude Estimates and Photometry. ALPO Saturn Section observers in 2011-12 submitted no systematic visual estimates of Saturn's satellites employing recommended techniques by the ALPO Saturn Section. Even though photometry has largely replaced visual magnitude estimates of Saturn's moons, visual observers should still try to establish the comparative brightness of a satellite relative to reference stars of calibrated brightness when the planet passes through a field of stars that have precisely known magnitudes. To do this, observers need to employ a good star atlas that goes faint enough and an accompanying star catalogue that lists reliable magnitude values. A number of excellent computer star atlases exist that facilitate precise plots of Saturn's path against background stars for comparative magnitude estimates.

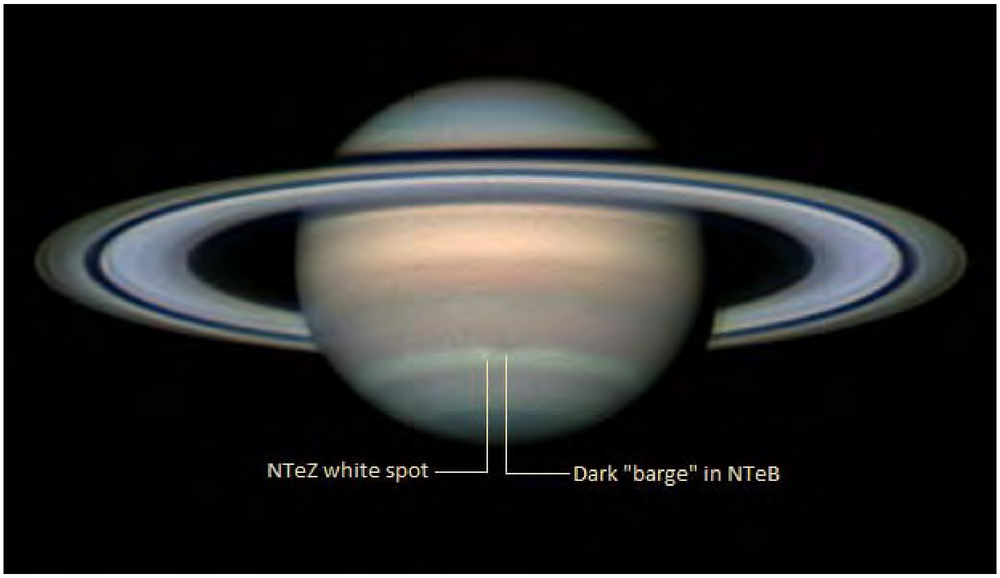


Illustration 019. 2012 June 11 11:20UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 8.0, Tr = 4.0. CMI = 12.2, CMII = 328.9°, CMIII = 181.4°, B = +12.6°, B´ = +14.7°. Elongated dark feature in the NTeB at the CM as well as a small but fairly bright spot in the NTeZ (slightly east of the CM) in very good seeing.

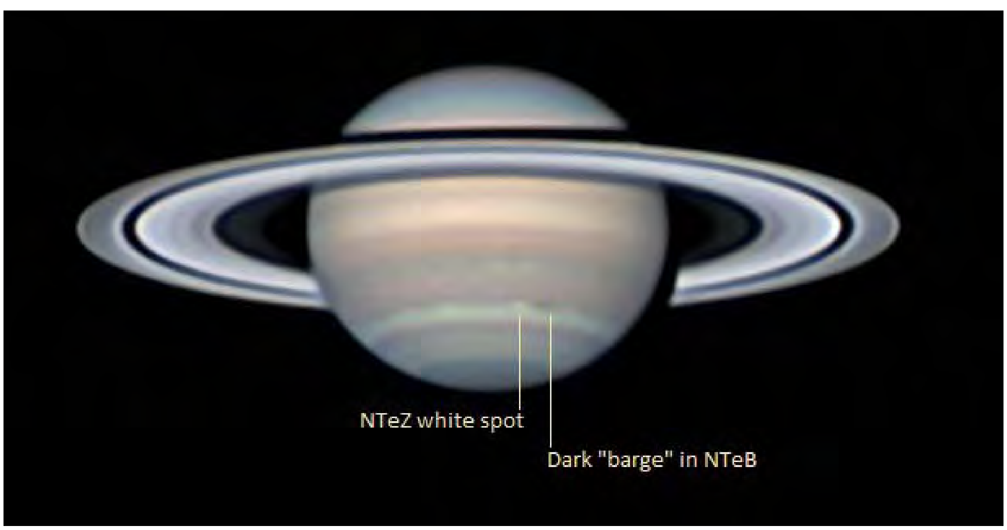


Illustration 020. 2012 June 14 02:14UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW with RGB filters. S = 7.5, Tr = 4.0. CMI = 64.9°, CMII = 296.9, CMIII = 146.2°, B = +12.6°, B´ = +14.8°. Dark area or “barge” in the NTeB and NTeZ white spot both west of and approaching the CM in good seeing conditions. Other less prominent discrete features are also visible in the NTrZ and NTeZ.

The methodology of visually estimating satellite magnitudes is pretty simple. It starts with selection of at least two stars with well-established magnitudes and those that have about the same color and brightness as the satellite. One of the stars chosen should be slightly fainter and the other a little brighter than the satellite so that the difference in brightness between the stars is roughly 1.0 magnitude. This makes it easy to divide the brightness difference between the two comparison stars into equal magnitude steps of 0.1. To estimate the visual magnitude of the satellite, simply place it along the scale between the fainter and brighter comparison stars. In the absence of suitable reference stars, however, a last resort alternative is to use Saturn's brightest satellite, Titan, at visual magnitude 8.4. It is known to exhibit only subtle brightness fluctuations over time compared with the other bright satellites of Saturn that have measured amplitudes.

Some observers have begun using digital imagers with adequate sensitivity to capture the satellites of Saturn together with nearby comparison stars, thereby providing a permanent record to accompany visual magnitude estimates as described above. Images of the positions of satellites relative to Saturn on a given date and time are worthwhile for cross-checking against ephemeris predictions of their locations and identities. It is important to realize, however, that the brightness of satellites and comparison stars on digital images will not necessarily be exactly the same as visual impressions because the peak wavelength response of the CCD chip is typically different than that of the eye. Observers who have photoelectric photometers may also contribute measurements of Saturn's satellites, but they are notoriously difficult to measure owing to their faintness compared with the planet itself. Rather sophisticated techniques are required to correct for scattered light surrounding Saturn and its rings.

Spectroscopy of Titan. Since 1999 observers have been urged to attempt spectroscopy of Titan whenever possible as part of a cooperative professional-amateur project. Although Titan has been studied by the Hubble Space Telescope (HST), very large Earth-based instruments, and at close range the ongoing *Cassini-Huygens* mission, opportunities continue for amateurs to contribute systematic observations using appropriate instrumentation. Thanks to the *Cassini-Huygens* mission starting in 2004, we now know that Titan is a very dynamic world with transient and long-term variations. From wavelengths of 300nm to 600nm, Titan's hue is dominated by a reddish methane (CH_4) atmospheric haze, and beyond 600nm, deeper CH_4 absorption bands appear in its spectrum. Between these CH_4 wavelengths are "portals" to Titan's lower atmosphere and surface, so regular monitoring in these regions with photometers or spectrophotometers is a useful complement to professional work. Long-term studies of Titan's brightness from one apparition to the next is meaningful in helping shed light on Titan's known seasonal variations. Observers with suitable equipment are being asked to participate in these professional-amateur projects, and further details can be found on the Saturn page of the ALPO website at *http://www.alpo-astronomy.org/* as well as directly from the ALPO Saturn Section.

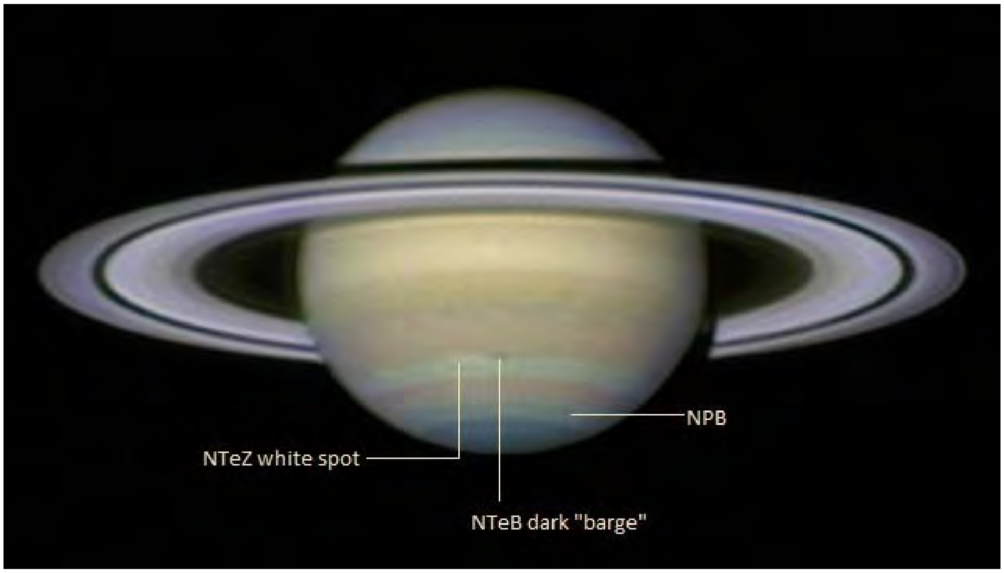


Illustration 021. 2012 June 19 20:51UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 260.9°, CMII = 306.4°, CMIII = 148.8°, B = +12.6°, B´ = +14.8°. Dark "barge" at the CM in the NTeB and the somewhat elongated NTeZ white spot slightly east of the CM in better-than-average seeing. Notice the myriad fine belt and zone details within Saturn's northern hemisphere, including the narrow NPB encircling the NPR).

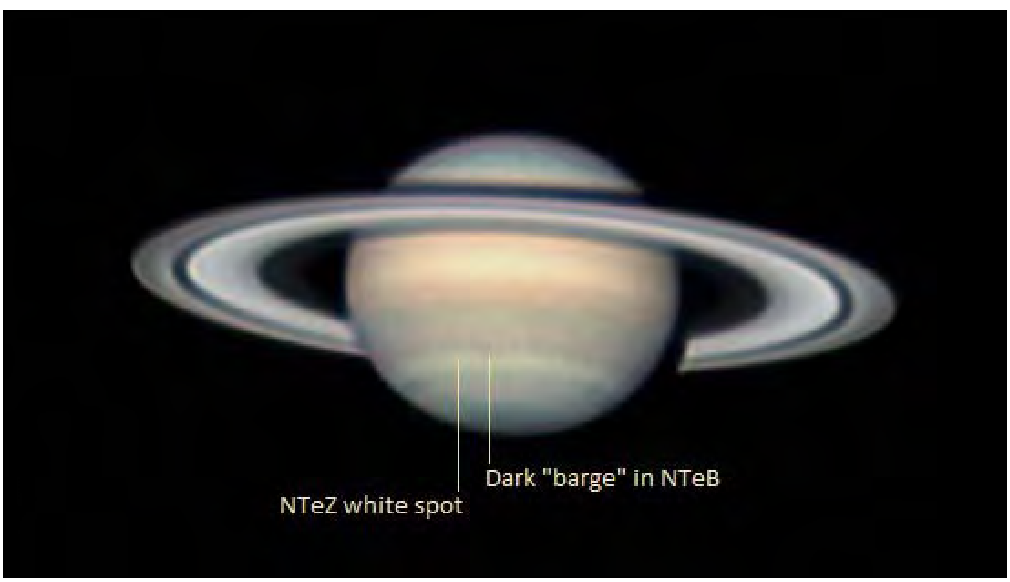


Illustration 022. 2012 August 12 09:07UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW with RGB filters. S and Tr not specified. CMI = 74.5°, CMII = 191.8°, CMIII = 329.6°, B = +13.5°, B´ = +15.5°. The dark "barge" lying slightly east of the CM is visible along with hints of the more diffuse NTeZ white spot father east.

Simultaneous Observations

Simultaneous observations, or studies of Saturn by individuals working independently of one another at the same time and on the same date, offer unparalleled chances verification of ill-defined or traditionally controversial phenomena. The ALPO Saturn Section has organized a simultaneous observing team so that several individuals in reasonable proximity to each another can maximize the opportunities for viewing and imaging Saturn at the same time using similar equipment and methodology. Joint efforts like this significantly reinforce the level of confidence in the data submitted for each apparition. Some examples of such observations of Saturn during this apparition were cited earlier in this report. In forthcoming apparitions such continued valuable work is strongly encouraged.

Pro-Am Opportunities

Our routine involvement in professional-amateur (Pro-Am) projects continued in 2011-12 with the standing invitation by *Cassini* scientists for amateurs to collect and submit as many images of discrete phenomena sighted or imaged on the globe of Saturn. Readers of this Journal may recall the collaborative efforts of amateurs and professionals in keeping track of the dynamic, brilliant NTrZ white storm raging on Saturn during the 2010-11 observing season. Moreover, dating back to the time *Cassini* started observing Saturn at close range a decade ago (in April 2004), digital images at wavelengths ranging from 400nm - 1μ have been actively sought by the professional community from amateurs and remains as a project of high importance. In addition, more advanced observers should utilize classical broadband filters (e.g. Johnson system: B, V, R and I) with apertures upwards of 30.5 cm (12.0 in.) or larger, while also imaging through a 890-nm narrow band CH_4 (methane) filter.

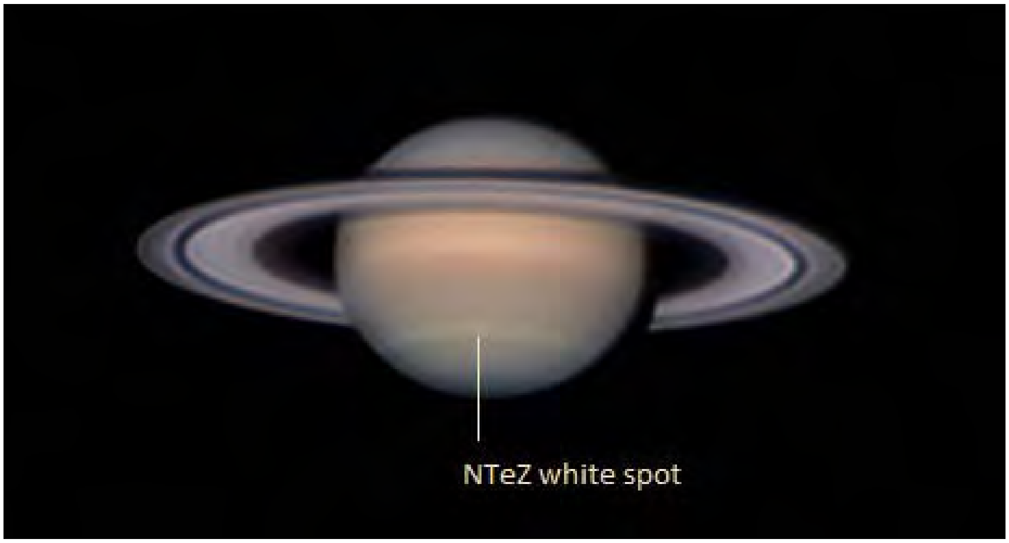


Illustration 023. 2012 July 23 08:56UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 5.5, Tr not specified. CMI = 104.7°, CMII = 148.2°, CMIII = 310.1°, B = +12.9°, B´ = +15.2°. The NTeZ white spot is near the CM.

Illustration 024. 2012 April 08 06:19UT. Digital image by Brian Combs. 35.6 cm (14.0 in.) SCT with RGB + IR blocking filter. S and Tr not specified. CMI = 159.0, CMII = 29.5°, CMIII = 319.5°, B = +14.0°, B´ = +13.9°. In addition to the oval NNTeZ white spot near the CM, considerable detail is visible across the northern hemisphere of the globe in very good seeing.

So, to maintain our vital Pro-Am effort, the *Cassini* team requests that observers systematically patrol the planet every clear night for individual features, keeping track of their motions and morphology, and subsequently furnish input of interesting large-scale targets for on-board spacecraft imaging systems to begin close-up surveillance. Note that visual observers with apertures ranging upwards from about 15.2 cm (6.0 in.) can play a very meaningful role by making routine visual numerical relative intensity estimates and recording suspected variations in belt and zone reflectivities (i.e., intensity) and color. The *Cassini* team combines ALPO Saturn Section images with data from the Hubble Space Telescope and from other professional ground-based observatories for immediate and future study.

As a means of facilitating regular Pro-Am observational cooperation, readers are asked to contact the ALPO Saturn Section with any questions as to how they can share their observational reports, drawings, and images of Saturn and its satellites with the professional community. The author is always happy to offer guidance to novices, as well as more experienced observers. A meaningful resource for learning how to observe and record data on Saturn is the ALPO Training Program, and it is recommended that beginners take advantage of this valuable educational resource.

Conclusions

Based on mean visual numerical relative intensity estimates obtained during 2011-12, the South Polar Region (SPR), South Tropical Zone (STrZ), North Equatorial Belt (NEB), North Temperate Zone (NTeZ), and North Polar Region (NPR), each exhibited varying degrees of lighter overall relative intensity compared with the immediately preceding apparition. Features such as the South Equatorial

Belt (SEBw), North Tropical Zone (NTrZ), North Temperate Belt (NTeB), all seemed slightly dimmer than in 2010-11. It should be noted, however, that estimating numerical relative intensities of features in Saturn's southern hemisphere were hampered by the less advantageous views of these areas during the observing season coupled with regions wholly or partially hidden by the rings as they crossed the globe.

With regard to activity on Saturn's globe during 2011-12, aside from the obvious remnants of the massive North Tropical Zone (NTrZ) storm of 2010-11 appearing on most images this apparition in the region between Saturnigraphic latitude +35° and +45°, observers were able to satisfactorily image recurring white spot phenomena in the North North Temperate Zone (NNTeZ) from early April until late July 2012. Imaging techniques also captured repeated occurrences of an Equatorial Zone (EZn) white elongation from late April through mid-August 2012, sporadic appearances of a North Temperate Zone (NTeZ) white oval during June, July, and August 2012, and a dark barge in the North Temperate Belt (NTeB) also during the latter span of three months. Other very small short-lived light and dusky features among the northern hemisphere belts and zones were recognized on some of the best drawings and images with moderate-to-larger apertures throughout the observing season.

Illustration 025. 2012 April 12 15:34UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 5.0, Tr not specified. CMI = 261.9°, CMII = 350.8°, CMIII = 275.5°, B = +13.8°, B´ = +14.0°. The small NNTeZ white spot is west of the CM. Image is near-simultaneous with that of Christopher Go at 15:51UT on the same date.

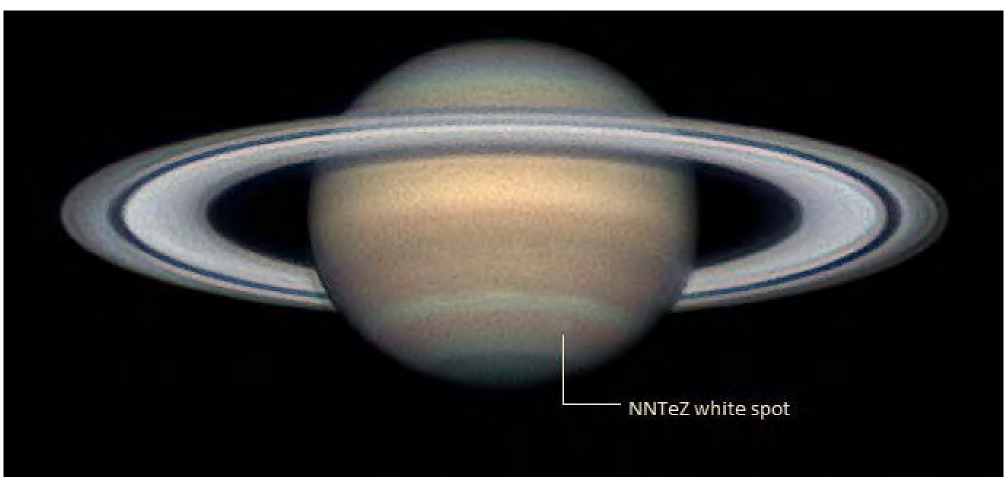


Illustration 026. 2012 April 12 15:51UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 6.7, Tr = 4.0. CMI = 0.4, CMII = 271.9°, CMIII = 285.1°, B = +13.8°, B´ = +14.0°. The small NNTeZ white spot is near the CM. Image is near-simultaneous with that of Trevor Barry at 15:34UT on the same date.

ALPO observers worldwide continued their regular worldwide daily coverage of Saturn during 2011-12 on the lookout for discrete phenomena, and all data are passed on to the *Cassini* team as in previous apparitions. Such Pro-Am cooperation shall continue into the future.

With respect to the Ring System, apart from routine visual observations and digital images showing Cassini's (A0 or B10), Encke's (A5), and possibly Keeler's (A8) divisions, several less conspicuous intensity minima at different locations within Ring B were recorded with digital imagers and suspected by visual observers. Although observers used standard methodology is looking for the bi-colored aspect of the rings during the 2011-12 apparition, there were no reports of the phenomenon by visual observers or indications of its presence on digital images submitted.

Digital imaging, which now occurs as routinely as visual studies of Saturn, frequently reveals minute detail on the globe and in the rings often below the normal visual threshold. With a combination of both observational methods, opportunities substantially increase for detecting changes on Saturn during any given observing season. Because of their sensitivity, digital imagers help detect outbursts of activity that visual observers can ultimately try to study with their telescopes. This helps establish limits of visibility of such features in integrated light (no filter) and at various wavelengths.

With regard to Saturn's satellites, during the 2011-12 apparition observers did not submit magnitude estimates.

The author is grateful to all those mentioned in this report for their dedicated support by submitting drawings, digital images, descriptive reports, simultaneous observations, and visual numerical relative intensity estimates during the 2011-12 apparition.

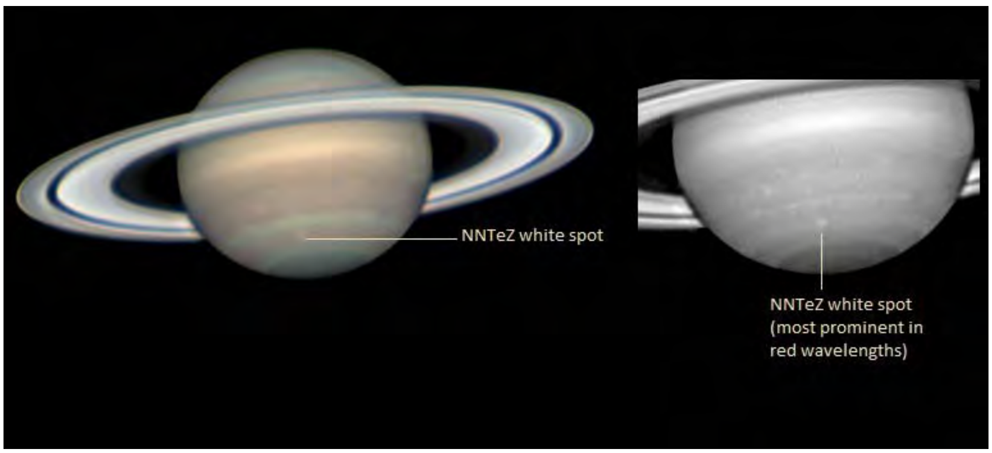


Illustration 027. 2012 April 13 14:15UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW with RGB filters. S and Tr not specified. CMI = 340.0°, CMII = 38.4°, CMIII = 321.9°, B = +13.8°, B´ = +14.0°. The small NNTeZ white spot is slightly east of the CM (insert shows the feature in red light). Image is basically simultaneous with that of Christopher Go taken 5 minutes later at 14:20UT on the same date. The Seeliger opposition effect, caused by coherent back-scattering of sunlight by μ-sized icy particles in the rings, is also seen.

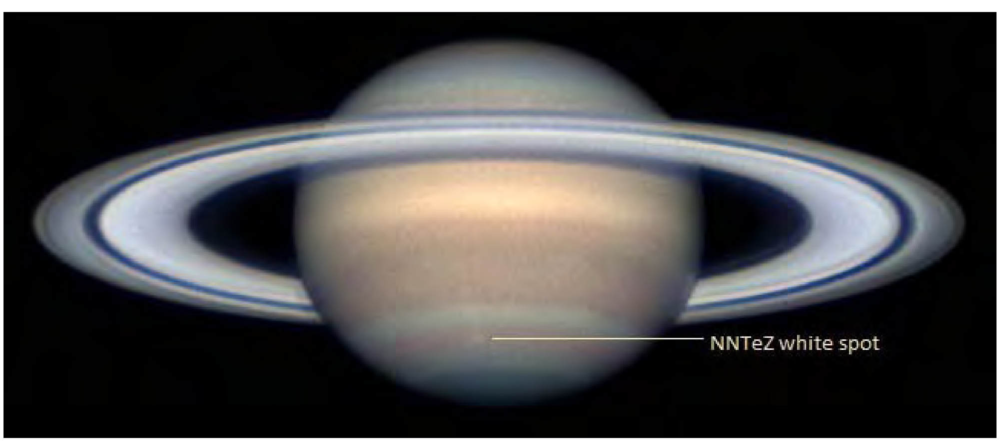


Illustration 028. 2012 April 13 14:20UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 6.7, Tr = 4.0. CMI = 342.9, CMII = 41.2°, CMIII = 324.7°, B = +13.8°, B´ = +14.0°. The small NNTeZ white spot is slightly east of the CM. Image is almost simultaneous with that of Trevor Barry Go taken 5 minutes earlier at 14:15UT on the same date.

Systematic observational work enhances our programs, bolstering Pro-Am collaboration as we collectively seek to better understand Saturn as a planet. Observers worldwide are encouraged to join us in our endeavors in future apparitions.

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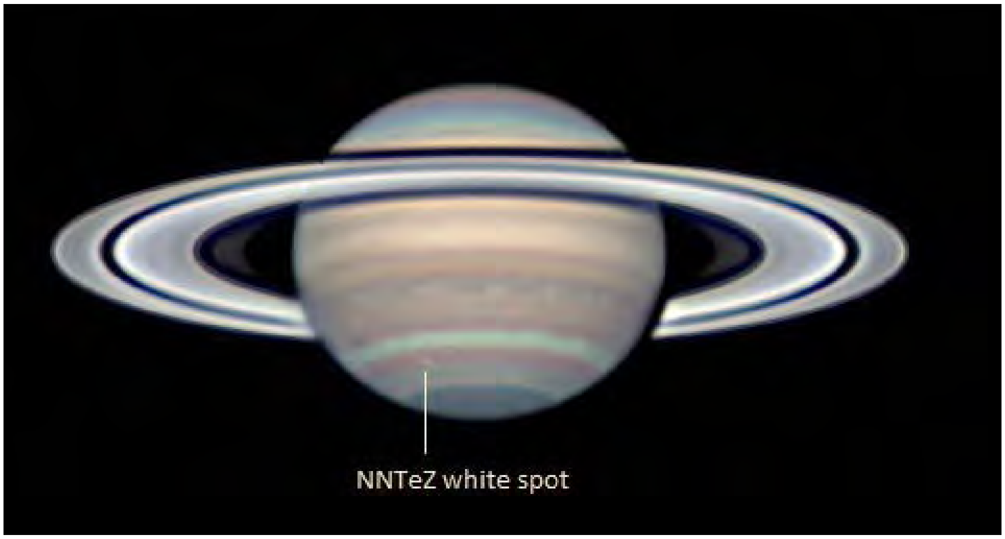


Illustration 029. 2012 May 7 03:51UT. Digital image by Donald C. Parker. 40.6 cm (16.0 in.) NEW using RGB filters. S = 6.5, Tr = 4.0. CMI = 78.7°, CMII = 95.8°, CMIII = 350.9°, B = +13.2°, B´ = +14.3°. The small NNTeZ white spot is east of the CM. Considerable detail is visible within the northern hemisphere of the globe in moderate seeing.

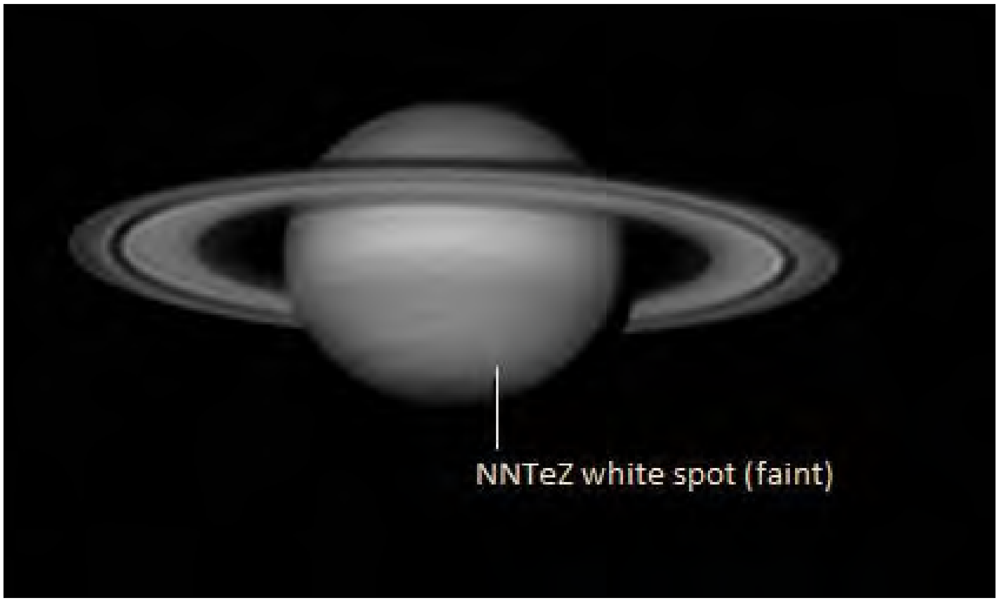


Illustration 030. 2012 July 23 09:31UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 5.5, Tr not specified. CMI = 125.9°, CMII = 167.9°, CMIII = 329.8°, B = +13.0°, B´ = +15.2°. The small NNTeZ white spot, which had apparently faded in prominence (even at red wavelengths), is just perceptible west of the CM.

Illustration 031. 2012 May 23 12:51UT. Digital image by Daniel Chang. 23.5 cm (9.25 in.) SCT and RGB filters. S = 7.0, Tr = 6.0. CMI = 224.3°, CMII = 72.6°, CMIII = 307.9°, B = +12.8°, B´ = +14.5°. The dark grey NPR is devoid of any recognizable activity in 2011-12.

Illustration 032. 2012 February 21 07:17UT. Digital image by Efrain Morales. 30.5 cm (12.0 in.) SCT and RGB filters. S and Tr not specified. CMI = 106.5°, CMII = 53.9°, CMIII =40.5°, B = +15.1°, B´ = +13.3°. The inner and outer halves of Ring A are apparent at the ansae, and notice that the inner portion of Ring A appears a little brighter than the outer region.

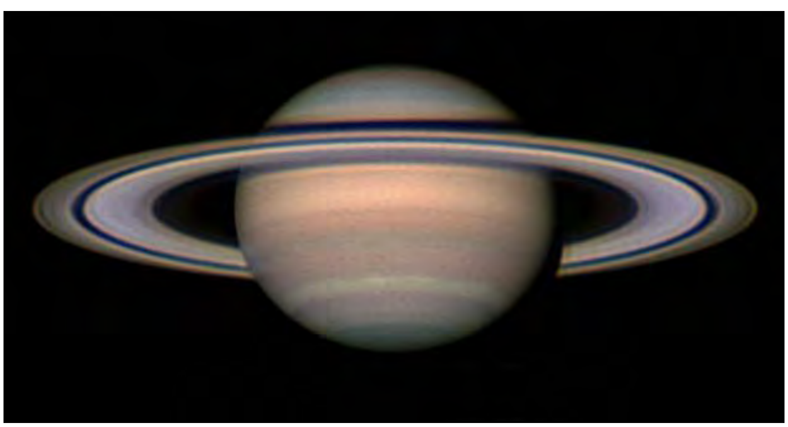


Illustration 033. 2012 June 18 11:10UT. Digital image by Christopher Go. 28.0 cm (11.0 in.) SCT with RGB + IR blocking filter. S = 6.5, Tr = 3.5. CMI = 156.1, CMII = 246.9°, CMIII = 90.9°, B = +12.6°, B´ = +14.8°. Details are very obvious within Ring A, including Encke's "complex" (A5), Keeler's gap (A8), and the lighter inner and duller outer halves of the ring. Considerable detail can be seen in Ring B, with Cassini's Division (A0 or B10) noticeable all the way around the ring system except where blocked from our view by the globe.

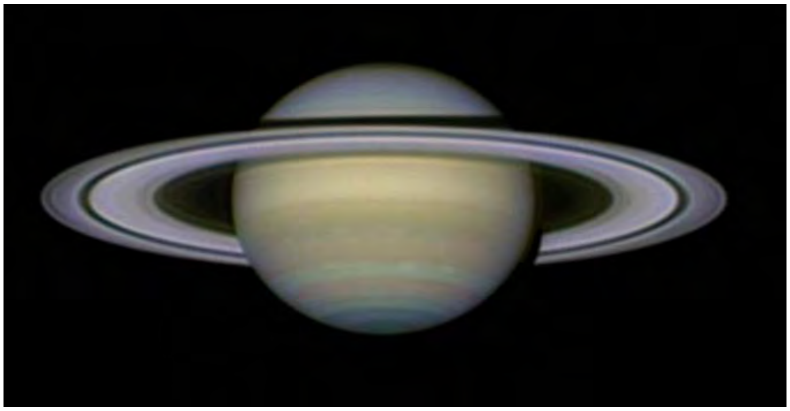


Illustration 034. 2012 June 18 21:06UT. Digital image by Damian Peach. 35.6 cm (14.0-in.) SCT with RGB filters. S and Tr not specified. CMI = 145.5°, CMII = 222.9°, CMIII = 66.5°, B = +12.6°, B´ = +14.8°. Considerable detail is visible within the rings especially at the ansae. Encke's "complex" (A5), Keeler's gap (A8), and the lighter inner and duskier outer half of Ring A are apparent. Lots of detail can be seen in Ring B, with Cassini's Division (A0 or B10) encircling the ring system, and minor "intensity minima" within Ring B such as B1, B2, B5, and B8 are fairly distinct.

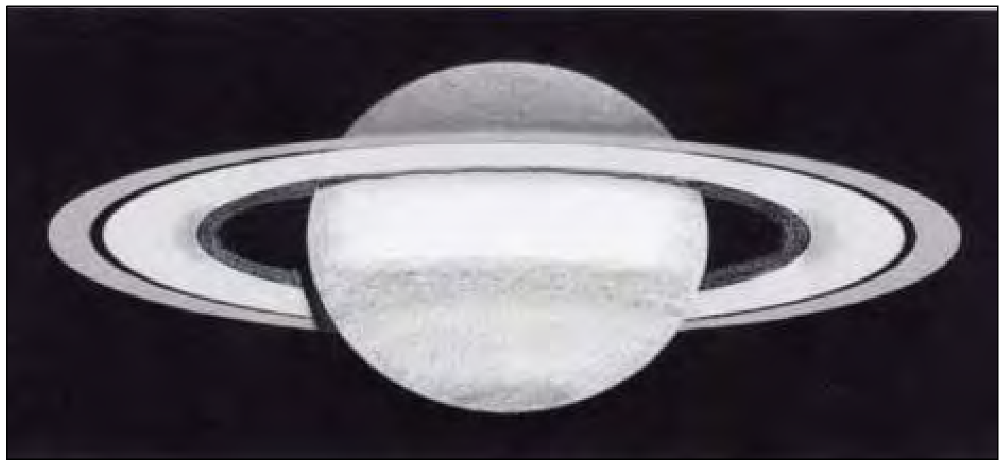


Illustration 035. 2012 March 15 08:00UT. Drawing by Michael Rosolina. 35.6 cm (14.0-in.) SCT at 340X in Integrated Light and alternative use of W11 (yellow-green) and W80A (medium blue) filters. S = 5.5, Tr = 4.0. CMI = 112.8°, CMII = 36.3°, CMIII = 355.1°, B = +14.6°, B´ = +13.6°. Ring C is seen at the ansae in average seeing.

Illustration 036. 2012 May 13 13:16UT. Digital image by Toshihiko Ikemura. 38.0 cm (15.0 in.) NEW and RGB filters. S and Tr not specified. CMI = 75.9°, CMII = 246.6°, CMIII = 134.0°, B = +13.0°, B´ = +14.4°. Ring C at the ansae and the Crape Band across the globe are visible in this image.

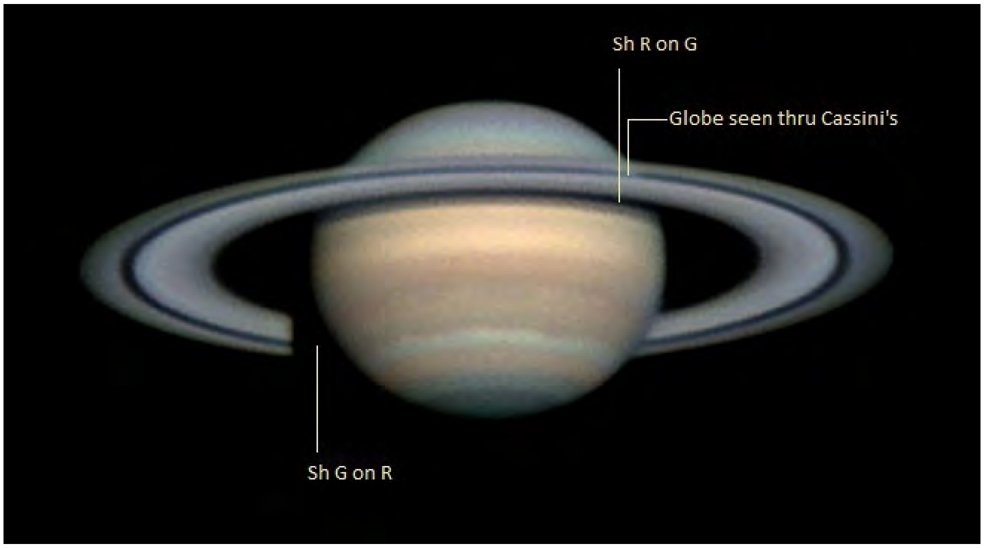


Illustration 037. 2012 January 19 16:17UT. Digital image by Freddy Willems. 35.6 cm (14.0-in.) SCT and RGB filters. S and Tr not specified. CMI = 278.9°, CMII = 200.2°, CMIII = 226.1°, B = +15.2°, B´ = +12.9°. Projected Sh R on G is visible north of the rings across the globe, as well as Sh G on R is to the east of the globe of Saturn (as it appears prior to opposition). Interestingly, note that the globe can be seen through Cassini's division (A0 or B10).

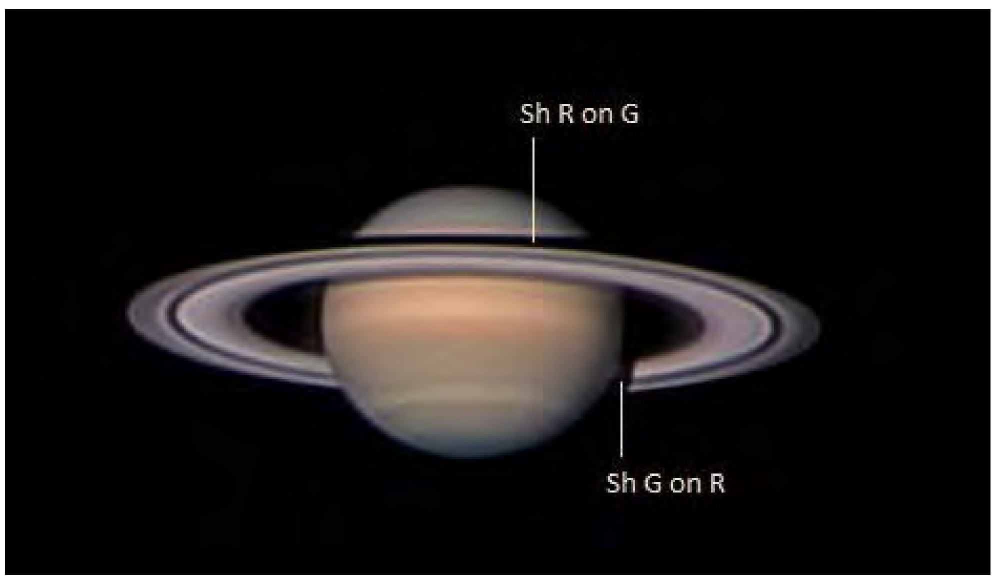
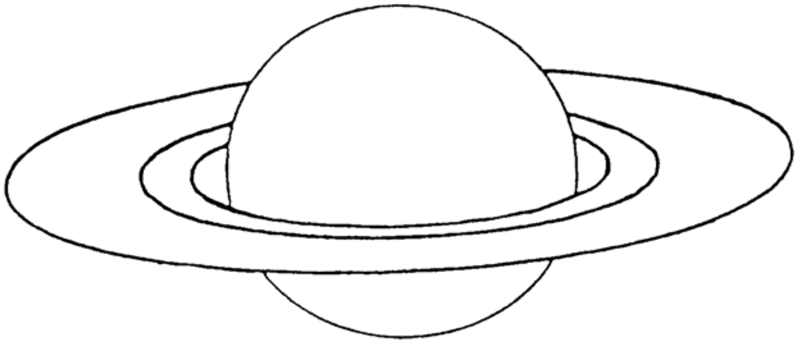


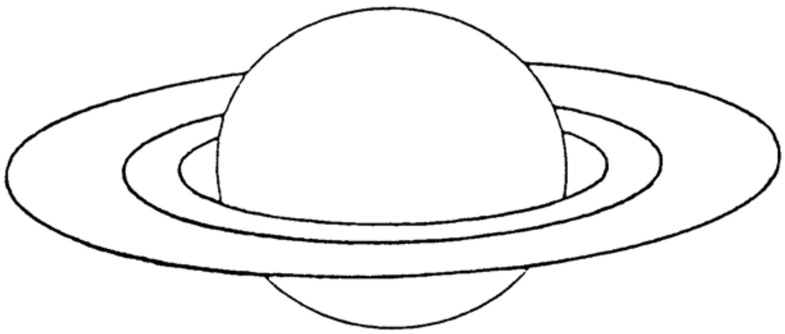
Illustration 038. 2012 July 19 09:23UT. Digital image by Trevor Barry. 40.6 cm (16.0 in.) NEW and RGB filters. S = 6.5, Tr not specified. CMI = 343.8°, CMII = 155.9°, CMIII = 322.6°, B = +12.9°, B´ = +15.2°. Projected black Sh R on G is visible south of the rings across the globe, as well as Sh G on R is to the west of the globe of Saturn (as it appears after opposition).

Association of Lunar and Planetary Observers (A.L.P.O.): The Saturn Section

A.L.P.O. Visual Observation of Saturn for B = –14° to –16°

S





N

Coordinates (check one): [ ] IAU [ ] Sky

Observer________________________________Location____

UT Date (start) _________________ UT Start ______________ CM I (start) ____________° CM II (start) ____________° CM III (start) ____________°

UT Date (end) _________________ UT End _____________ CM I (end) ____________° CM II (end) ____________° CM III (end) ____________°

B = _________° B′ = _________° Instrument ____ Magnification(s) _________ x_{min} _________ x_{max}

Filter(s) IL(none) _____________ f_1 _____________ f_2 _____________ f_3 _____________ Seeing ______________ Transparency ________________

Saturn Global and Ring Features	Visual Photometry and Colorimetry IL	 f_1	 f_2	 f_3	Absolute Color Estimates	Latitude Estimates ratio y/r

<u>Bicolored Aspect of the Rings</u>: No Filter (IL) (*check one*): [ ] E ansa = W ansa [ ] E ansa > W ansa [ ] W ansa > E ansa
(*always use IAU directions*) Blue Filter (________) (*check one*): [ ] E ansa = W ansa [ ] E ansa > W ansa [ ] W ansa > E ansa
Red Filter (________) (*check one*): [ ] E ansa = W ansa [ ] E ansa > W ansa [ ] W ansa > E ansa

IMPORTANT: Attach to this form all descriptions of morphology of atmospheric detail, as well as other supporting information. Please <u>do</u> <u>not</u> write on the back of this sheet. The intensity scale employed is the *Standard A.L.P.O. Intensity Scale*, where 0.0 = completely black ⇔ 10.0 = very brightest features, and intermediate values are assigned along the scale to account for observed intensity of features.

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http://moon.scopesandscapes.com/ALPO_Lunar_Program.htm

Smart-Impact Webpage

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The Lunar Observer

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

Lunar Selected Areas Program

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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 mb.
- **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 mb)
- **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 mb.
- **Monograph No. *5.*** *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878.* By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Hard copy $10 for the United States, Canada, and Mexico; $15 elsewhere. File size approx. 2.6 mb.
- **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 mb.
- **Monograph No. 7.** *Proceedings of the 48th Convention of the Association of*

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Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.76 pages. Hard copy $12 for the United States, Canada, and Mexico; $16 elsewhere.File size approx. 2.6 mb.

- **Monograph No. 8**. *Proceedings of the 49th Convention of the Association of Lunar and Planetary Observers. Atlanta, Georgia, July 9-11,1998.122* pages. Hard copy $17 for the United States, Canada, and Mexico; $26 elsewhere.File size approx. 2.6 mb.

- **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 mb.

- **Monograph Number 10.** *Observing and Understanding Uranus, Neptune and Pluto*. By Richard W. Schmude, Jr. 31 pages. File size approx. 2.6 mb.

- **Monograph No. 11**. *The Charte des Gebirge des Mondes* (Chart of the Mountains of the Moon) by J. F. Julius Schmidt, this monograph edited by John Westfall. Nine files including an accompanying guidebook in German. Note files sizes:
  Schmidt0001.pdf, approx. 20.1 mb;
  Schmidt0204.pdf, approx. 32.6 mb;
  Schmidt0507.pdf, approx. 32.1 mb;
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  Schmidt1719.pdf, approx. 22.2 mb;
  Schmidt2022.pdf, approx. 21.1 mb;
  Schmidt2325.pdf, approx. 22.9 mb;
  SchmidtGuide.pdf,approx. 10.2 mb

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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

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- **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”).

- **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.

- **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) *ALPO_Jupiter*, the ALPO Jupiter Section e-mail network; to join, send a blank e-mail to ALPO_Jupiter-subscribe@yahoogroups.com (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/GaliForm.pdf; send SASE to John Westfall for observing kit and report form via regular mail. (5) *Jupiter Observer’s Startup Ki*t, $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

ALPO Resources

People, publications, etc., to help our members

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.

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).

Back Issues of *The Strolling Astronomer*

- Download JALPO43-1 thru the latest current issue as a 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).

Many of the hard-copy back issues listed below are almost out of stock and there is no guarantee of availability. Issues will be sold on a first-come, first-served basis. Back issues are $4 each, and $5 for the current issue. We can arrange discounts on orders of more than $30. Order directly from Secretary/Treasurer “Matthew Will” (see address under “Board of Directors,”):

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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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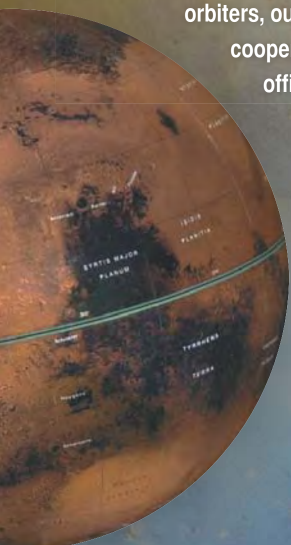

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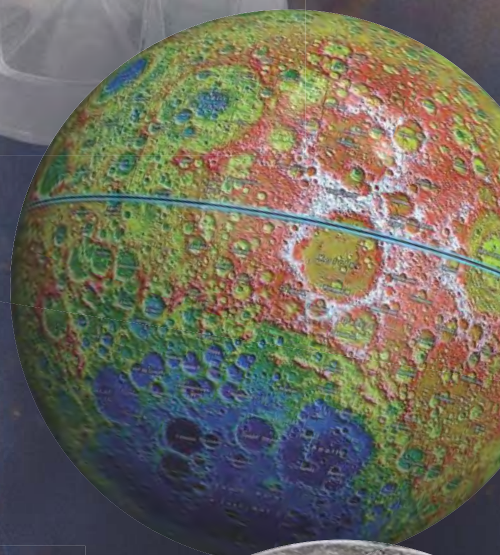

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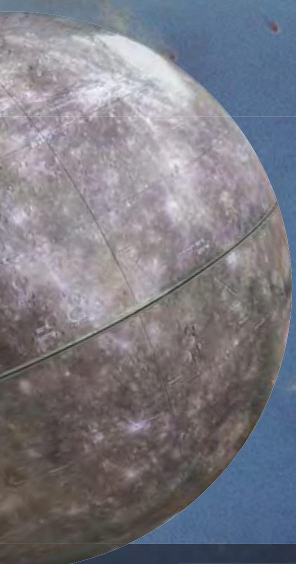

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