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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 61, Number 1, Winter 2019

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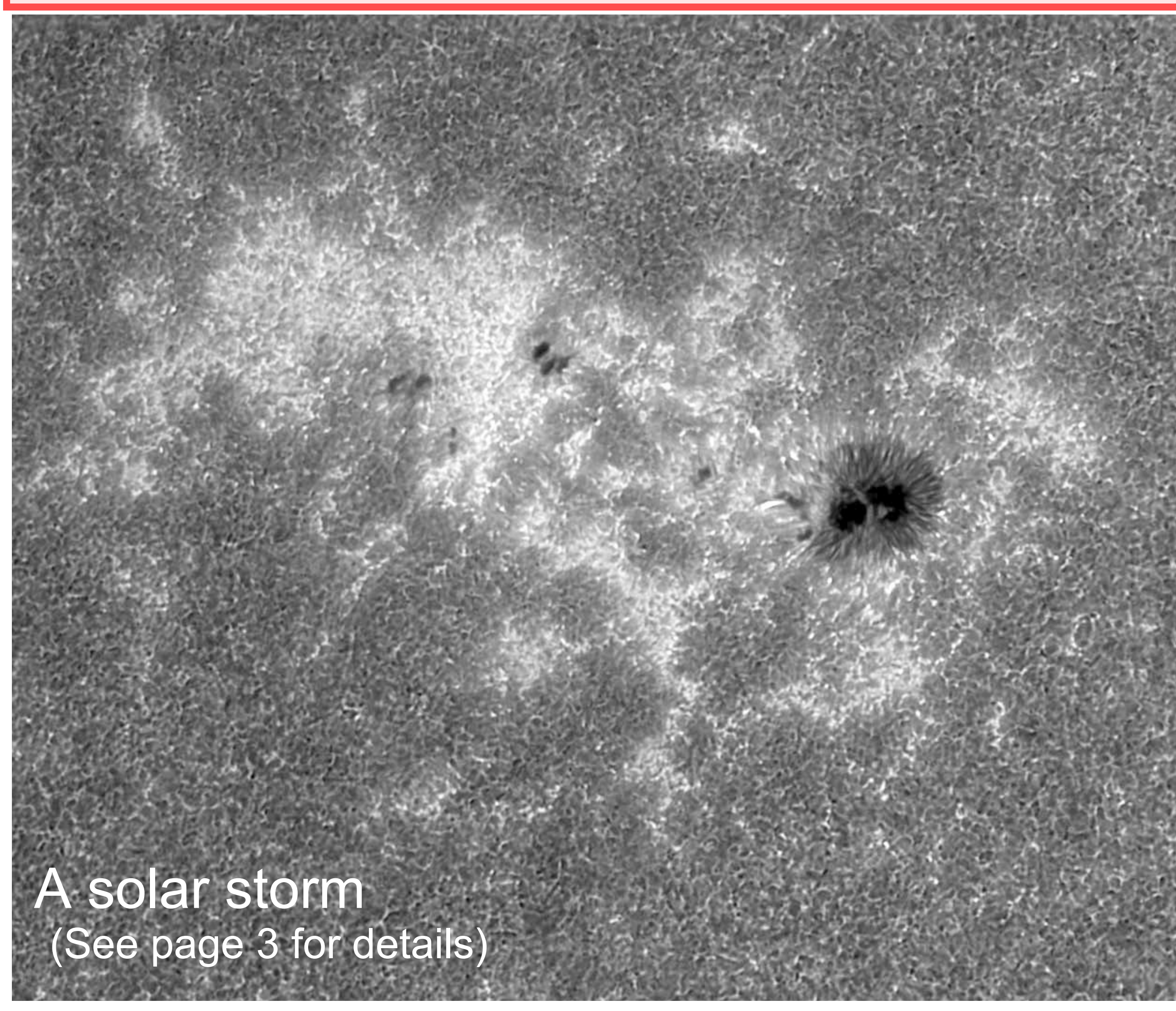
Founded in 1947



A solar storm

(See page 3 for details)

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 61, No.1, Winter 2019
This issue published in December 2018 for distribution in both portable document format (pdf) and 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.

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

Founded in 1947

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Association of Lunar & Planetary Observers (ALPO)

Founded by Walter H. Haas, 1947

Point of View

Catch a Falling Star, But Watch It!'

By Robert Lundsford, ALPO Meteors Section coordinator

What keeps someone awake at night staring up at the sky while lying on their back? It must be something pretty interesting or at least entertaining! I would hope so, or friends and family would think they were a bit odd. Well, when time allows, I do this a lot. Friends and most of the family seem to understand my quest for streaks in the sky. My wife though, even after nearly 40 years of marriage, still doesn't get it. My quest to view nature's fireworks in the form of meteors is a major part of my life. If you have ever seen a fireball brighter than the Full Moon, you would understand.

After a hectic day, I find it relaxing to lie back and take in the starry night, viewing the stars and constellations much the same way they have been for thousands of years. What is different night after night is the meteor activity occurring above. As the Earth revolves around the Sun we encounter numerous orbits of comets and asteroids that leave little bits of material that show up in our skies as meteors. Most of this material is tiny and creates meteors that are barely visible to the eye. But every now and then, a big chunk enters the atmosphere and you have a tremendously bright streak the shoots across the sky, often fragmenting before it finally extinguishes. If the fireball is close by, you may even hear a loud sonic boom a few minutes after the object has disappeared. What's the brightest fireball I have seen? Well, there have been many but the most memorable was during the 1998 Leonid fireball shower. A majority of the meteors that night were of negative magnitude, that is, extremely bright. A few even rivaled the Full Moon. Towards the end of the night a tremendous Leonid shot overhead into the western sky, turning the night sky bright blue and leaving a persistent path that lasted at least 15 minutes. It must have been magnitude -18 if not brighter!

See "Catch a Falling Star" on page 19.

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News of General Interest

Our Cover: A Sunspot to Behold

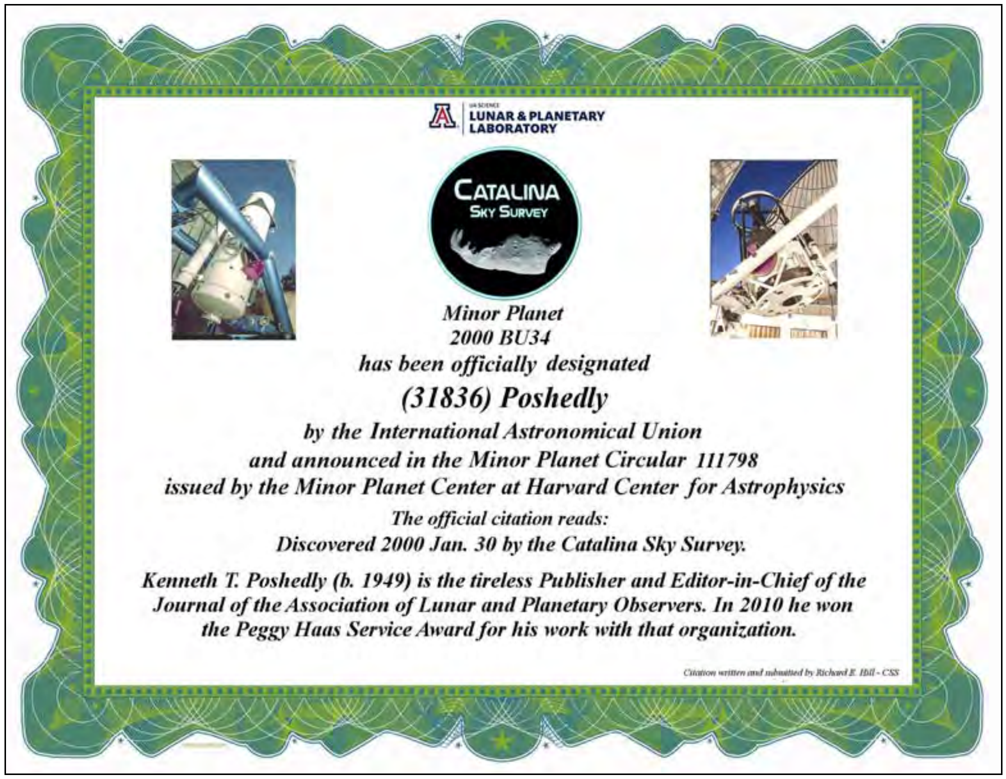
A beautiful and dramatic image by Christian Viladrich of solar active region AR2706 graces the front cover our Journal this time. It was taken 27 April 2018 15:14 UT. More details about this region are included later in this Journal in Rik Hill's write-up about Carrington Rotation 2203.

Equipment and exposure details: Takahashi TOA150 apochromatic refractor with internal 50 mm blue ERF (energy rejection filter); Barr Associates CaK filter 393.35 nm (central wavelength) 0.24 nm (width of the passband or the full width half max of the bell curve of light passed through the filter) FWHM; Scale: 0.24 arc seconds/ pixels; Basler 1920-155 camera; Exposure, 45 frames x 7 milliseconds; Gain, 5300; Solar Scintillation Monitor (Min/Avg/Max) settings, 0.62/1/32/ 2.84 arc seconds.

Note that the roundish umbra in the larger spot is about Earth-size.

Please consider submitting your own work to the APO Solar Section.

Asteroid "31836 Poshedly", a real "rock 'n' roller"



I offer my most humble thanks on this unexpected surprise some weeks ago! While I'm nowhere near the expert observer that many of you are, I just try to offer my own talents to help the ALPO succeed as best I can.

I consider my job sort of like being a drummer in a band (which I also do sometimes; email me separately on that topic). As a drummer, my job is to remain in the background and play as best I can to make the guitarists, keyboardist and everybody else up front look really good. And it seems to be working out.

And Jeff (Beish), maybe if Elon Musk does leave his company, I might get a front-row seat -- so to speak - for a trip to Minor Planet 31836 Poshedly. I'll save a seat for you, too!

It is soooo great to now be associated with you in the higher realms of true science research.

Again, THANK YOU, Rik Hill for your work-behind-the-scenes and to all of you for your support all these many years and the years to come.

ALPO Member Trevor Barry Featured on "60 Minutes Australia"

It's so good to announce that one of our own ALPO members has been recognized in a major way by being featured in a special network news story. Amateur astronomer -- and MAJOR contributor to our own ALPO Saturn Section -- Trevor Barry was the subject of a "60 Minutes Australia" segment a few months ago.

Now age, 67, he continues to promote professional-amateur collaboration by gathering observations using his backyard observatory and submitting them to NASA. Part of the "60 Minutes Australia" story shows Trevor travelling to California and meeting Carolyn Porco, planetary scientist and imaging team leader for the Cassini mission at Saturn at NASA's Jet Propulsion Laboratory, who has been receiving -- and admiring -- Trevor's work for so long

Trevor's knowledge, ability and, most of all, his enthusiasm should be an inspiration to all of us.

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The full "60 Minutes Australia" segment is available to watch on Youtube at this link:

https://www.youtube.com/watch?v=wQQXin1WKVo

ALPO 2019 Conference News

Interested parties are hereby invited to submit papers and research posters on the astronomy-related topics of their choice for presentation at the next ALPO conference to be held jointly with the Southeastern Region of the Astronomical League at Gordon College, in Barnesville, Georgia, Friday and Saturday, July 12 and 13, 2019.

Barnesville is located just southwest of Atlanta and is accessible by air via Atlanta's Hartsfield Airport and by freeway via I-75.

Paper presentations will take place from 9 a.m. to 5 p.m., Friday, with additional papers being presented on Saturday morning as-needed. The annual ALPO board meeting will be held on Saturday afternoon. As is traditional, there will be an awards dinner on Saturday evening.

Presentations should be no longer than approximately 15 minutes in length; the preferred method is 12 minutes for the paper presentation plus several minutes for follow-up questions.

The preferred format is Microsoft PowerPoint.

Research posters, commonly done at other academic and professional conferences everywhere, also requested.

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.

A hard-copy version of your paper should be made available for future web site publication.

More details about paper presentations will be published in the Summer issue of this Journal, for release in early June.

Additional details, including registration and lodging information, will be distributed in the coming weeks.

ALPO Interest Section Reports

ALPO Online Section

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

A report on improvements to the ALPO online image archives is included later in this issue of your ALPO Journal.

The ALPO web site is now up and fully operational following a major service upgrade by our by our internet service provider.

The ALPO Publications Section portion of the web site is now partially uploaded with only JALP issues previous to 2001 yet left to be uploaded.

Follow us on Twitter, "friend" us 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 & 'Observers Notebook' Podcasts

Tim Robertson, program coordinator
cometman@cometman.net

ALPO Lunar & Planetary Training Program

The ALPO Lunar & Planetary Training Program currently has five active

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students at various stages of the program.

Ours is a two-step program, and there is no time requirement for completing the steps. But I have seen that those students that are motivated usually complete the steps in a short amount of time. The motivation comes from the desire to improve their observing skills and contribute to the pages of the Journal of the ALPO.

The Lunar & Planetary Training Program is open to all members of the ALPO, 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.

The course of instruction for our program is two-tiered.

- The first tier is the "Basic Level" and includes reading the ALPO's Novice Observers Handbook and mastering the fundamentals of observing. These fundamentals include performing simple calculations and understanding observing techniques.
- When the student has successfully demonstrated these skills, he or she can then advance to the "Novice Level" for further training where one can specialize in one or more areas of study. This includes obtaining and reading handbooks for specific lunar and planetary subjects. The novice then continues to learn and refine upon observing techniques specific to his or her area of study and is assigned to a tutor to monitor the novice's progress in the Novice Level of the program.

When the novice has mastered this final phase of the program, that person can then be certified to "Observer Status" for that particular field.

'Observers Notebook' Podcasts

The ALPO's *Observers Notebook* series of podcasts is coming up on two years old. I have recorded over 60 podcasts with various members of the ALPO, mostly section coordinators, to highlight the programs within each section.

A new *Observers Notebook* podcast is released every about every two weeks, and if you subscribe to it via iTunes it will automatically be downloaded to your device.

The length of the podcast averages around 30 minutes in length. The longest podcast thus far is over 1 hour and 30 minutes. But we can record longer, there is no time limit – the hosting service that I am using has unlimited space available for podcasts.

It takes a great amount of time and money to make and produce the podcast. Thus far, it has been done with the help of a service called "Patreon", and we currently have five supporters – two of whom are NOT members of the ALPO!

PLEASE the *Observers Notebook* podcasts by giving as little as $1 a month; for $5 per month, you receive early access to the podcast before it goes public, for a monthly donation of $10, you receive a copy of *the Novice Observers Handbook*, and for $35 a month, you receive producer credits on the podcast and a one year membership to the ALPO. You can help us out by going to the link below:

https://www.patreon.com/ObserversNotebook

The most recent podcasts now available include a fun conversation with solar observer John O'Neal who talked about the Parker Solar Probe. I got the Mercury Section Coordinator Frank Melillo to discuss his section, Mike Reynolds came on to talk about the upcoming (January 2019) total lunar eclipse, and soon you will hear one of our member profile podcasts with *Observers Notebook* Patreon donor Steve Siedentop.

If you have an idea for a podcast subject matter, please drop me a note. I would like to have a discussion on the use of color filters for planetary observing and how you plan your own evening observing sessions. I am also looking for member profile pieces where we get to know the members of the ALPO. Please contact me if any of you would be interested in discussing those subjects.

Our podcasts will also be used to get the word out on any breaking astronomy news or events happening in the night sky. So let me know if you have any breaking news that you want announced.

Here are a few interesting statistics you might be interested in as well:

- Number of downloads as of November 2018: 12,800+

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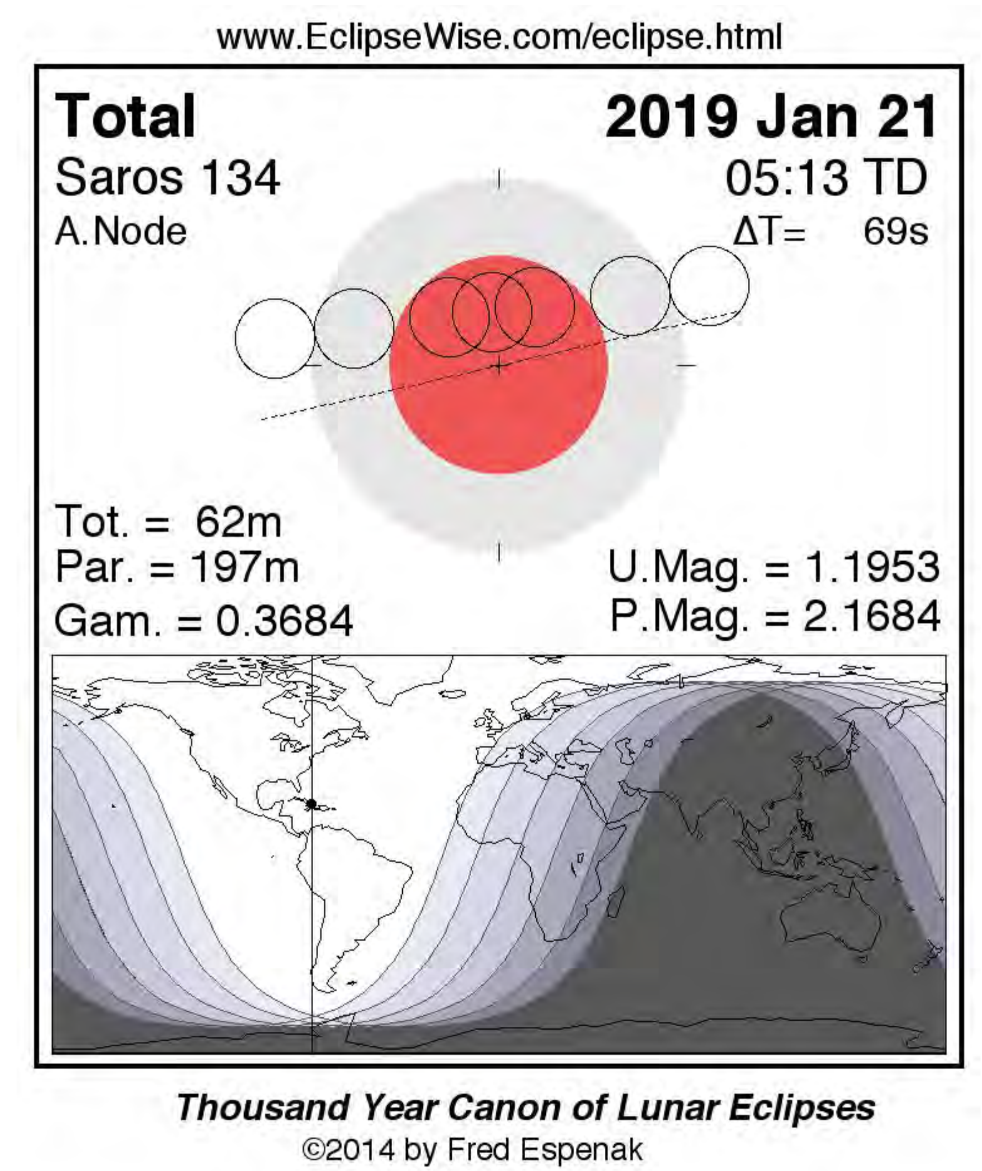

Table of January 2019 Lunar Eclipse Event Times and Other Data

Eclipse Event/Contact	Contact	Time, UT; January 21, 2019	Contact Position Angle, PA
Penumbral Eclipse Starts	P1	02:36:28.8	290.6°
Partial Eclipse Starts	U1	03:33:55.0	298.0°
Totality Begins	U2	04:41:18.6	327.8°
Greatest Eclipse		05:12:18.0	6.9°
Totality Ends	U3	05:43:18.1	46.0°
Partial Eclipse Ends	U4	06:50:42.0	75.7°
Penumbral Eclipse Ends	P4	07:48:05.8	83.2°

- Number of Subscribers (all formats): 200+
- Average of number daily downloads (last 3 months): 53
- iTunes rating: 5 Stars!
- Locations of most downloads: USA, UK, Canada, Turkey, Australia, Sweden, and Mexico.

The number one most downloaded podcast so far is with Carl Hergenrother where we discuss the "Bright Comets of 2018" (episode 33).

You can hear the podcast on iTunes, Stitcher, iHeart Radio, Amazon Echo, and Google Play just search for *Observers Notebook*. You can also listen to it at the link below:

https://soundcloud.com/observersnotebook

The *Observers Notebook* is also on Facebook – just search for "Observers Notebook" in the search field on top.

Thanks for listening!

For more information about the ALPO Lunar & Planetary Training Program or the *Observers Notebook*" podcasts, contact Tim Robertson at:
• (e-mail) cometman@cometman.net
•(regular mail) Tim Robertson
195 Tierra Rejada Rd #148
Simi Valley CA, 93065

ALPO Observing Section Reports

Eclipse Section

Mike Reynolds, section coordinator
m.d.reynolds@fscj.edu

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A report on X-band observations made during the 2017 Great American Solar Eclipse is included later in this issue of your ALPO Journal.

A three-page ALPO Lunar Eclipse Observers' Report Form and explanatory paper by the late John Westfall titled "Timing an Eclipse of the Moon with the Unaided Eye" are included in this issue of your ALPO Journal.

Observers in the Central Pacific, Americas, Europe and Africa are well-placed for a total lunar eclipse on Sunday night, January 20/Monday morning, January 21, 2019, a member of Saros 134. The Moon will not pass as deeply into Earth's umbral shadow, with only 62 minutes of totality, compared to last summer's total lunar eclipse on July 27, 2018 experiencing 103 minutes of totality.

Usually a shallow lunar passage through Earth's umbral shadow such as this eclipse indicates a colorful and/or bright totality.

For U.S. observers, the times for this eclipse are good; see the accompanying table for details.

Observation forms are available at alpo-astronomy.org under the Eclipse Section. Please send your total lunar eclipse reports to our acting assistant section coordinator:

Keith Spring
2173 John Hart Circle
Orange Park, FL 32073

E-mail -- star.man13@hotmail.com

Visit the ALPO Eclipse Section online at www.alpo-astronomy.org/eclipseblog

Mercury / Venus Transit Section

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

Meteors Section

Robert Lunsford, section coordinator
lunro.imo.usa@cox.net

A reminder here that your section recorder has taken advantage of podcasts to verbally spread the news of upcoming major meteoric events. Tim Robertson does a great job asking interesting questions while I try my best not to bore the listener! Give these podcasts a try at:

https://soundcloud.com/observersnotebook

Be sure to also check out the other interesting podcasts offered by the many sections of ALPO!

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

Meteorites Section

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

Section News

This report includes an example of a potential amateur-professional collaboration and information about meteorite highlights and new meteorite approvals from August 1, 2018 to October 31, 2018 from the Meteoritical Society's Nomenclature Committee. We received several inquiries about suspected meteorites, most of which are terrestrial and do not require further analysis.

As always, ALPO members who collect meteorites are encouraged to report unusual features in their meteorite samples that might be of interest to researchers for specialized analysis.

Meteorite photographer extraordinaire John Kashuba brought a special sample of the Almahata Sitta ureilite (formerly known as asteroid 2008 TC3) to our attention for further (non-destructive) investigation by a meteoriticist or graduate student. It exhibits an interesting large inclusion that is probably diamond.

Meteorite News

Noteworthy meteorite falls approved during this period were:

- The Aba Panu L3 chondrite fall in Nigeria on April 19, 2018.
- Tintigny, a brecciated eucrite "probable fall" in Luxembourg that fell through a roof in 1971.
- The Mangui L6 chondrite from Yunnan, China, that contains black shock-melt veins. One of the Mangui stones fell through a farmer's "silt" roof.

The Meteoritical Bulletin* records officially recognized, classified meteorites of the world's inventory. As of October 31, 2018, it contains a total of 59,824 meteorites (in contrast to 793,095 known asteroids recorded by the IAU Minor Planet Center**). There were 568 new meteorites approved; most from desert regions and Antarctica. Newly approved meteorites include the following:

- 476 ordinary chondrites
- 22 carbonaceous chondrites
- 2 CK chondrites
- 1 R chondrite
- 8 irons
- 2 pallasites
- 5 ureilites

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- 34 HEDs
- 5 lunar
- 5 Martian
- 3 lodranites
- 1 ungrouped achondrite
- 1 enstatite achondrite-ungrouped
- 1 angrite
- 2 winonaites

For more information and official details on particular meteorites, go to https://www.lpi.usra.edu/meteor/metbull.php

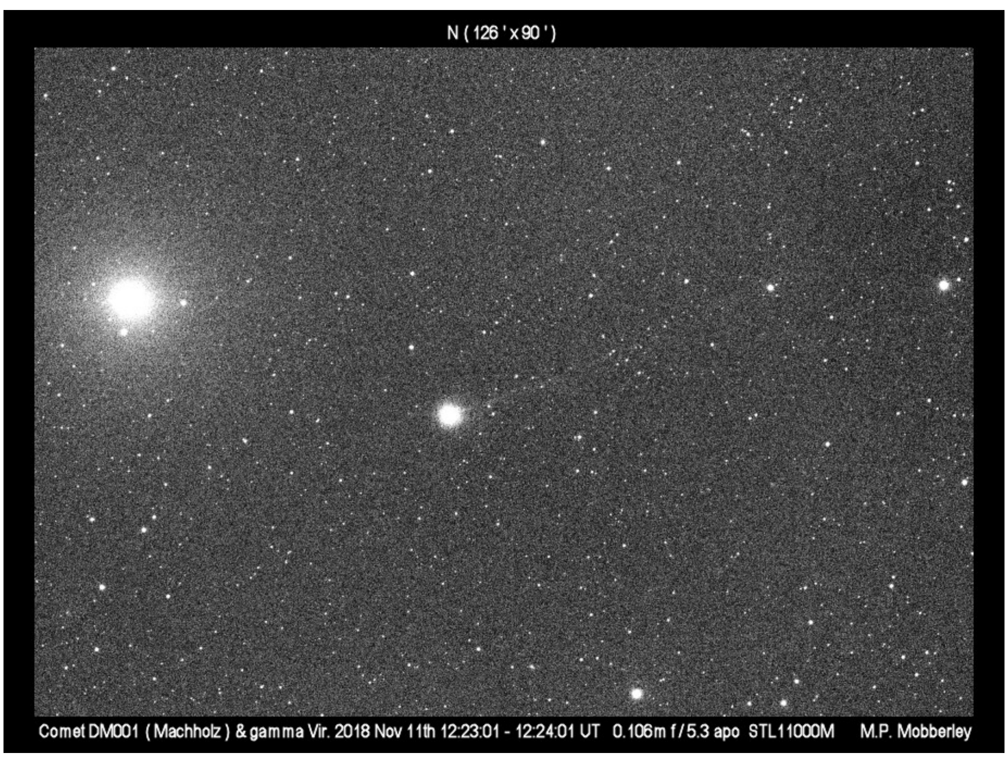
Miller Range 15430, an H5 chondrite Antarctica, was the smallest meteorite reported this period with a mass of only 0.17 grams. The largest meteorite approved was Aba Panu, the 160 kg L3 fall from Nigeria. Note that there have only been 12 recorded type L3 falls.

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

Comets Section

Report by Carl Hergenrother, section coordinator
carl.hergenrother @ alpo-astronomy.org

The year 2018 ended with a flurry of comet activity. During the past few months leading up to mid-November, a number of comets have become brighter than 10th magnitude including 21P/Giacobini-Zinner, 38P/Stephan-Oterma, 46P/Wirtanen, 64P/Swift-Gehrels and newly discovered C/2018 V1 (Machholz-Fujikawa-Iwamoto). By the time you read this, 46P/Wirtanen will have passed within 0.087 AU of Earth in December and peaked at 3rd magnitude, resulting in a naked-eye comet for dark sky observers.



CCD image of comet C/2018 V1 (Machholz-Fujikawa-Iwamoto) taken by Martin Mobberley with iTelescope's T14 FSQ106 telescope in New Mexico.

The most exciting comet event of the past few months weight years. Former ALPO Comet Section Coordinator Don Machholz discovered C/2018 V1 (Machholz-Fujikawa-Iwamoto) on November 7 with his 0.47-m reflector at 113x. Don spent 746 hours of visual hunting since his last discovery. The comet was also independently discovered by two Japanese CCD observers, Shigehisa Fujikawa and Masayuki Iwamoto. This is Machholz's 12th discovery and his first since C/2010 F4, the second for Iwamoto after his find of C/2013 E2 (Iwamoto) and the seventh discovery named for Fujikawa. While Fujikawa's first comet was C/1969 P1 (Fujikawa) and his previous discovery was C/2002 X5 (Kudo-Fujikawa), he also independently discovered two comets in 1968.

The ALPO Comet Section is grateful to the following observers who contributed observations during past three months: magnitude estimates of comets C/2018 V1 (Machholz-Fujikawa-Iwamoto), C/2018 N2 (ASASSN), C/2018 N1 (NEOWISE), C/2018 L2 (ATLAS), C/2017 T3 (ATLAS), C/2017 T2 (PANSTARRS), C/2017 S3 (PANSTARRS), C/2017 M4 (ATLAS), C/2016 R2 (PANSTARRS), C/2016 N6 (PANSTARRS), C/2016 M1 (PANSTARRS), C/2015 V2 (Johnson), 364P/PANSTARRS, 66P/du Toit, 64P/Swift-Gehrels, 48P/Johnson, 46P/Wirtanen, 38P/Stephan-Oterma, 37P/Forbes, 29P/Schwassmann-Wachmann and 21P/Giacobini-Zinner by Salvador Aguirre, Juan Jose Gonzalez, Carl Hergenrother, Raymond Ramlow, John Sabia, Willian Souza, and Christopher Wyatt. CCD images were received from Salvador Aguirre, Charles Bell, John Chumack, Carl Hergenrother, Gianluca Masi, Martin Mobberley, Mike Olason, Raymond Ramlow and John Sabia of comets C/2016 N6 (PANSTARRS), C/2016 M1 (PANSTARRS), 364P/

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Ephemerides for Comets 38P/Stephan-Oterma, 46P/Wirtanen, 64P/Swift-Gehrels

Date	R.A.	Decl.	r (au)	d (au)	Elon (deg)	m1	Const	Max El 40°N	Max El 40°S
38P/Stephan-Oterma									
2019 Jan 01	08 35.34	+40 47.1	1.71	0.79	150	9.9	Lyn	89	9
2019 Jan 11	08 35.02	+43 50.7	1.76	0.83	153	10.4	Lyn	86	6
2019 Jan 21	08 32.21	+45 59.8	1.82	0.88	153	10.9	Lyn	84	4
2019 Jan 31	08 28.84	+47 10.7	1.88	0.96	150	11.5	Lyn	83	3
2019 Feb 10	08 26.73	+47 28.1	1.95	1.06	144	12.1	Lyn	83	3
2019 Feb 20	08 27.09	+47 02.6	2.02	1.17	137	12.8	Lyn	83	3
2019 Mar 02	08 30.28	+46 05.7	2.09	1.30	131	13.4	Lyn	84	4
2019 Mar 12	08 36.15	+44 47.1	2.17	1.45	124	14.1	Lyn	85	5
2019 Mar 22	08 44.29	+43 14.2	2.25	1.60	117	14.8	Lyn	87	7
2019 Apr 01	08 54.16	+41 32.3	2.33	1.77	111	15.4	Lyn	89	9
46P/Wirtanen									
2019 Jan 01	07 01.47	+57 20.6	1.09	0.12	145	4.1	Lyn	72	0
2019 Jan 11	08 27.04	+59 32.5	1.13	0.18	140	5.1	Lyn	71	0
2019 Jan 21	09 06.76	+57 53.0	1.18	0.24	140	6.2	Uma	72	0
2019 Jan 31	09 23.32	+55 15.1	1.24	0.31	141	7.2	Uma	75	0
2019 Feb 10	09 30.28	+52 11.4	1.31	0.38	142	8.3	Uma	78	0
2019 Feb 20	09 34.42	+48 52.8	1.39	0.47	141	9.4	Uma	81	1
2019 Mar 02	09 38.62	+45 28.6	1.47	0.57	139	10.5	Uma	85	5
2019 Mar 12	09 44.02	+42 05.0	1.55	0.68	135	11.5	Uma	88	8
2019 Mar 22	09 50.99	+38 47.2	1.64	0.80	130	12.5	LMi	89	11
2019 Apr 01	09 59.35	+35 37.9	1.72	0.94	125	13.5	LMi	85	15
64P/Swift-Gehrels									
2019 Jan 01	02 57.60	+29 54.4	1.56	0.73	129	10.2	Ari	80	18
2019 Jan 11	03 21.58	+28 42.1	1.61	0.83	124	10.8	Ari	79	19
2019 Jan 21	03 44.99	+27 42.4	1.67	0.95	119	11.6	Tau	78	19
2019 Jan 31	04 07.76	+26 53.5	1.73	1.08	114	12.4	Tau	77	20
2019 Feb 10	04 29.95	+26 12.6	1.80	1.22	109	13.3	Tau	76	20
2019 Feb 20	04 51.60	+25 37.1	1.87	1.37	103	14.3	Tau	75	21
2019 Mar 02	05 12.74	+25 04.2	1.95	1.53	98	15.2	Tau	73	21
2019 Mar 12	05 33.40	+24 31.8	2.02	1.71	93	16.2	Tau	68	22
2019 Mar 22	05 53.61	+23 58.2	2.09	1.88	87	17.1	Tau	63	22
2019 Apr 01	06 13.34	+23 22.2	2.17	2.07	82	18.0	Gem	57	22

PANSTARRS, 64P/Swift-Gehrels, 48P/Johnson, 46P/Wirtanen, 38P/Stephan-Oterma, 37P/Forbes and 21P/Giacobini-Zinner.

I would also like to thank Jim Melka and Martin Mobberley for recently agreeing to contribute their collection of comet images to the Comet Section archives.

2019 starts with the same objects gracing the sky as in late 2018. After its close approach to Earth in December, 46P/Wirtanen will still be a bright object as 2019 begins. The comet should start the year around magnitude 4.1, but quickly fade to around 7.2 by the end of January, 10.3 by the end of February and 13.5 by the end of March. Halley-type comet 38P/Stephan-Oterma will start the year at around magnitude 10.0 or a bit brighter, but also fade to 11.5 by the end of January and 15.4 by the end of March. No other comets are expected to be brighter than magnitude 10 during the January-to-March quarter, though 64P/Swift-Gehrels should start January around magnitude 10.2 before rapidly fading.

Looking ahead to the rest of 2019, only long period comet C/2017 T2 (PANSTARRS) is expected to become a bright object. It will be a 9th magnitude object by the end of the year as it brightens to peak in 2020 of 7th-8th magnitude.

As always, the Comet Section is happy to receive all comet observations, whether images, drawings, magnitude estimates, and even spectra. Please send your observations via email to *carl.hergenrother @ alpo-astronomy.org*

Drawings and images of current and past comets are being archived in the ALPO Comets Section image gallery at *http://www.alpo-astronomy.org/gallery/main.php?g2_itemId=4491*

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

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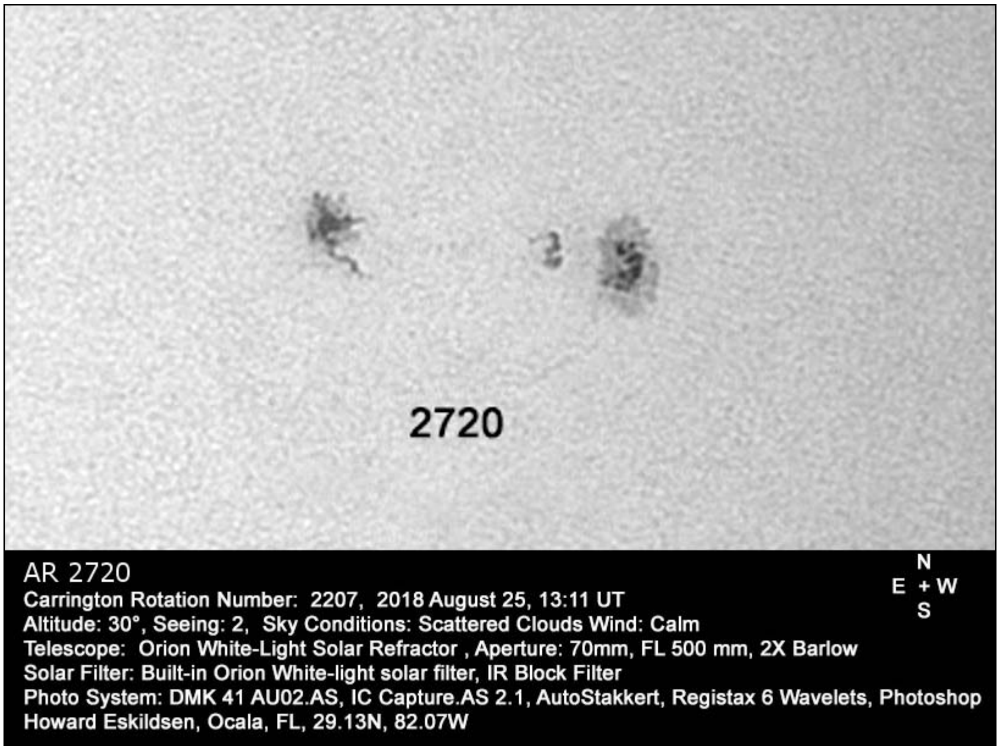

Solar Section

Report by Rik Hill, section coordinator & science advisor
rhill@lpl.arizona.edu

A report on Carrington Rotations 2202 through 2205 is included inside this issue of your ALPO Journal.

Solar activity is low but we still have over a year to the predicted nadir. At this writing, we have had 185 spotless days in 2018 (60%), which is normal.

So far in the current year, our archive has received over 2,500 images and reports, a true testament to the perseverance of our observers. That works out to over 200 submissions per rotation. The highest number of submissions were made during rotation CR2007, from August 6th till September 2nd. This rotation made the news because of AR2720 (on the Sun from 8/24-8/29) that showed reversed polarity in magnetograms, suggesting it might be a cycle 25 active region (Figure A).

This interpretation has been disputed because of its low latitude (+08) being very uncharacteristic of a new cycle spot which should be around ±45°. Still, reverse polarity will be a hallmark of any cycle 25 spots whenever they do start to appear.

Our email list continues as the main mode of rapid communication among observers. Its smooth operation is due to Rick Gossett's vigilance. It's a good way to share information about solar and Section activity as seen from our members around the world.

Pam Shivak, after getting settled in her new home, continues to keep our presence on FaceBook where a lot of our new members come from and where the ALPO has its own page.

The new ALPO Solar Section poster has been distributed to our staff. If you see it at meetings, take a quick pic of it and post it on one of the social media so we can gloat!

Sunny skies to all!

To join the Yahoo Solar ALPO e-mail list, please go to *https://groups.yahoo.com/neo/groups/Solar-Alpo/info*

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

Mercury Section

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

The 2017 Mercury apparition report is included inside this issue of your ALPO Journal.

As we enter 2019, I am hoping that many of you observed Mercury during the favorable morning apparition in December. I myself have some images and am looking forward to receiving your observations throughout the rest of the year 2018.

There are a few things to look forward to in 2019, like the transit of Mercury on November 11, plus another morning apparition, which will be very favorable in November — especially the second half. More information will follow in future issues.

Please send in your observations to the Mercury section so we can have nice coverage of its favorable morning apparition of the year.

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

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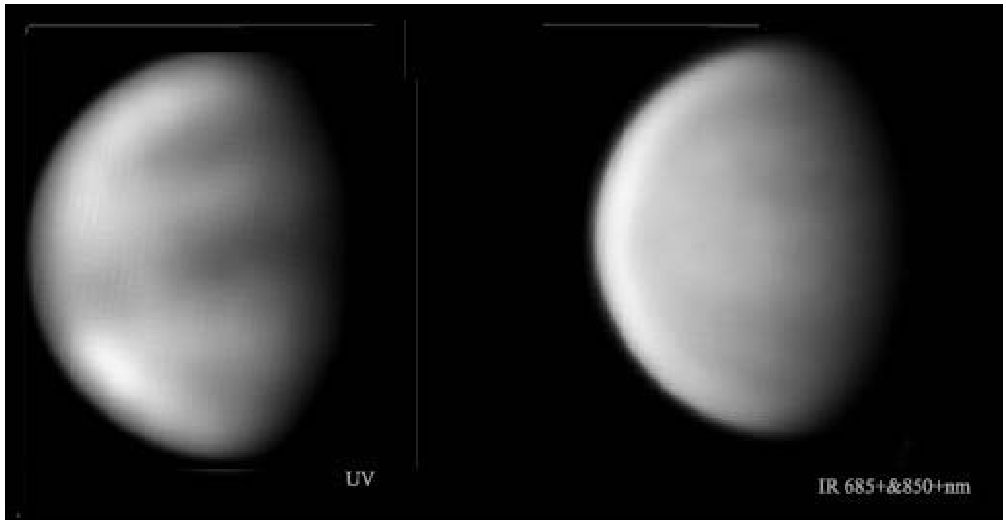
Venus Section

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



Manos Kardasis of Athens, Greece submitted these comparative excellent UV and IR images taken at 18:15UT on June 1, 2018 employing his 35.6cm (14.0 in) SCT (Schmidt-Cassegrain) in very good seeing conditions. Both images show a shaded and somewhat irregular terminator, and most notably in the UV image the characteristic horizontal V, Y, or ψ (psi)-shaped dusky clouds that are typically aligned along the planet's equatorial region and terminator in ultraviolet wavelengths. The north and south cusp caps are visible. The apparent diameter of Venus is 13.3", gibbous phase (k) 0.800 (80% illuminated), and visual magnitude -3.8. South is at top of image.

Venus entered Inferior Conjunction with the Sun back on October 26, 2018, thereby marking the end of the 2018 Eastern (Evening) Apparition. Venus rises ahead of the Sun by several hours as the new year begins, reaching greatest elongation West on January 6, 2019, roughly a day after appearing at theoretical dichotomy (predicated half-phase) on January 5th.

During the current 2018-19 Western (Morning) Apparition, Venus is passing through its waxing phases as it shrinks in angular diameter, slowly changing from a thin crescent to a gibbous and ultimately a fully illuminated disk as it reaches Superior Conjunction on August, 14, 2019.

The accompanying table of Geocentric Phenomena in Universal Time (UT) are presented for the convenience of observers for the 2018-19 Western (Morning) Apparition:

As of the date of this report, it is expected that the ALPO Venus Section observers should soon begin submitting images taken in integrated light, color filters, and at UV and IR wavelengths, as well as visual drawings for the 2018-19 Western (Morning) Apparition.

Readers of this Journal should be well-acquainted with our on-going collaboration with professional astronomers as exemplified by our sharing of visual observations and digital images at various wavelengths during ESA's previous Venus Express (VEX) mission that ran from 2006 and ended in 2015. It remains as one of the most successful Pro-Am efforts involving ALPO Venus observers around the globe. These observations shall remain important for further study and will continue to be studied and analyzed for several years to come as a result of this endeavor. For reference, the VEX website is

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

Geocentric Phenomena of the 2018-19 Western (Morning) Apparition of Venus in Universal Time (UT)

Inferior Conjunction	2018 Oct 26 14^h (angular diameter = 61.8°)
Predicted Dichotomy	2019 Jan 05.81 d (Venus is predicted to be exactly half-phase)
Greatest Elongation West	2019 Jan 06 05^h (46°)
Superior Conjunction	2019 Aug 14 06^h (angular diameter = 61.8")

A follow-up Pro-Am effort is underway with Japan's (JAXA) *Akatsuki* mission that began full-scale observations a year ago beginning in April 2016, and is continuing well into 2018-19; the website for *Akatsuki* mission has already "gone live" so that interested and adequately equipped ALPO observers can still register and start submitting images if they have not already done so. More information will continue to be provided on the progress of the mission in forthcoming reports in this Journal.

It is extremely important that all observers participating in the programs of the ALPO Venus Section always first send their observations to the ALPO Venus Section at the same time submittals are contributed to the *Akatsuki* mission.

This will enable full coordination and collaboration between the ALPO Venus Section and the *Akatsuki* team in collection and analysis of all observations

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Lunar Calendar for January through March 2019

Jan	01	16:50	Moon-Venus: 1.4° S
	03	02:37	Moon-Jupiter: 3.4° S
	05	13:46	Moon South Dec.: 21.6° S
	05	20:28	New Moon
	05	20:41	Partial Solar Eclipse
	06	19:08	Moon Descending Node
	08	23:29	Moon Apogee: 406100 km
	14	01:46	First Quarter
	19	18:20	Moon North Dec.: 21.5° N
	20	17:48	Moon Ascending Node
	21	00:12	Total Lunar Eclipse
	21	00:16	Full Moon
	21	14:58	Moon Perigee: 357300 km
	27	16:11	Last Quarter
	30	18:54	Moon-Jupiter: 3° S
	31	12:36	Moon-Venus: 0.1° S
Feb	01	19:48	Moon South Dec.: 21.5° S
	02	02:18	Moon-Saturn: 0.7° S
	03	01:35	Moon Descending Node
	04	16:04	New Moon
	05	04:26	Moon Apogee: 406600 km
	12	17:26	First Quarter
	16	04:56	Moon North Dec.: 21.6° N
	17	04:42	Moon Ascending Node
	19	04:06	Moon Perigee: 356800 km
	19	10:53	Full Moon
	26	06:28	Last Quarter
	27	09:17	Moon-Jupiter: 2.5° S
Mar	01	01:23	Moon South Dec.: 21.6° S
	01	13:40	Moon-Saturn: 0.3° S
	02	06:03	Moon Descending Node
	02	16:28	Moon-Venus: 1.3° N
	04	06:25	Moon Apogee: 406400 km
	06	11:04	New Moon
	14	06:27	First Quarter
	15	13:59	Moon North Dec.: 21.8° N
	16	12:22	Moon Ascending Node
	19	15:47	Moon Perigee: 359400 km
	20	21:43	Full Moon
	26	22:28	Moon-Jupiter: 2° S
	28	00:10	Last Quarter
	28	09:02	Moon South Dec.: 21.9° S
	29	01:11	Moon-Saturn: 0.1° N
	29	09:08	Moon Descending Node
	31	20:14	Moon Apogee: 405600 km

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

whether they are submitted to the *Akatsuki* team or not. If there are any questions, please do not hesitate to contact the ALPO Venus Section for guidance and assistance.

Those still wishing to register to participate in the coordinated observing effort between the ALPO and Japan's (JAXA) *Akatsuki* mission should utilize the following link:

https://akatsuki.matsue-ct.jp/

The observation programs of the ALPO Venus Section are listed on the Venus page of the ALPO website at *http://www.alpo-astronomy.org/venus* as well as in considerable detail in the author's *ALPO Venus Handbook* available from the ALPO Venus Section as a pdf file.

Observers are urged to attempt to make simultaneous observations by performing digital imaging of Venus at the same time and date that others are imaging or making visual drawings of the planet. Regular imaging of Venus in both UV, IR and other wavelengths is important, as are visual numerical relative intensity estimates and reports of features seen or suspected in the atmosphere of the planet (for example, dusky atmospheric markings, visibility of cusp caps and cusp bands, measurement of cusp extensions, monitoring the Schröter phase effect near the date of predicted dichotomy, and looking for terminator irregularities).

Routine use of the standard ALPO Venus observing form will help observers know what should 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 observing form is located online at:

http://www.alpo-astronomy.org/gallery/main.php?g2_view=core.DownloadItem&g2_itemId=85642

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Venus observers should monitor the dark side of Venus visually for the Ashen Light and use digital imagers to capture any illumination that may be present on the plane as a cooperative simultaneous observing endeavor with visual observers. Also, observers should undertake imaging of the planet at near-IR wavelengths (for example, 1,000 nm), whereby the hot surface of the planet becomes apparent and occasionally mottling shows up in such images attributable to cooler dark higher-elevation terrain and warmer bright lower surface areas in the near-IR.

The ALPO Venus Section encourages 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 200 observations from 22 observers during the July-September quarter.

Fourteen contributed articles were published in addition to numerous commentaries on images submitted.

Bill Dembowski continued the series of articles on lunar rays and the *Focus-On* series continued under Jerry Hubbell, with articles on Magnetic Anomalies and the Apollo 17 Region.

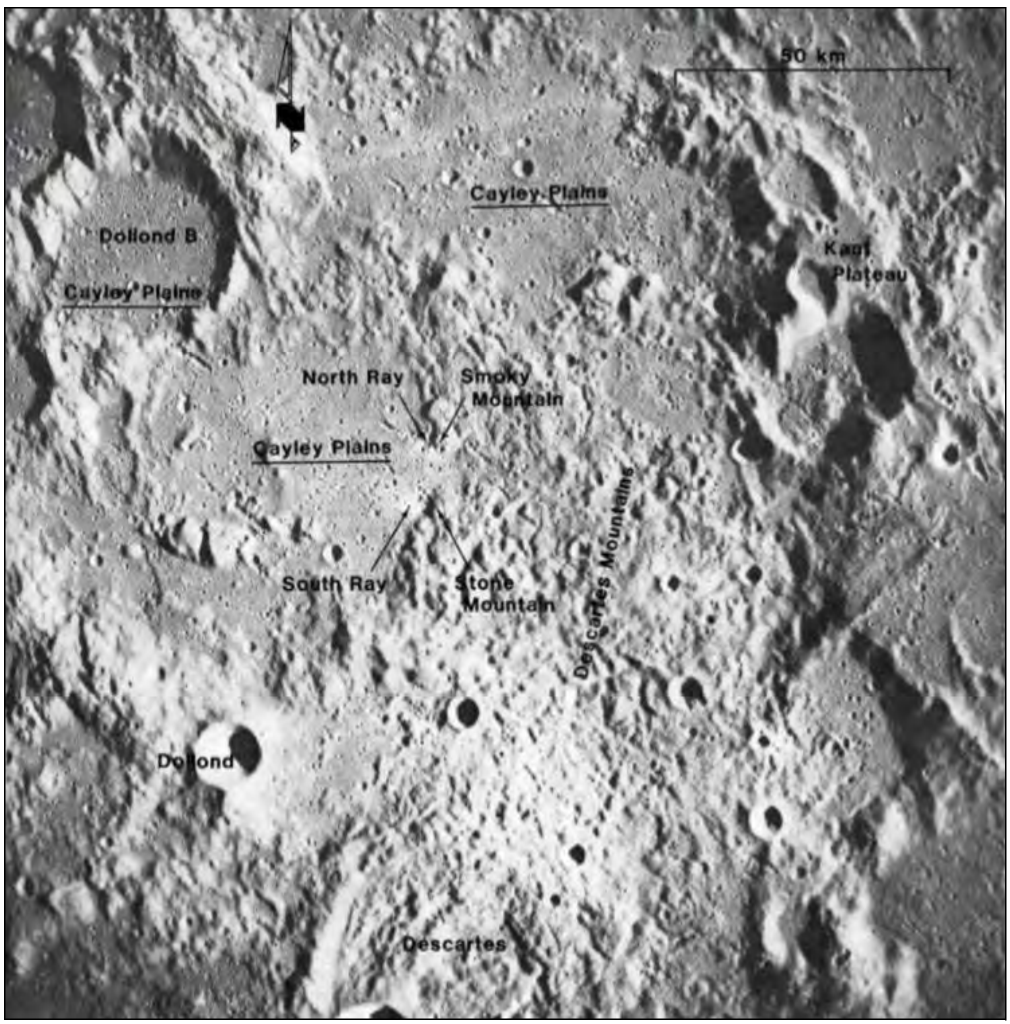
The next *Focus-On* subjects will continue the series on each of the Apollo landing sites.

Electronic submissions can now be submitted through the ALPO website, *(lunar@alpo-astronomy.org).* (The former method of sending them to both myself and Jerry Hubbell will still work, but please don't submit both through the website and directly). See the most recent issue of *The Lunar Observer* *(moon.scopesandscapes.com/tlo)* for instructions on its use. Hard copy submissions should continue to be mailed to me at the address listed in the ALPO resources section of the Journal.

The lunar image gallery/archive is also now active. By the end of the year all images submitted in 2018 should be available. Images will continue to be inserted, working back through the years

Thanks to Theo Ramakers and Larry Owens for setting up the gallery.

Visit the following online web site for more info moon.scopesandscapes.com (including current and archived issues of



Apollo 16 Landing Site – Descartes and Cayley Plains, NASA Apollo Mission metric camera frame 439. (Source: November 2018 *The Lunar Observer*.)

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The Lunar Observer).

Lunar Meteoritic Impacts

Brian Cudnik,
program coordinator
cudnik@sbcglobal.net

Two reports of impacts were received over the last three months:.

The ROCG (Remote Observatory of Campos dos Goytazes) group in Brazil reported a lunar meteor impact candidate, which occurred at 21:31:14 UTC on 14 August 2018. Their image is shown below. This may have been a Perseid meteor, as the peak of this shower occurred two days earlier. The Moon was favorably placed in the days immediately before (as a waning crescent) and after (as a waxing crescent) the peak of the Perseids.

Another report was received from Nicolás Bonini from Montevideo, Uruguay, who observed visually a possible lunar meteor impact, on 14 November at 01:23 UT. Unfortunately this was not reported to the nearest second. The event was viewed with a Celestron Powerseeker 127 mm f/8 Newtonian scope and a 10mm eyepiece. It was a point-like flash, a "dot of light on the dark side" that lasted a second or less, viewed in the area of Mare Nubium and Mare Humorum and estimated to have a visual magnitude between 5.5 and 6. This happened while the person was setting up to observe the occultation of a star in Capricornus, which has a very similar brightness.

We seek confirming observations for both of these two lunar impact candidates. The Lunar Meteoritic Impact Section will continue the ongoing work of coordinating observations for this and other meteor showers throughout the remainder of 2018 and beyond. Check the ALPO website and/or join the Lunarimpacts listserve for more information.

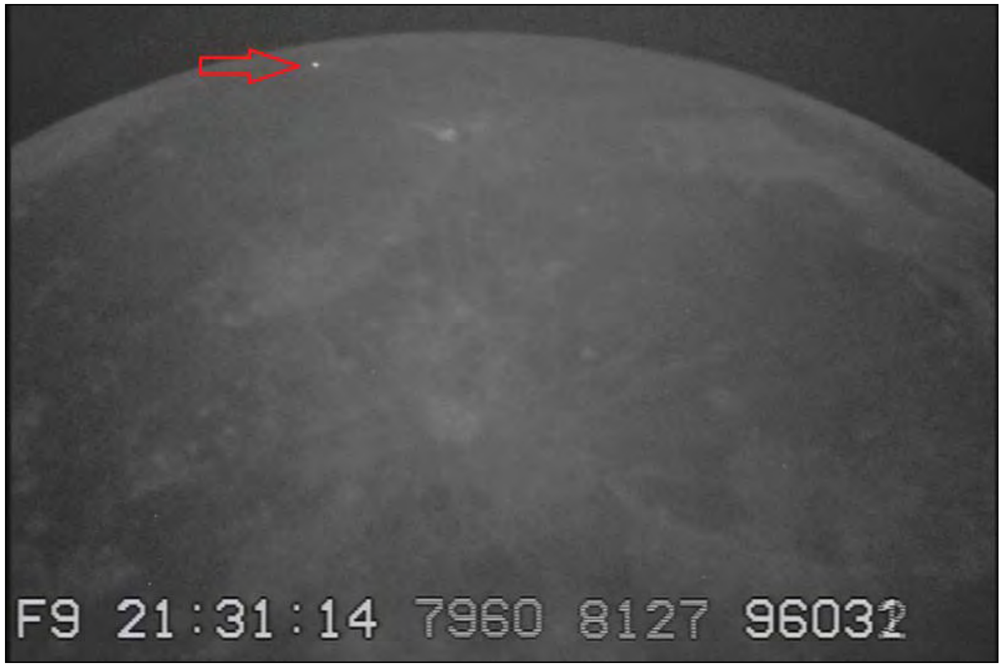

Image by the Remote Observatory of Campos dos Goytazes group in Brazil of possible lunar meteoritic impact on 14 August 2018. See text for more details.

Please visit the ALPO Lunar Meteoritic Impact Search site online at *http://alpo-astronomy.org/lunarupload/lunimpacts.htm*

Lunar Transient Phenomena

Report by Dr. Anthony Cook,
program coordinator
tony.cook@alpo-astronomy.org

We welcome new participants in our program, whether they are experienced visual observers, or high-resolution lunar imagers. This helps us to solve some past historical lunar observational puzzles.

A list of dates and UTs to observe repeat illumination events can be found on: *http://users.aber.ac.uk/atc/lunar_schedule.htm*, and LTP observational alerts are given on this Twitter page: *https://twitter.com/lunarnaut*

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

Lunar Domes

Report by Raffaello Lena,
acting program coordinator
raffaello.lena@alpo-astronomy.org

We have received many images including some by Richard Hill, K.C. Pau, Francesco Badalotti, Ivica Zajac, Guy Leinen, Dirk Cornelis, Frank Schenck and Ryan Cornell for a total of 86 images. Some images display the well-known domes in Milichius, Arago, Gambart, Reinhold and Lansberg domes. Many images are shared in our Facebook group, "Lunar Dome Atlas Project" ((*https://www.facebook.com/groups/814815478531774/*). At the present time, we have completed a report regarding the Tobias Mayer-Milichius domes field which is planned for publication in the spring issue of this Journal (JALPO61-2).

The identification of further domes and lunar cones in the wide Marius shield is ongoing and future updates will be done, including morphometric and spectral properties of further twenty two volcanic

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constructs. Guy Leinen has imaged another small and isolated dome, with a central vent on the summit, located to the east of Maraldi D and to the north of Lucian crater, previously not introduced and described in our maps, termed C34. It lies at 15.98° N and 38.14° E. The dome height, determined using GLD100 dataset, amounts to 120 m, its diameter amounts to 3.6 km, while the average slope angle corresponds to 3.8°.

K.C. Pau has imaged four domes located near Manilius and Hyginus, termed Man1-3 and Hyg3, now characterized and classified according to the classification scheme introduced in our previous studies. Some of these investigations will be the object of some Lunar Planetary Science Conference abstracts for March 2019.

Phillips has imaged a lunar dome in the western branch of the Apennine Bench Formation (ABF) which occurs south of Archimedes. This dome (termed ABF1) is 240 m high with a diameter of 7.5 km, yielding an average slope angle of 3.7°. It is located at 8.93° W and 26.55° N. In the revised catalogue of lunar domes by Kapral and Garfinkle, a dome (termed Beer 6) is reported at same coordinates but with a diameter of 6.2 km and a height of 200 m. Our measurements based on GLD100 dataset indicate a base diameter of 7.5 km and the height is determined to 240 m.

During a survey organized with some observers of the BAA, I have examined the western branch of the Apennine Bench Formation (ABF) which can be considered a megadome extending for 120 km and with an average slope angle of 0.5°. The presence of a possible dome located in contact with Montes Teneriffe was reported in the October 2018 issue of The Lunar Observer (the ALPO Lunar Section circular), where in the Lunar Geological Change Detection Programme by T. Cook are included two images made by two UAI observers (Taccogna and Tonon) and a drawing made by BAA member Colin Ebdon as follow up of a report made by Maurizio Cecchini about the identification of a small swell.

As coordinator of the lunar domes programs for both the ALPO and the BAA, I have examined the proposed feature using GLD100 dataset and analyses, including the mode of formation, indicate that this swell (here termed Teneriffe 1), is located at 49.08° N and 15.7° W. It has a base diameter determined to 9.8 x 7.4 km. The height is determined to 55 ± 5m, resulting in an average slope of 0.72° ± 0.07°. It fits properties of the class In2 of putative intrusive domes. In this case, magma accumulates within the lunar crust, slowly increasing in pressure and causing the crustal rock above it to bow upward without a lava effusion. When assuming an intrusive origin of the swell, this would indicate that laccolith formation proceeded until the second stage characterized by flexure of the overburden.

Interested observers can participate in the lunar domes program by contacting and sending their observations to both Raffaello Lena (coordinator email raffaello.lena@alpo-astronomy.org) and Jim Phillips (assistant coordinator (thefamily90@gmail.com).

Mars Section

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

A report on the Martian South Polar Hood can be found later inside this issue of your ALPO Journal.

Mars is well placed for observing in the evening sky. The dust storm has been slow to resolve, and as of this writing on November 13, Olympus Mons still appears to be a dark spot, albeit of low contrast, as it protrudes above the dusty mixing layer. However, albedo features are visible, with only slightly lower contrast than normal.

Eastern quadrature was on December 3, with Mars at magnitude 0.00 and apparent diameter 9.14 arc seconds. The brightness and size will gradually diminish, so that on February 4, the magnitude will be 0.92 and the diameter 6.0 arc seconds. This 6 arc seconds size marks the end of the traditional observing season, though committed observers will continue beyond February. Mars crosses the celestial equator into the northern sky on January 2, and will continue northward, becoming more favorably placed for observers in Earth's Northern Hemisphere as its solar elongation decreases from evening to evening. The elongation with the Sun will be 30 degrees on June 1, but conjunction with the Sun does not occur until September. I encourage observers to persevere in documenting the appearance of the planet in 2019.

Your coordinator, Roger Venable, was instrumental in establishing the Mars Observing Award of the Astronomical League during this apparition. One observer, Mark Simonson, has completed the challenging requirements for the award -- congratulations, Mark! Several other observers have made good progress, and are hoping to complete the requirements soon. Interested observers can find the observing and documentation requirements on the website of the Astronomical League at https://www.astroleague.org/content/mars-observing-program .

The Mars image gallery online has been updated with a great many images. To

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find it, go the ALPO website at www.alpo-astronomy.org and look in the sidebar on the far right, for "Section Galleries." There you will find lots of images from the ALPO sections, including the Mars Section.

Share your drawings, images, and descriptions with us in the Yahoo Mars observers message list, at https://groups.yahoo.com/neo/groups/marsobservers/info .

Minor Planets Section

Frederick Pilcher, section coordinator
pilcher35@gmail.com

Some of the highlights published in the *Minor Planet Bulletin*, Volume 45, No. 4, October-December 2018, are hereby presented. These highlights represent the recent achievements of the ALPO Minor Planets Section.

A satellite of an asteroid may be detected photometrically if a brief dip is observed in the rotational lightcurve as the secondary either transits or is occulted by the primary. Their combined light is reduced during these satellite events. Dual-period software can separate the two lightcurves with separate periods from the observed combined lightcurve. Several asteroids with this behavior were reported, as in the accompanying table.

If the satellite's orbital plane is not close to the line of sight, satellite events are not observed. It may be possible to detect the presence of the satellite if primary and secondary have different rotation periods and amplitudes, and their combined lightcurve can be separated with dual period software. Asteroids reported to have different primary and secondary rotation periods, but no observed transit/occultation events, are also listed in the accompanying table.

Tumbling behavior (simultaneous rotation about a principal axis and precession of that axis) was observed for asteroids also listed in the accompanying table. It was not possible to determine which period was rotation and which was precession

Three other very small Earth approachers were found to have very short rotation periods, faster than the centrifugal limit and therefore indicative of their being solid rocks (monoliths) rather than rubble piles.

In addition to asteroids specifically identified above, lightcurves with derived rotation periods are published for 157 other asteroids as listed below:

33, 49, 91, 132, 235, 289, 323, 418, 424, 461, 504, 617, 719, 791, 820, 821, 832, 866, 874, 896, 910, 965, 1049, 1090, 1097, 1117, 1180, 1184, 1237, 1266, 1315, 1326, 1329, 1334, 1382, 1533, 1555, 1591, 1594, 1627, 1737, 1741, 1748, 1793, 1856, 1866, 1877, 1887, 2021, 2040, 2061, 2164, 2204, 2353, 2449, 2558, 2623, 2656, 2672, 2764, 2811, 2827, 2895, 2956, 3002, 3198, 3210, 3287, 3341, 3343, 3363, 3394, 3483, 3738, 3800, 3995, 4022, 4142, 4221, 4348, 4435, 4488, 4522, 4575, 4713, 4911, 5129, 5133, 5251, 5518, 5579, 5852, 5928, 5996, 5999, 6358, 7529, 8083, 9856, 10113, 11434, 11864, 11889, 12769, 13035, 13538, 14339, 14892, 15318, 15549, 16070, 19911, 20447, 21893, 22283, 25916, 26074, 36183, 36198, 42237, 42273, 42284, 42701, 44283, 60381, 63583, 65996, 68347, 75768, 76978, 85953, 85989, 86401, 26421, 137509, 138847, 139289, 148567, 153957, 162168, 220839, 337084, 387814, 415029, 444193, 450648, 455550, 467309, 469737, 505657, 2015 DP155, 2016 JP, 2017 YE5, 2018 BY2, 2018 EB, 2018 EJ4, 2018 FQ5.

Table 1. Asteroids Detailed in This Report

Minor Planet	Type	Author(s)	Primary Rotation Period (h)	Orbital Revolution Period (h	Status
Asteroids with Occulting Satellites					
2207 Antenor	Trojan	R.Stephens et al.	7.9645	uncertain	tentative
2491 Tvashtri	Hungaria	B. Warner	4.0852	26.712	secure
15745 Yuliya Amor type	Amor type	V. Benishek et al.	3.2495	11.735	secure
29168 1990 KJ	Main belt	R. Stephens	2.5827	35.66	tentative
66391 1999 KW4	Near Earth	B. Warner	2.7660	17.452	secure
Asteroids with Non-Occulting Satellites					
85628 1998 KV2	Amor type	B. Warner	2.999	13.28	tentative
139345 2001 KA67	Near Earth	Stephens, Warner	44.25	6.011	tentative
2013 US3	Near Earth	B. Warner	450	2.4050	tentative
Tumbling Asteroids					
1144 Oda	Outer main belt	F. Pilcher	648	553	—
2010 WC9	Near Earth	B. Warner	0.18469	0.12376	—
Probably Solid Rock Asteroid (Very Fast Rotation Periods)					
2018 GE3	Near Earth	A. I. Gornea et al.	0.304		—
2018 JX	Near Earth	B. Warner	0.057637		—
2018 LK	Near Earth	B. Warner	0.123		—

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Secure periods have been found for some of these asteroids, and for others only tentative or ambiguous periods. Some are of asteroids with no previous lightcurve photometry, others are of asteroids with previously published periods that may or may not be consistent with the newly determined values. Newly found periods that are consistent with periods previously reported are of more value than the uninitiated 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/MPB/mpb.php

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 section staff members Schmude, MacDougal and McAnally

Jupiter will be visible in the early morning sky starting in January. It will be have a southerly declination and, hence, observers in the southern hemisphere will get the best view in 2019.

Assistant Coordinator Craig MacDougal reports that over 500 individuals are on the Yahoo Jupiter group and that 517 images of Jupiter were exchanged during the 2017-2018 apparition.

Unfortunately, no activity has been reported to John McAnally (Jupiter Transit Timings Program).

This writer continues to make brightness measurements of Jupiter in the V, J and H filters. Jupiter is maintaining a nearly constant brightness compared to previous years. The writer hopes to start work on the 2015-2016 Jupiter report in the near future.

Recently, a group of astronomers including the writer published a paper in *Nature Communications* about Jupiter's heat budget.

The writer has decided to retire the Galilean Satellite Eclipse Timings Program. I did this because the orbital models of the satellites are accurate to about a second, whereas visual timings are accurate to about a minute or so.

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

Galilean Satellite Eclipse Timing Program

Editor's Note: The late John Westfall completed several Eclipse Timing Program reports for future publication in this Journal.

As stated above, this program is being discontinued.

For those who remain interested, an Excel catalog of this program's observations from the 1975/76 through the 2000/01 Jupiter apparitions is available. This read-only, two-megabyte file contains the results of 10,308 visual timings, with 20 entries for each timing. The data are more detailed than given in the reports published in this Journal over the years, and include observed UT, delta-t, the predicted event time based on the Lieske E-2 ephemeris, as well as the observer name, instrument aperture, and observing conditions.

Saturn Section

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

Saturn remains reasonably well-placed for worthwhile observation throughout the autumn months. Saturn reached opposition last year on June 27th remaining visible most of the night.

The accompanying Table of Geocentric Phenomena for the 2018-19 Apparition in Universal Time (UT) is included here for the convenience of observers.

As of this writing, the ALPO Saturn Section has received an impressive collection of excellent images of the planet at visual and infrared wavelengths during the previous 2018-19 apparition that ended on January 2, 2019. Supplementing digital images were several superb visual drawings of Saturn. Observers continued to report discrete atmospheric phenomena in Saturn's northern hemisphere, including what

Table of Geocentric Phenomena for the 2019-20 Apparition of Saturn in Universal Time (UT)

Conjunction	2019 Jan 02^d UT
Opposition	2019 July 09^d
Conjunction	2020 Jan 13^d
Opposition Data for July 09, 2019	
Equatorial Diameter Globe	18.08″
Polar Diameter Globe	16.68″
Major Axis of Rings	41.05″
Minor Axis of Rings	18.24″
Visual Magnitude (m_v)	+0.2
B = Declination Constellation	+26.18° -22.80° Sagittarius

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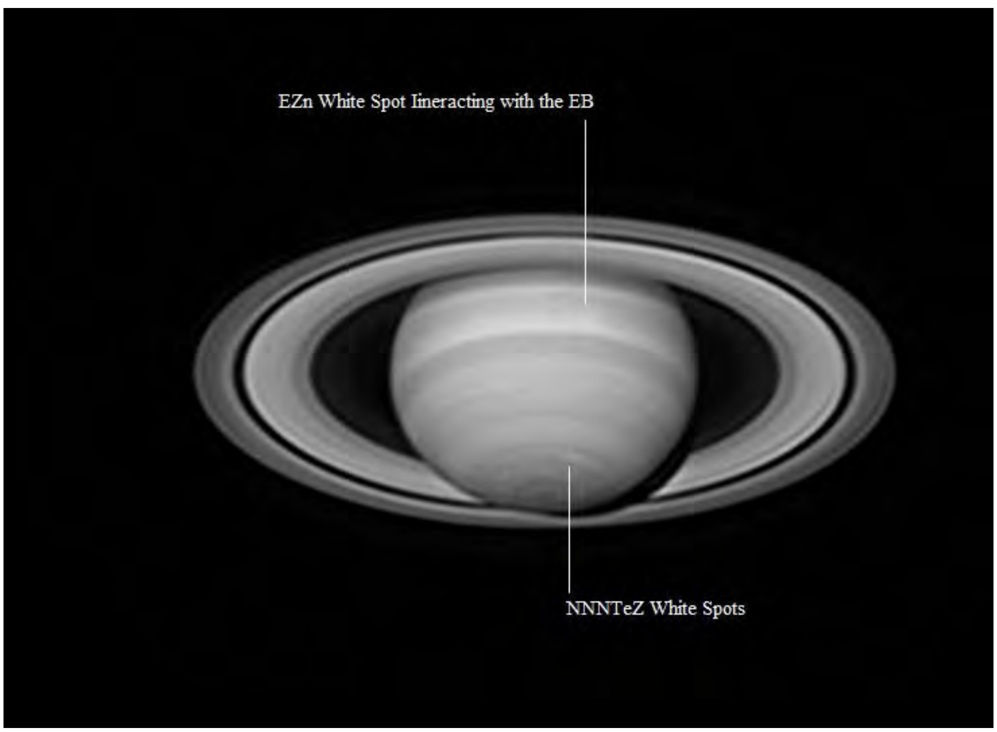
appeared to be a recurring white spot in the EZn (northern half of the Equatorial Zone), as well as a small white spot in the EZs (southern half of the Equatorial Zone, with apparent interaction with the EB (Equatorial Belt) as well as a persistent group of white spots in the NNNTeZ (North North North Temperate Zone) with what appears to be a closely associated white spot near the southern edge of the NPR (North Polar Region).

Intermittent whiter spots appeared in the NTrZ (North Tropical Zone) and NTeZ (North Temperate Zone). The aforementioned white spots have persisted and have shown up well in images captured with RGB, 685nmIR, and red filters. It will be extremely worthwhile to continue to monitor Saturn to determine the longevity and changing morphology of these features if they persist during the current 2019-20 apparition.

Observers should be watchful for any new atmospheric phenomena that might suddenly appear. With the rings tilted as much as +26o toward our line of sight from Earth in 2019-20, observers still have near-optimum views of the northern hemisphere of the globe and north face of the rings during the apparition.



Excellent image of Saturn taken by Clyde Foster of Centurion, South Africa on October 5, 2018 at 1706 UT. His red channel image was captured in fair excellent using a 35.6cm (14.0 in.) SCT. His image shows the recurring diffuse white spot within the EZn adjacent to and apparently interacting with the EB, plus a string of long-lived white spots in Saturn's NNNTeZ (North North North Temperate Zone). Cassini's division (A0 or B10) is quite obvious running all the way around the circumference of the rings except where the globe blocks our view of the rings. Also seen are Keeler's gap (A8) and Encke's "complex" (A5) as well as a few possible "intensity minima" at the ring ansae. The north polar hexagon is also barely visible. The apparent diameter of Saturn's globe was 16.3" with a ring tilt of +26.6º. CMI = 336.0°, CMII = 289.0°, CMIII = 238.8°. Visual magnitude +0.5. S is at the top of the image.

Pro-Am cooperation with the *Cassini* mission continued during the previous 2016-17 apparition as NASA's unprecedented close-range surveillance of the planet for nearly thirteen years that started back on April 1, 2004, and concluded its remarkable odyssey on last year on September 15, 2017 when it plunged into Saturn's atmosphere.

For years to come, however, planetary scientists are carefully studying the vast database of images and data gleaned from the *Cassini* mission, Pro-Am efforts will not cease in 2019-20 as we regularly monitor atmospheric phenomena on Saturn and actively share our results and images with the professional community. Thus, anyone who wants to join us in our observational endeavors is highly encouraged to submit systematic observations and digital images of the planet at various wavelengths throughout the new 2019-20 apparition are most welcome.

Observers are also reminded that visual numerical relative intensity estimates (also known as visual photometry) are an important part of our visual observing program and are badly needed to keep track of any recurring brightness variations in the belts and zones on Saturn as well as the major ring components.

Our ALPO Saturn observing programs are listed on the Saturn page of the ALPO website at http://www.alpo-astronomy.org/saturn as well as in more detail in the author's book, *Saturn and How to Observe It*, available from Springer, Amazon.com, etc., or by writing to the ALPO Saturn Section for further information.

Observers are urged to pursue digital imaging of Saturn at the same time that others are imaging or visually monitoring the planet (i.e., simultaneous observations).

The ALPO Saturn Section thanks all observers for their dedication and perseverance in regularly submitting so many excellent reports, visual drawings, and images. *Cassini* mission scientists, as

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well as other professional specialists, continue 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

The 2017-18 Remote Planets apparition report is included inside this issue of your ALPO Journal.

The planets Uranus and Neptune will be visible in the evening sky during January. Uranus will remain visible in the evening sky in February and early March. Pluto will be too close to the Sun to observe in January but by March it will be an early morning target.

This writer has compiled several ultraviolet brightness measurements of Uranus and Neptune with the assistance of Brian Harden, an Honors student at Gordon State College (near Atlanta). I hope to make more brightness measurements during late 2018.

The accompanying image for this report below was taken by Frank Melillo on November 9, 2018 at 3:15 UT with a red filter (610 nm). Please note the bright North Polar Region and the small bright spot on the right limb just below the bright North Polar Region.

Others have also imaged Uranus showing albedo features. These will be described in greater detail in the 2018-2019 remote planets apparition report.

The 2017-2018 remote planets apparition report appears later in this Journal.

To find any of the remote planets for telescopic observations, I suggest that you first use a star chart which shows the position of the target, then use binoculars to find the target. [Note: *skyandtelescope.com* is a great source to find specific locations of sky objects.]

Next, locate the target in the finder scope of your telescope. Finally, use a low-power eyepiece and center it in the field-of-view.

Note that you may need a dark site to locate Neptune in binoculars and in the finder scope.

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*

Catch a Falling Star

(Continued from page 2)

Not only can meteors be bright, they can also “rain” down from the heavens. Most known showers only produce 1 or 2 meteors per hour, and the strongest annual showers can average a meteor per minute. On rare occasions, though, the Earth passes through large swarms of particles and meteors can be seen every few seconds. I recall seeing the early stages of the famous 1966 Leonid storm when meteors were falling every 5 to 10 seconds. It was strange to me in my youth that no sound was produced by these objects as they zipped though the sky. It was just a silent show of celestial fireworks.

I had been trying to witness another meteor storm since then and it was not until 1999 that my wish came true. I had to go all the way to a windy and cold hillside in southern Spain, but the meteors appeared and the trip was well worth it. Two years later, atop a cold Mt. Lemmon in Arizona, came the display of a lifetime. The Leonids roared back to life during the early morning hours, often producing 5 or 6 meteors at a time. I recall one instance where meteors shot out of the Leonid radiant simultaneously in different directions forming celestial "spokes" like in a wheel. Data of hundreds of meteors were obtained that morning and by dawn, I was totally exhausted. As I relaxed in the brightening sky, meteors were still darting everywhere every few seconds.

Now admittedly, this does not happen very often, but when it does, it's totally unforgettable. While upcoming predictions of these events are becoming more reliable, surprises from known and unknown sources still occur. This is what keeps me going when rates are low. You never know when a sudden burst of activity may occur or when that bright fireball may appear. The sky is full of surprises; why not give it a chance to surprise you?

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Company Profile: Catsperch Observing Chairs

By Ron Burrows, owner
Wood Wonders

> In appreciation for his advertising support of the ALPO Journal all these many years, we invited Ron Burrows to tell us the history of his company. As you'll see, it all goes back to his own personal interest in amateur astronomy. Please seriously consider a Catsperch observing chair as part of your own equipment setup.

I have always heard "Look to Your Passion in Life". Making wooden creations is a passion I have carried my entire life. I have been involved with wood working since I was 6 years old, just tall enough to use a jig saw. My father had a wood shop and passed on the knowledge of a craftsman. He also passed on to me the core belief that everything I make must be of utmost quality and I always strive to make works of art, to be passed on to the next generation.

Growing up during the Space Race of the 1960's, I was drawn to look up at the Moon and wonder. At the time, I had a small collapsible spy glass-type telescope and would wait for a clear night to go outside and try to get a view of the Moon. On some nights, for brief moments, I could even see craters and mountains if I could only hold that little scope steady enough.

Then one day, I was in K-Mart and saw my heart's desire, a 70mm refractor on a wooden tripod. I spent all summer saving the $27 needed to buy that, but I finally got it. I had the only telescope in my neighborhood and shared views of the Moon and planets with all my friends. Then life happens and I didn't look through a telescope for years. One day, my 25-year-old son brought an 80mm refractor over. Looking at the Moon that evening sparked my passion for looking up again and sent me on a life changing journey.

I knew that little 80mm would never do and soon found myself with a bad case of aperture fever. I got my first Dobsonian scope in 2005. It was a 12-inch, f/4.9, and I quickly realized that bending over to look through the eyepiece just doesn't work. So I started researching on the internet the different observing chairs and kept landing on the "Catsperch" as a highly recommended design, except that it was no longer available.

Being a wood worker, I made my own chair just by going through the pictures on the Catsperch web site. Using this chair made such a huge difference in my observing experience. The design was so solid and well-thought-out. I started thinking about making them available to the astronomy community again, so I contacted Jim Fly, the originator of the Catsperch, to see if I could help him get the chairs back on the market. He sent me a set of plans and I built prototypes of the "Original Catsperch" and "Catsperch Frazier Pro" versions and then created my company, "Wood Wonders".

Jim and I formed a business relationship and after working through the long list of backorders, the chairs were again on the market. Over time, I expanded the Catsperch offerings with the "Summit" and "Miniperch" versions, as well as adding my unique line of "Wood Wonders Eyepiece Cases".

To date, I have made some 500 Catsperch chairs and 300 eyepiece cases. It just amazes me to be in my own little workshop in the backyard, making a chair or case, and see that my work is going half way around the world. Being a craftsman with a love of the night sky, it's been wonderful to combine two of my biggest passions. To share my craft of woodworking with the astronomy community and then travel around the country to star parties, has been a wonderful journey. I'm sure glad my son brought that little 80mm scope over to my house so many years ago. It's been a great time making all that sawdust and looking up at the stars.

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Membership Report: Sponsors, Sustaining Members and Newest Members (as of November 10, 2018)

by Matthew L. Will, ALPO Membership Secretary/Treasurer

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

PATRONS, BENEFACTORS, PROVIDERS, FUNDERS and UNIVERSAL Members - Giving $250 or more per membership

Member	City	State
John Centala	Marion	IA
Howard Eskildsen	Ocala	FL
Mike Hood	Kathleen	GA
Gordon Lamb	Pendleton	KY
Gregory Macievic	Camden	OH
Stephen Sands	Alton	IL
Thomas R Williams	Houston	TX

SPONSORS - Members giving $150 or more per membership

<table>
<tr><th>Member</th><th>City</th><th>State</th><th>Country</th></tr>
<tr><td>John Bedsole</td><td>Mobile</td><td>AL</td><td rowspan="8">USA</td></tr>
<tr><td>Robert A Garfinkle</td><td>Union City</td><td>CA</td></tr>
<tr><td>Ed Grafton</td><td>Houston</td><td>TX</td></tr>
<tr><td>Carl Hergenrother</td><td>Tucson</td><td>AZ</td></tr>
<tr><td>Gerald Hubbell</td><td>Locust Grove</td><td>PA</td></tr>
<tr><td>Robert Maxey</td><td>Summit</td><td>MS</td></tr>
<tr><td>John W Mc Anally</td><td>Waco</td><td>TX</td></tr>
<tr><td>John R Nagle</td><td>Baton Rouge</td><td>LA</td></tr>
<tr><td>Detlev Niechoy</td><td>Goettingen</td><td></td><td>Germany</td></tr>
<tr><td>Roy Parish</td><td>Shreveport</td><td>LA</td><td rowspan="7">USA</td></tr>
<tr><td>Patrick J Peak</td><td>Louisville</td><td>KY</td></tr>
<tr><td>Theo Ramakers</td><td>Oxford</td><td>GA</td></tr>
<tr><td>Berton & Janet Stevens</td><td>Las Cruces</td><td>NM</td></tr>
<tr><td>Roger Venable</td><td>Chester</td><td>GA</td></tr>
<tr><td>Gary K Walker, Md</td><td>Macon</td><td>GA</td></tr>
<tr><td>Christopher Will</td><td>Springfield</td><td>IL</td></tr>
</table>

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SUSTAINING MEMBERS - Members giving $75 per membership

<table>
<tr><th>Member</th><th>City</th><th>State</th><th>Country</th></tr>
<tr><td>Jay Albert</td><td>Lake Worth</td><td>FL</td><td>USA</td></tr>
<tr><td>Raffaello Braga</td><td>Milano</td><td></td><td>ITALY</td></tr>
<tr><td>Orville H Brettman</td><td>Huntley</td><td>IL</td><td rowspan="28">USA</td></tr>
<tr><td>Brian Combs</td><td>Macon</td><td>GA</td></tr>
<tr><td>Thomas Deboisblanc</td><td>Westlake Village</td><td>CA</td></tr>
<tr><td>William Dembowski</td><td>Windber</td><td>PA</td></tr>
<tr><td>Leland A Dolan</td><td>Houston</td><td>TX</td></tr>
<tr><td>T Wesley Erickson</td><td>Warner Springs</td><td>CA</td></tr>
<tr><td>William Flanagan</td><td>Houston</td><td>TX</td></tr>
<tr><td>Gordon Garcia</td><td>Bartlett</td><td>IL</td></tr>
<tr><td>Joe Gianninoto</td><td>Tucson</td><td>AZ</td></tr>
<tr><td>Robin Gray</td><td>Winnemucca</td><td>NV</td></tr>
<tr><td>Dr John M Hill</td><td>Tucson</td><td>AZ</td></tr>
<tr><td>William Howes</td><td>Holliston</td><td>MA</td></tr>
<tr><td>David Jackson</td><td>Reynoldsburg</td><td>OH</td></tr>
<tr><td>Roy A Kaelin</td><td>Flossmoor</td><td>IL</td></tr>
<tr><td>Vince Laman</td><td>San Clemente</td><td>CA</td></tr>
<tr><td>Jim Lamm</td><td>Stallings</td><td>NC</td></tr>
<tr><td>Radon B Loveland</td><td>Mesilla</td><td>NM</td></tr>
<tr><td>Enrique Madrona</td><td>Mentor</td><td>OH</td></tr>
<tr><td>Dr Michael T Mc Ewen</td><td>Oaklahoma</td><td>OK</td></tr>
<tr><td>David Mcgee</td><td>Duluth</td><td>MN</td></tr>
<tr><td>Jean-christophe Meriaux</td><td>San Bruno</td><td>CA</td></tr>
<tr><td>Guido E Santacana</td><td>San Juan</td><td>PR</td></tr>
<tr><td>Mark L Schmidt</td><td>Racine</td><td>WI</td></tr>
<tr><td>Neal Scott</td><td>Deland</td><td>FL</td></tr>
<tr><td>Bob Soltis</td><td>Lakewood</td><td>OH</td></tr>
<tr><td>Lawrence Trutter</td><td>Springfield</td><td>IL</td></tr>
<tr><td>Eric Utt</td><td>Stonington</td><td>CT</td></tr>
<tr><td>Dorothy Wood</td><td>Ramona</td><td>CA</td></tr>
</table>

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Special thank you notices are given to ALPO members that have made special donations, in the past year. These include contributions from John and Elizabeth Westfall, for $350, Wayne Bailey for $250, and Richard Schmude for $100.

The ALPO is also grateful a donation of $9575.86 as a charitable bequest of late the Robert L. Robinson trust. Robert was a former ALPO member and left this gift contribution for the ALPO.

Also, contributions to the ALPO have been made in the name of our former ALPO Executive Director and Journal Editor, the late John E. Westfall, totaling $5475.00. The following persons have contributed these funds.

- Mary and Charles Desimio
- Michael D. Fontes
- Capt. Won Kim
- Virginia McDonald
- Derald Nye
- Adele and Bob Passalacqua
- Matthew Will

The ALPO wishes to thank all of those that have contributed funds in the name of John Westfall. Donations to the ALPO, in John's name, are still being accepted. If you still wish to make a contribution, please send your check or money order to the ALPO, PO Box 13456, Springfield, IL 62791-3456 or you can pay by credit card on the Astronomical League online store at this URL: https://www.astroleague.org/store/index.php?main_page=product_info&cPath=10&products_id=50&zenid=g29852ugiccivalvfgkjc5i185

If paying by check, please write on the check's memo line "in memory of John E. Westfall." If paying online, there should be an option for "special instructions" where one can state that the donation is in the memory of John.

Thank you!

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NEWEST MEMBERS...

The ALPO would like to wish a warm welcome to those who recently became members. Listed below are those who have become new members from November 14, 2017 through November 10, 2018, their locations, and their interest in lunar and planetary astronomy. The legend for the interest codes are located at the bottom of the page. Welcome aboard!

Member	City	State	Country	Interests
Astrobarcelona Scp Alex Rubio	Barcelona		Spain	
Bryan Avery	Vacaville	CA	USA	
Sergio Babino	Montevideo		Uruguay	
Lewis Beman	Columbus	OH	USA	
Larry Black	Cedar Rapids	IA	USA	123456789ahimps
Michael Blake	Closter	NJ	USA	
Erik Bogen	Cleveland	OH	USA	
Frank Bohac	Tucson	AZ	USA	
Roy Boyd	Athens	OH	USA	
Darryl W Boyer	Tucson	AZ	USA	4ds
Robert K Buchheim	Gold Canyon	AZ	USA	
Michael Bunch	Pelham	TN	USA	
Jeffrey Carels	Brugge		Belgium	01234578dx
Rafael C Caruso	Hamilton	NJ	USA	035dps
Christopher Cokinos	Tucson	AZ	USA	
Randal Dean	Dallas	TX	USA	
Peter Detterline	Douglassville	PA	USA	
Katharyn Downing	Orange Park	FL	USA	
Jeffrey Edmonds	Washington	DC	USA	
Leonard Entwisle	Elland		United Kingdom	
Darryl Everon	Oranjestad	OS	Aruba	
Allen Frohardt	Sunnyvale	CA	USA	0345s
Matt Getridge	Mechanicsville	VA	USA	
William Gourley	Lenexa	KS	USA	
Michael Harris	Louisville	KY	USA	
Guy Heinen	Linger		Luxembourg	
Michael J Hoffert	Rowland Hts	CA	USA	
William Howes	Holliston	MA	USA	
Marvin Huddleston	Mesquite	TX	USA	
Richard Lawson	Louisville	TN	USA	
Michael Lawson	Chester	VA	USA	
Raffaello Lena	Rome		Italy	
Pablo Lewin	Glendora	CA	USA	
Daniel Lorraine	Cranston	RI	USA	
Lance Mangum	Idaho Falls	ID	USA	
Grant Martin	Hazelwood	MO	USA	
Timothy Martinez	Albuquerque	NM	USA	

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Member	City	State	Country	Interests
David Mc Kee	Duluth	MN	USA	
Dennis Means	Marana	AZ		
Maximillian J Michaels	Graceville	FL		
Robert Minor	Berkeley	CA		
Justin Modra	Centennial	CO		
Michael Napper	Jacksonville	FL		
Frank Nelson	Louisville	KY		
Michael Olason	Aurora	CO		Acd
James Paciello	Maryville	TN		
Preston Pendergraft	Trussville	AL		
Denis Pilon	Regina	SK	Canada	
Charles Rohrmann	Stanley	NC	USA	
Jessica Sain	Blacksburg	VA		
Steven Schultz	Lakeland	FL		
Neal Scott	Deland	FL		
Bob Soltis	Lakewood	OH		23456xcehimx
Keith Spring	Orange Park	FL		
Michael Stauffer	Holly Springs	NC		0
Stephen Thornton	Hemet	CA		
Vincent Tramazzo	Tucson	AZ		
Fred Veretto	Oceanside	CA		
Paulius Vidugiris	Panevezys		Lithuania	
Leonard Vorhis	Hawthorne	CA	USA	
Dr Alex Vrenios	Phoenix	AZ		0prs
Americo Watkins	Bradwell		United Kingdom	
Eric Weeks	Portland	OR	USA	
Myron Wheeler	Mocksville	NC		
Richard P Wilds	Williamsvile	NY		356789adehstv
Clint Wilkinson	Melbourne	FL		
Marcelo Zurita	Joao Pessoa		Brazil	

Table of Interest Codes

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

Timing an Eclipse of the Moon with the Unaided Eye

The late John Westfall prepared this overview for the total lunar eclipse of December 21, 2010. The document has been edited for use with any total lunar eclipse. We are grateful for John's contribution.

In map-making and navigation it is essential to be able to find one's latitude and longitude. With GPS we now find these coordinates with ease. We thus may forget that, prior to the invention of the telescope, the only practical way to find longitude involved two observers at different places noting the local time of the phases of eclipses of the Moon. The difference of time between the two locations gave their longitude difference.

This procedure provided the only longitudes measured in ancient and medieval times. The results were not very accurate. Part of the error undoubtedly was due to the imprecision of timing events by "hours of the night." But some of the error was also attributable to the naked-eye timing of the events.

Naked-eye timings of the phases of a lunar eclipse are rarely done these days, so there are few published data on their accuracy. For this reason, the writer invites observers to time, without telescope or binoculars, the four umbral contacts of total lunar eclipses.

Although the timings must be made without optical aid, this doesn't mean you can't observe most of the eclipse through binoculars or a telescope. However, to avoid any possible bias in the timings made with your unaided eyes, we recommend the following:

Beginning 10 minutes before the predicted time of an eclipse contact, view the Moon with the naked eye only. Also, during this period do not look at a timepiece or listen to time signals until the instant that you believe the eclipse contact has occurred. Then note that time to 0.1-minute precision. You can now resume viewing through binoculars or a telescope.

We hope that some observers will be interested in this minimal-technology way to observe an eclipse of the Moon. When the event is over, please send your results to ALPO Eclipse Section, listed below. Be sure to note any circumstances, such as clouds or haze, which may have affected your results.

<u>*Please send reports to:*</u>
Mike Reynolds
ALPO Eclipse Coordinator
12740 Shellcracker Rd
Jacksonville, FL 32226
✉m.d.reynolds@fscj.edu

Keith Spring
ALPO Assistant Eclipse Coordinator
✉star.man13@hotmail.com

ALPO LUNAR ECLIPSE OBSERVERS' REPORT FORM

Please print or type information directly onto form. Complete sections applicable to your observations. The form mail be mailed or sent as an email attachment; addresses on page 3.

Observer Information – *Please PRINT or prepare a wordsmith document*

Observer: ____

Place of Observation: ____

Date:____/____/2_____ Time Started (U.T.):__________ Time Ended (U.T.):__________

Telescope:________ (in/cm) f/____ ❑ Reflector ❑ Refractor ❑ Cat ❑ _____________

Magnification(s): ________**X** ________**X** ________**X**

Seeing (1-10): _____ Transparency (1-6): _____ ❑ Clear ❑ Hazy ❑ Clouds ❑ ________

Mailing Address:____

☎ Telephone: __________________________ 🖂 E-mail:___________________________

Eclipse Observations conducted: ❑ Penumbral ❑ Partial ❑ Total

Contact timings

❑ Naked eye ❑ Binoculars; ____ **X** ____ ❑ Telescope; ____________________

U1	**UT**	**U2**	**UT**	**U3**	**UT**	**U4**	**UT**

See ***Timing an Eclipse of the Moon with the Unaided Eye*** for methodology

Describe methodology used:

Photometric Observations

Attach report, details as necessary

Crater Contact Timings

Crater	Immersion – Mid-Crater Contact	Emersion – Mid-Crater Contact	Crater	Immersion – Mid-Crater Contact	Emersion – Mid-Crater Contact
Grimaldi	**UT**	**UT**	Eudoxus	**UT**	**UT**
Aristarchus	**UT**	**UT**	Manilius	**UT**	**UT**
Kepler	**UT**	**UT**	Menelaus	**UT**	**UT**
Billy	**UT**	**UT**	Dionysius	**UT**	**UT**
Pytheas	**UT**	**UT**	Plinius	**UT**	**UT**
Copernicus	**UT**	**UT**	Tycho	**UT**	**UT**
Timocharis	**UT**	**UT**	Proclus	**UT**	**UT**
Plato	**UT**	**UT**	Taruntius	**UT**	**UT**
Campanus	**UT**	**UT**	Goclenius	**UT**	**UT**
Aristoteles	**UT**	**UT**	Langrenus	**UT**	**UT**

Totality Magnitude Estimate

Estimate 1:	Time Estimate 1 Made: **UT**
Estimate 2:	Time Estimate 1 Made: **UT**
Estimate 3:	Time Estimate 1 Made: **UT**

Method to determine Magnitude at Totality:

Sky Brightness

Estimate 1:	Time Estimate 1 Made: **UT**
Estimate 2:	Time Estimate 1 Made: **UT**
Estimate 3:	Time Estimate 1 Made: **UT**

Method to determine Sky Brightness:

Danjon Luminosity Estimates, L

L =	Time	Estimate made with
	UT	❑ Naked Eye ❑ Binoculars ❑ Telescope
	UT	❑ Naked Eye ❑ Binoculars ❑ Telescope
	UT	❑ Naked Eye ❑ Binoculars ❑ Telescope
	UT	❑ Naked Eye ❑ Binoculars ❑ Telescope

Imaging

❑ Camera; Film ❑ Camera; Digital ❑ CCD ❑ Video

For images submitted, please include:

- Telescope or lens used
- Camera
- Imaging specifics:
  - ASA/ISO
  - f/
  - exposure length
- Other specifics

Drawings

Please attach originals or high-quality copies of drawings. Include specifics, such as media, time of drawing, telescope/binoculars used, etc.

Occultations

❑ Total ❑ Graze

Provide separate list of timings. Observations should also be sent to IOTA.

Other Observations

Detail other observations made. Attach report(s) as necessary.

Please send reports to:
Mike Reynolds
ALPO Eclipse Coordinator
12740 Shellcracker Rd
Jacksonville, FL 32226
✉m.d.reynolds@fscj.edu

Keith Spring
ALPO Assistant Eclipse Coordinator
✉star.man13@hotmail.com

Papers & Presentations:

A New & Improved ALPO Image Archives

By Theo Ramakers,
Assistant Coordinator, ALPO Online Section
theo@ceastronomy.org

Abstract

Despite a general email distribution of the announcement of the new ALPO-Astronomy gallery, as well as posting submission instruction pages on a variety of section pages, it appears that many in the ALPO are still not familiar with the new organization of the ALPO image galleries and how to use them. The following explanation is meant to once more show how to easily use our image gallery for the benefit of all.

Theo Ramakers

Presentation

The ALPO is extremely proud of its image archive and has worked hard to make it as all-inclusive as possible and as easy-to-use as possible. We know that our image archive is especially of interest to scientists who might use the observations/images to follow different events on the Sun, Moon or planets.

ALPO has reorganized its online image galleries and updated many observations which had been previously posted. On recommendation of the ALPO executive director in the Winter 2017 edition of this Journal, we have established archives for a number of ALPO sections.

Now, images and drawings can be submitted for inclusion in the appropriate image gallery by simply sending an email with the digital image or observation attached to an email address which states the name of the observing section followed by our email domain, "@alpo-astronomy.org".

Table of E-Mail Addresses for Submitting to the ALPO Image Galleries

Destination ALPO Observing Section	E-mail Address to Use
Solar	solar@alpo-astronomy.org
Mercury	mercury@alpo-astronomy.org
Venus	venus@alpo-astronomy.org
Mars	mars@alpo-astronomy.org
Saturn	saturn@alpo-astronomy.org
Jupiter	jupiter@alpo-astronomy.org
Remote Planets	remote@alpo-astronomy.org
Comets	comets@alpo-astronomy.org
Lunar	lunar@alpo-astronomy.org

These emails will be forwarded automatically to those in the organization involved with the planet/object, such as the archivist, section scientist, and possibly others. for them to properly post. A table of the correct email addresses to use for your image submittals is included here.

Note that the Solar, Mercury, Venus, Mars, Jupiter and Saturn ALPO web pages offer recommendations on how observations should be made and state what information should be included in either annotations on the images/observations, or what should be included in filenames of these images/observations. However the Comets, Lunar and Remote Planets sections web pages do NOT offer recommendations.

In order to make the images most useful for those who use the image galleries for research, almost all of the archives are organized by apparition, and within the apparition by date, time in UT, the abbreviated observer name and the filter used. This is the naming method recommended by the software program *WinJupos*. By naming/organizing the images in this way, the observations/images are presented in descending order with the most recent images shown first.

The small representation of the images are shown in pages of 50 thumbnails per page. At the top left of the overview page, one can see all the page numbers; to navigate to another page, simply click on the number and the appropriate thumbnails will be displayed for that page.

To review some of the image information including the date/time, abbreviated observer's name, or filter used, hover the curser over the thumbnail and the data contained in the filename will be displayed.

While the Comet Section organizes its folders by year of discovery and name of the comet, both the Solar Section and the Lunar Section organize their image galleries a bit differently. The Solar Section folders are organized by year and within the year, by Carrington Rotation number. And within these folders, the images are further organized by date/ time of the image or observation as described above.

The Lunar Section displays its images in folders keyed to maps in Antonín Rükl's *Atlas of the Moon*. To access images from a desired Rükl map, do the following:

1. Go to the alpo-astronomy.org website, then left-click on *Lunar Section* in the left sidebar (see Figure 1).

Figure 1. Left sidebar on ALPO home page with "Lunar Section" indicated.

2. On the *Lunar Section* web page, left-click on *ALPO Lunar Image Gallery* in the right sidebar (see Figure 2).

3. On the Rükl map grid page of the Full Moon, left-click on the desired map square (see Figure 3).

The image gallery folder keyed to that map square displays to show the included images and drawings. The folder itself is labeled with the letter "R" and the number of the Rükl map.

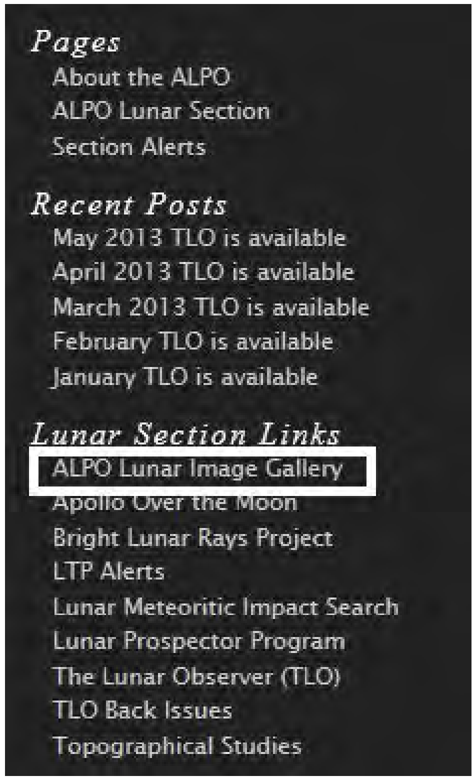

Figure 2. Right sidebar on Lunar Section web page with "ALPO Lunar Image Gallery" indicated.

NOTE: To access Full Moon images, left-click on the link beneath the Full Moon grid.

Once in the galleries, images are generally displayed in three different sizes. The overview page displays image thumbnails 150 pixels wide. Figure 4 shows the 2018 Mars Images gallery page; depending on your screen resolution, either all or part of this gallery page may be displayed. Clicking on a thumbnail opens a 640-pixel image of the observation or picture.

Then clicking on this intermediate size image will result in the full image being displayed in a new window that overlays the intermediate view (as long as it does not exceed the number of pixels your browser allows for display as a frame window).

To see the full size of the image, it is most useful to right-click the intermediate sized image and then select open image

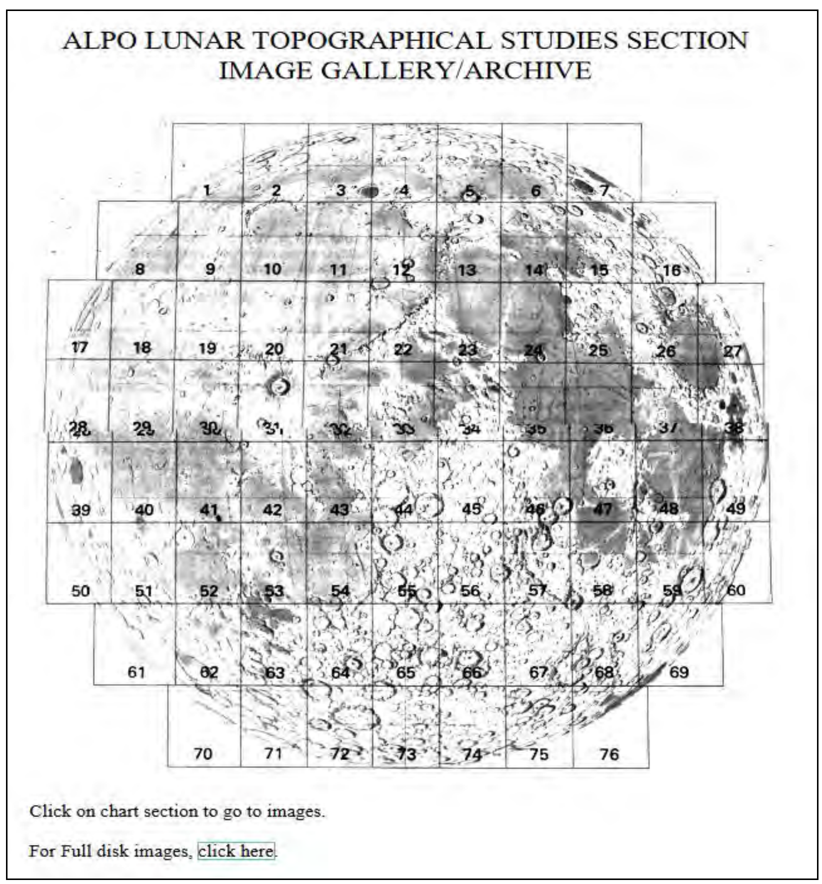

Figure 3. Full Moon with Rükl map grid overlay.

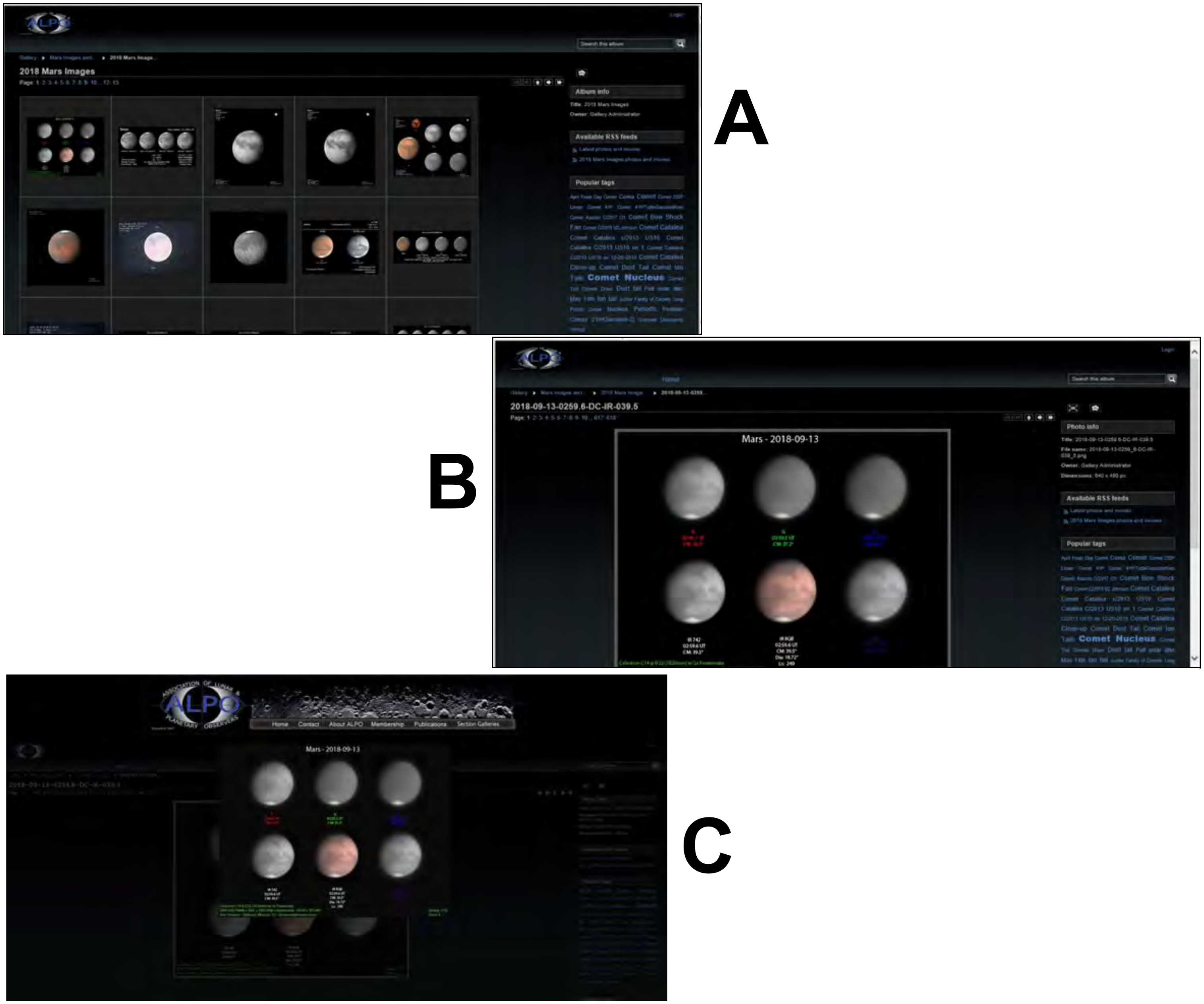

Figure 4. Three levels of image gallery resolution, using the Mars archive as an example. A, Top-level thumbnails, 150 pixels. B. Intermediate-level images, 640-pixels. C, High-resolution images in native pixel resolution.

in new page or new tab, followed by selecting the new tab or window. This way, you can see the image as it is displayed by your browser. This will allow you to see the image in the native pixel size, even if the number of pixels exceeds the size of your browser window. Similarly, you can download the image for further review.

Conclusion

The images in the ALPO galleries have the benefit that their file names have been updated to conform to the *WinJupos* standard, which might not be the case for images on other websites, or for images submitted directly by the observers.

Those who require images for a research project can request a CD with images from the observing section. That person will review the request and approve the copies be made and distributed by the ALPO archivist.

We hope that by allowing ALPO members and nonmembers access to the images as a gallery, we can encourage those who are interested in our Solar System to also become involved and perhaps do their own research.

Papers & Presentations:

X-Band Observations of the August 21, 2017 Partial Solar Eclipse

By Stephen A. Tzikas
Tzikas@alum.rpi.edu

Introduction

On August 21, 2017, I observed the solar eclipse from my home in Reston, VA (a Washington, DC suburb). One of the various types of observations I made was in radio X-band frequency, using the 20m Skynet Dish in Green Bank, WV. These radio observations are stored in the Skynet database and are accessible to other users of Skynet. These observations can be accessed by the following link: *http://www.gb.nrao.edu/20m/peak/log2017.htm*. The specific observation numbers are listed in the table below.

Discussion

All observations of the Sun were for a period of 3 minutes in Track mode. The time in UTC (seconds) is for the beginning of the observation. The UTC time for the maximum extent of the partial eclipse in Green Bank, WV, was used, and not that of my physical location in Reston, VA. The central frequency of observation was 9,000 MHz. Integration time was 5 minutes. Observations were done in low resolution and using 1,024 channels. Specifics of observing locations (UTC = +4 hours for both locations) are:

Green Bank, West Virginia, USA

38.4195° N, 79.8318° W
Partial solar eclipse visible (86.69% coverage of Sun)
Duration: 2 hours, 47 minutes, 21 seconds
Partial begins: Aug 21, 2017 at 1:12:07 pm = 61927 UTC seconds
Maximum: Aug 21, 2017 at 2:38:37 pm = 67117 UTC seconds
Partial ends: Aug 21, 2017 at 3:59:28 pm = 71968 UTC seconds

Washington DC, USA

38.9072° N, 77.0369° W
Partial solar eclipse visible (81.11% coverage of Sun)
Duration: 2 hours, 43 minutes, 44 seconds
Partial begins: Aug 21, 2017 at 1:17:53 pm = 62273 UTC seconds
Maximum: Aug 21, 2017 at 2:42:48 pm = 67368 UTC seconds
Partial ends: Aug 21, 2017 at 4:01:37 pm = 20:01:37 = 72097 UTC seconds

The purpose of these observations is to illustrate power increase over a 3-minute period after maximum lunar coverage has passed. The power values in the charts are not absolute for the Sun, but include system noise. System noise varies between observations, and while it is possible to remove it using calibration data and formulas, it was not done for this presentation of data. For the purpose of these illustrations, the noise is not relevant for the comparison.

Consider radio Skynet observation Skynet_57986_sun_30075_30281 (see Figure 1). The observation was completed in the morning before the partial eclipse began. This served as my control observation. Note the constant solar power level in Kelvin over the 3-minute period, as well as the frequency power levels for the whole observation.

Next, consider radio Skynet observation Skynet_57986_sun_30098_30298 (see Figure 2). The chart is at approximately 16 minutes after the maximum extent of the partial eclipse. The rate of power increase is significant as the Sun re-emerges. Also notice that the power levels in both charts still have a substantial way to recover to the levels seen in Skynet_57986_sun_30075_30281

The Green Bank link provided here will also take the reader to a few other radio observations of the eclipse by others. Different input parameters will affect how the data is collected and displayed by the 20m radio telescope. However, the observations provided here satisfied the intended purpose and were completed using identical input parameters so that a comparison could be made.

I gathered more than the two observations presented here to ensure I had observations that were error-free and also at appropriate times, as requested observations are queued, and not guaranteed at the specific moment of request.

Table of Skynet Observations for the Sun

Observation Number	UTC (seconds)
30075_30281	48623.589241
30090_30284	53726.950202
30092_30286	58784.923597
Start of Eclipse	61927
30095_30294	66150.753901
Maximum of Eclipse	67117
30098_30298	68086.454113
30099_30302	70339.784928
End of Eclipse	71968

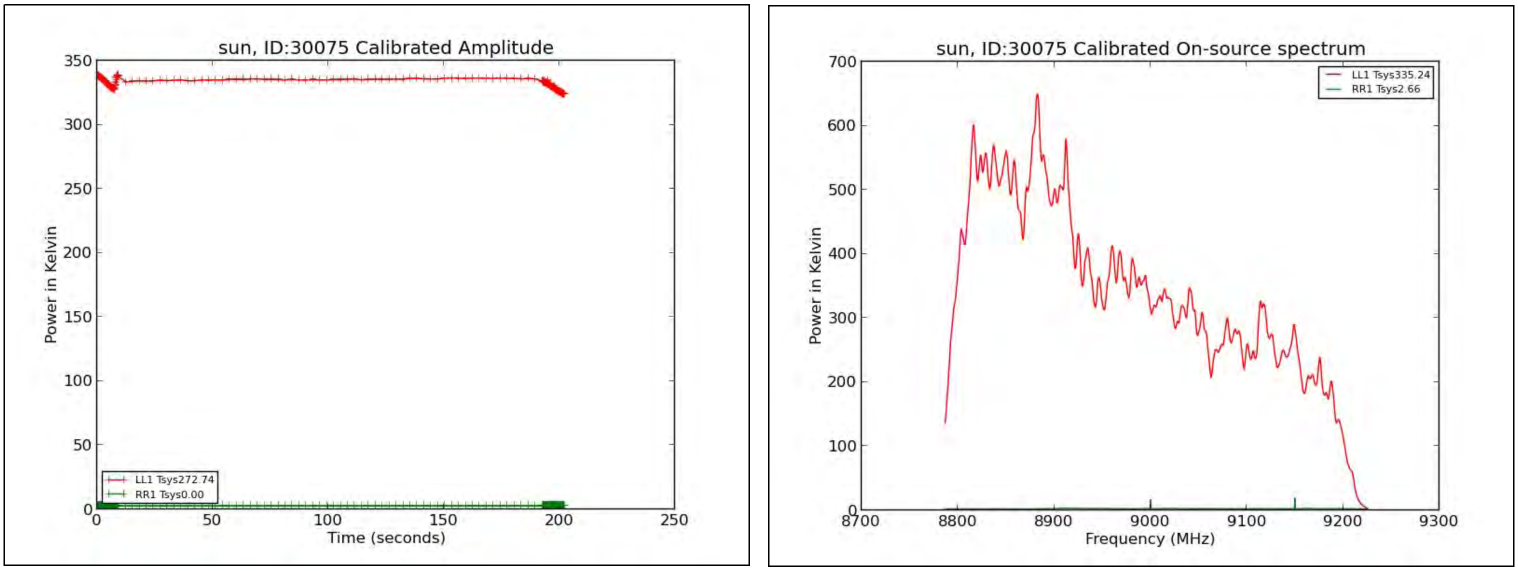

Figure 1. Skynet observation “Skynet_57986_sun_30075_30281” details.

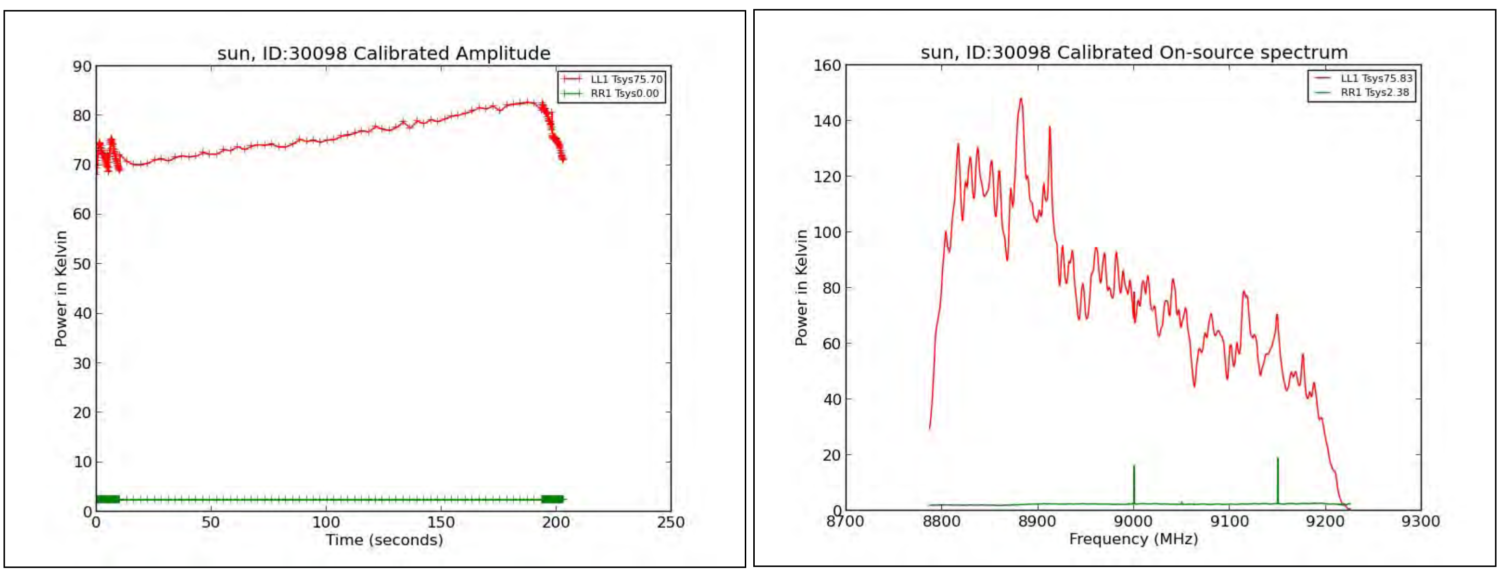

Figure 2. Skynet observation “Skynet_57986_sun_30098_30298” details.

Papers & Presentations: ALPO Solar Section

A Report on Carrington Rotations 2202 through 2205 (2018 03 22.9368 to 2018 07 09.)

By Richard (Rik) Hill,
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Scientific Advisor,
ALPO Solar Section
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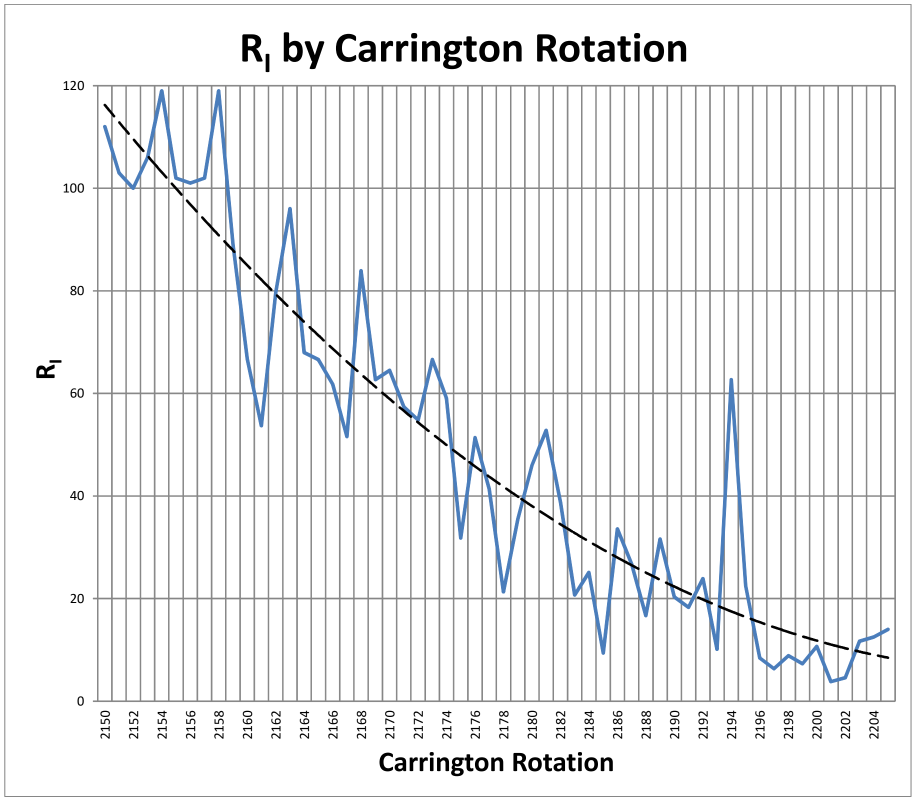
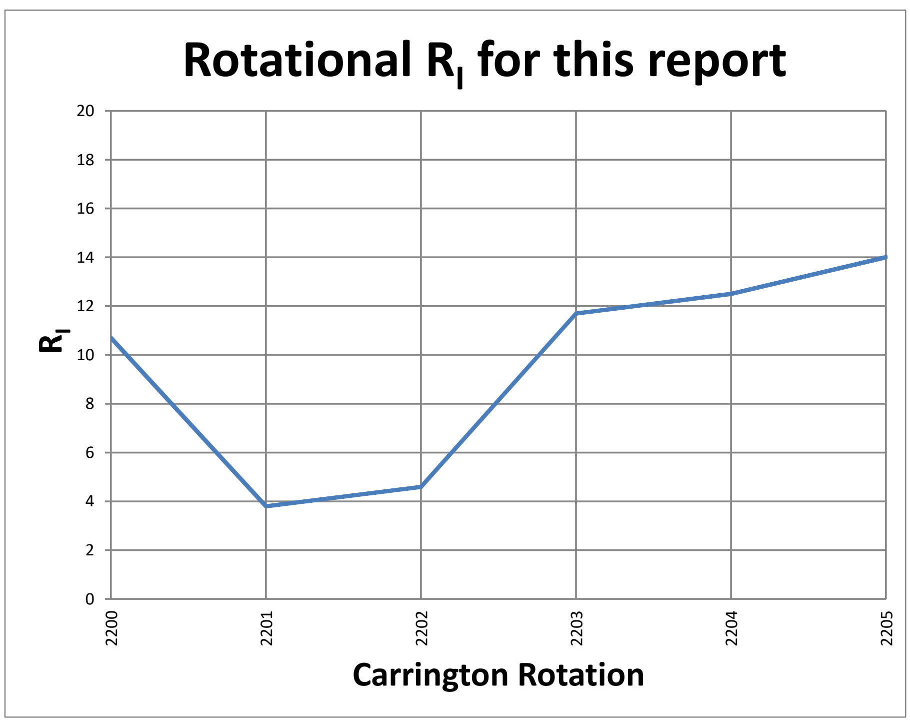
To our hard-copy readers: This paper can be viewed in full-color in the online (pdf) version of this Journal.

Overview

While activity statistically rose slightly throughout the report, it nevertheless remained low overall. No groups exceeded 160 millionths in area or a McIntosh class of "D" with this level of activity only being reached in Carrington Rotation 2205, which had the most interesting and developed sunspot group, AR 2715, that rose to Dao class producing the most flares of any active region in this report.

As can be seen in the upper plot on this page, solar activity is not yet at minimum, but close. A new feature for this report, and one that will be included in future reports, is a the lower plot of just the current reporting period as a quick reference.





Terms and Abbreviations Used In This Report

While this brief section is similar to the same in earlier reports it should be at least reviewed. As in previous reports, the ALPO Solar Section will be referred to as "the Section" and Carrington Rotations will be called "CRs". Active Regions are designated by the National Oceanic and Atmospheric Administration (NOAA) and will refer to all activity in all wavelengths for that region and will be abbreviated "AR" with only the last four digits of the full number

Table of Contributors to This Report

Observer	Location	Telescope	Camera	Mode	Format
Michael Borman	Evansville IN	102mm, RFR	Point Grey GS3	W-L	digital images
		90mm		H-a	
		102mm, RFR		CaK	
Richard Bosman	Enschede, Netherlands	110mm, RFR	Basler Ace 1280	H-a	digital images
		355mm, SCT		W-L	
Raffaello Braga	Milano, Italy	112mm,RFR	PGR Chameleon	H-a	digital images
Tony Broxton	Cornwall, UK	127mm, SCT	N/A	W-L	drawings
Jeffery Carels	Bruges, Belgium	100mm, RFR	ZWO-ASI 120MM	W-L	digital images
Jean-Francois (Jeff)	France	30mm, Projection	N/A	W-L	drawings
Gabriel Corban	Bucharest, Romania	120mm, RFL-N	Point Grey GS3-U3	H-a	digital images
				W-L	
Brennerad	Sao Palo, Brazil	90mm, MCT	ASI224MC	W-L	digital images
Franky Dubois	West-Vlaanderen,	125mm, RFR	N/A	visual sunspot	
Howard Eskildsen	Ocala, FL	80mm, RFR	DMK41AF02	W-L wedge	digital images
				CaK	
Joe Gianninoto	Tucson, AZ	85mm, RFR	N/A	W-L	drawings
		60mm, RFR		H-a	
Guilherme	Curitiba, Brazil	60mm, RFR	Lumenera Skynyx	H-a	digital images
Richard Hill	Tucson, AZ	90mm, MCT	Skyris 445m	W-L	digital images
		120mm, SCT		""	
Bill Hrudey	Grand Cayman	200mm, RFL-N	ASI174MM	W-L	digital images
		60mm, RFR		H-a	
David Jackson	Reynoldsburg, OH	124mm, SCT	N/A	W-L	drawings
Jamey Jenkins	Homer, IL	102mm, RFR	DMK41AF02	W-L	digital images
		125mm, RFR		CaK	
Pete Lawrence	Selsey, UK	102.5mm, RFR	ZWO ASI174MM	H-a	digital images
Monty Leventhal	Sydney, Australia	250mm, SCT	N/A	W-L/H-a	drawings
			Canon-Rebel	H-a	digital images
Tom Mangelsdorf	Wasilla, AK	120mm, RFR	N/A	W-L	drawings
Frank Mellilo	Holtsville, NY	200mm, SCT	DMK21AU03AS	H-a	digital images
Efrain Morales	Aguadilla, Puerto Rico	50mm, RFR	Point Grey Flea 3	H-a	digital images
German Morales C.	Bolivia	200mm, SCT	N/A	visual sunspot	
John O'Neal	NC			Na-D	digital images
Theo Ramakers	Oxford GA	80mm, RFR	ZWO ASI174MM	H-a	digital images
		11in. SCT	DMK41AU02AS	W-L	
		40mm, H-a PST	DMK21AU03AS	H-a	
		40mm, CaK PST		CaK	
Ryc Rienks	Baker City OR	203mm, SCT	N/A	W-L	drawings
		40mm, H-a PST		H-a	
Laura Schreiber	Wuertzburg, Germany	280mm, SCT	Basler IMX174	W-L	
Chris Schur	Payson, AZ	152mm, RFR	DMK51	CaK	digital images
				W-L (CaK-	
		100mm, RFR		H-a	
Randy Shivak	Prescott, AZ	152mm, RFR	ZWO-ASI174	H-a	digital images
Avani Soares	Canoas, Brazil	120mm, RFR	ZWO-ASI 224	W-L	digital images
Randy Tatum	Bon Air, VA	180mm, RFR	DFK31AU	W-L-	digital images
David Teske	Starkville MS	60mm, RFR	N/A	W-L/H-a	drawings
			Malincam	W-L	digital images
Vince Tramazzo	Tucson, AZ	94mm, RFR	N/A	W-L	drawings
		50mm, RFR		H-a	
James Kevin Ty	Manila, Philippines	TV101-RFR	ZWO-ASI 120MM	H-a	digital images

being used. The term "groups" refers to the visible light or "white light" sunspots associated with an Active Region. Statistics compiled by the author have their origin in the finalized daily International Sunspot Number data published by the WDC-SILSO (World Data Center - Solar Index and Long Term Solar Observations) at the Royal Observatory of Belgium. All times used here are Coordinated Universal Time and dates are reckoned from that. Dates will be expressed numerically, with month/day such as "9/6" or "10/23". Carrington Rotation commencement dates are from the table listed on the Section webpage on the ALPO website *http://alpo-astronomy.org/solarblog/wp-content/uploads/ephems/CNSun_2159_2306_A.pdf*

The terms "leader" and "follower" are used instead of "east" or "west" on the Sun to avoid misunderstandings. This follows the "right-hand rule" where, using your right hand, your thumb pointing up is the north pole and the rotation follows the curl of your fingers. Orientation of images shown here will be north up and celestial west to the right (northern hemisphere chauvinism). The cardinal directions (north, south, east, west) if used at all, will be abbreviated as N, S, E and W.

The abbreviation to indicate white-light observations is "w-l", while hydrogen-alpha is "H-a" and calcium K-line is "CaK". "Naked-eye sunspots" means the ability to see these spots on the Sun without amplification but through proper and safe solar filtration. As a reminder, you should never look at the Sun, however briefly, without such filtration even at sunrise/set.

Areas of regions and groups are expressed in the standard units of millionths of the solar disk, with a naked-eye spot generally being about 900-1,000 millionths for the average observer. The McIntosh Sunspot Classification used here is the one defined by Patrick McIntosh of NOAA (McIntosh 1981, 1989) and detailed in an article in the JALPO Volume 33 (Hill 1989). This classification system is also

Table of Contributors to This Report (Continued)

Observer	Location	Telescope	Camera	Mode	Format
David Tyler	Buckinghamshire, UK	178mm, RFR	ZWO	W-L	digital images
		90mm, RFR		H-a	
Christian Viladrich	Nattages, France	300mm, RFN	Basler 1920-155	W-L	digital images
Telescope Types: Refractor (RFR), Newtonian Reflector (RFN), Schmidt Cassegrain (SCT), Maksutov-Cassegrain (MCT), Cassegrain (Cass)					

detailed by the author on the Section website at *http://www.alpo-astronomy.org/solar/W-Lft.html* in an article on white-light flare observation. This will be referred to as the McIntosh Class. The magnetic class of regions is assigned by NOAA and will be entered parenthetically after the McIntosh class or elsewhere referred to as "mag. class".

Lastly, due to the constraints of publishing, most of the images in this report have been cropped, reduced or otherwise edited. The reader is advised that all images in this report, and a hundred times more, can be viewed at full resolution in the ALPO Solar Archives. This can be accessed by going to the Solar Section webpage and following the Archives link at the top of the right sidebar. You can also go to the Archives through this link: *http://www.alpo-astronomy.org/gallery/main.php?g2_itemId=1699*

Section observers, their equipment and modes of observing are summarized in Table 1 on this page. While not all individuals necessarily contributed to this specific report, they have contributed to recent reports and are ALPO Solar Section members. This should be used as a reference throughout this report.

References

Hill, R.E., (1989) “A Three-Dimensional Sunspot Classification System” Journal of the Assn of Lunar & Planetary Observers, Vol. 33, p. 10. *http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?1989JALPO..33...10H&data_type=PDF_HIGH&whole_paper=YES&type=PRINTER&filetype=.pdf*

Livingston, W., Penn, M.; (2008) “Sunspots may vanish by 2015.” *https://wattsupwiththat.files.wordpress.com/2008/06/livingston-penn_sunspots2.pdf*

McIntosh, Patrick S., (1989) “The Classification of Sunspot Groups” Solar Physics, Vol. 125, Feb. 1990, pp. 251-267.

McIntosh, Patrick S., (1981) The Physics Of Sunspots. Sacramento Peak National Observatory, Sunspot, NM; L.E. Cram and J.H.Thomas (eds.), p.7.

Additional references used in the preparation of this report:

Solar Map of Active Regions
https://www.raben.com/maps/date

SILSO World Data Center
http://sidc.be/silso/home

SILSO Sunspot Number
http://www.sidc.be/silso/datafiles

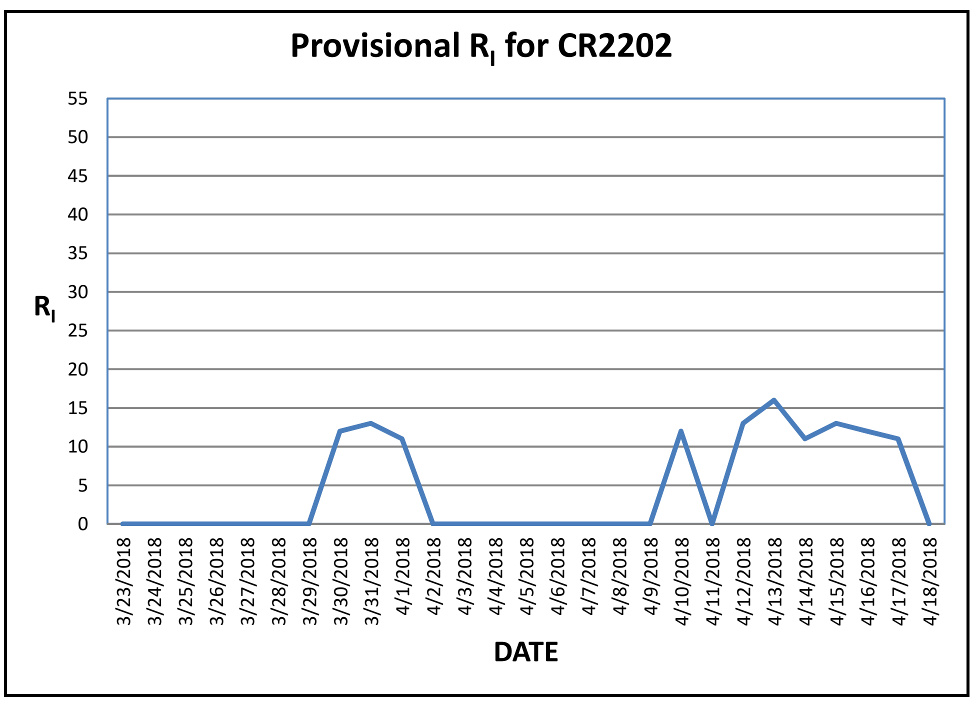
The Mass Time-of-Flight spectrometer (MTOF) and the solar wind Proton Monitor (PM) Data by Carrington Rotation
http://umtof.umd.edu/pm/crn/

Carrington Rotation 2202

Dates: 2018 03 22.9368 to 2018 04 19.2188

Avg. R_I = 4.59
High R_I = 16 (4/13)
Low R_I = 0 (17 days)

This rotation showed only a tiny increase over the 3.8 average R_I of the last rotation in the previous report. With only three designated active regions, there were 17 days of zero spots and never more than one group with spots (not just plage) on the Sun at any time except on the last day of the rotation when AR 2705 and 2706 were on together as plages. Neither of these attained a maximum over 30 millionths and classes of Axx and Bxo respectively, though most of the activity for the latter region was in the next rotation.



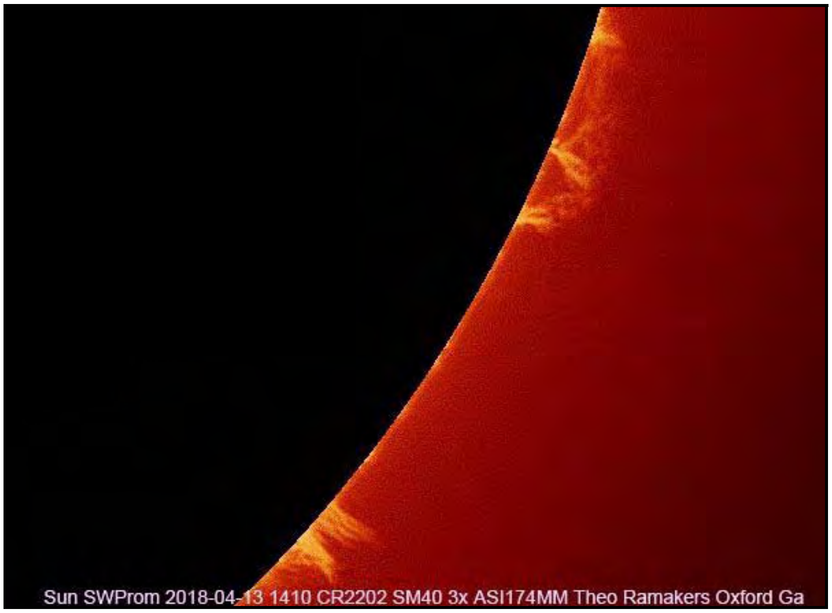


Figure 1. Prominences on the SW limb by Ramakers on 04/13 at 14:10 UT.

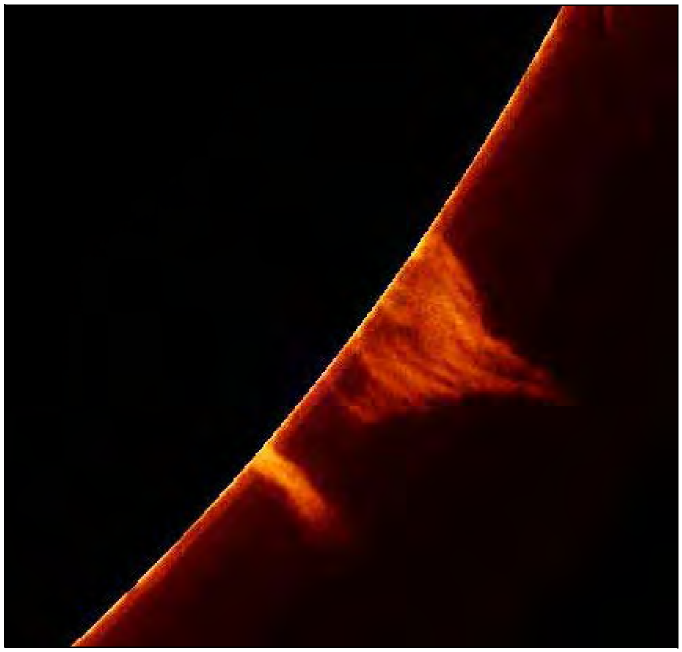


Figure 2. Prominences on the SW limb by Ramakers on 04/14 at 14:55 UT.

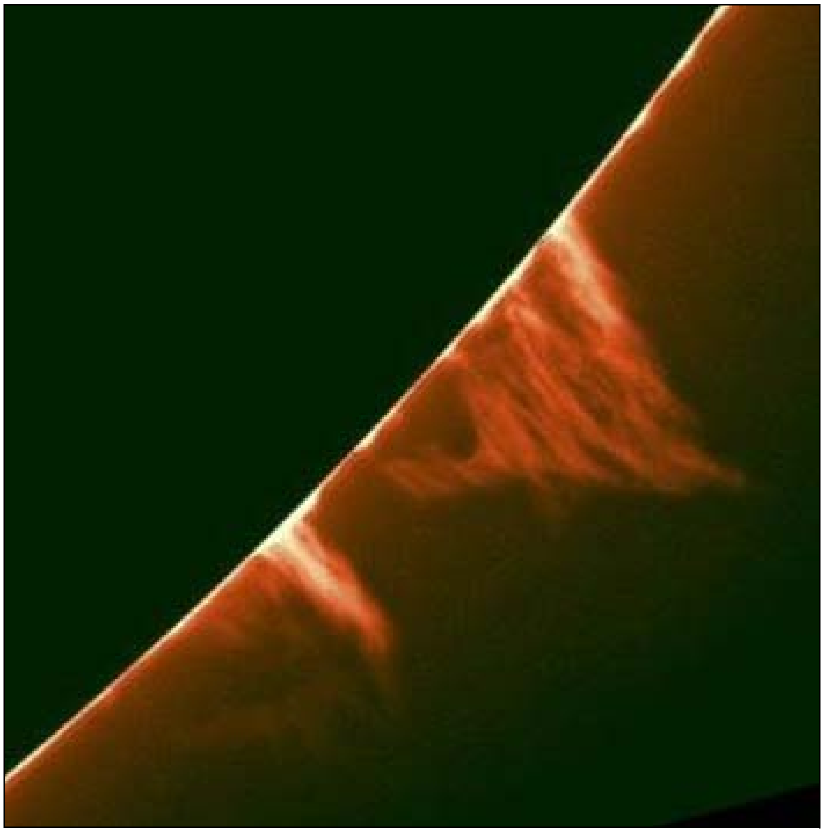


Figure 3. Prominences on the SW limb by Braga on 04/14, time unknown.

While this rotation seemed rather weak, one interesting thing did happen. On 4/10 an Axx spot group formed at around S45 latitude. It was not designated by NOAA because its life, like most A-groups was short and it did not develop further. But the latitude was around S45 and magnetic polarity such that it was a reasonable candidate for a Cycle 25 spot!

Adding to this candidate were numerous high-latitude limb prominences. Being at a high latitude (40°+) means the prominence will have a lower angular motion from day-to-day and hence will be visible for a longer period of time, allowing more time for study. Both Braga and Ramakers caught a nice eruptive prominence on the SW limb. Only individual images are shown here instead of a time sequence montage, as all Braga times were unknown and just listed as 00:00 UT.

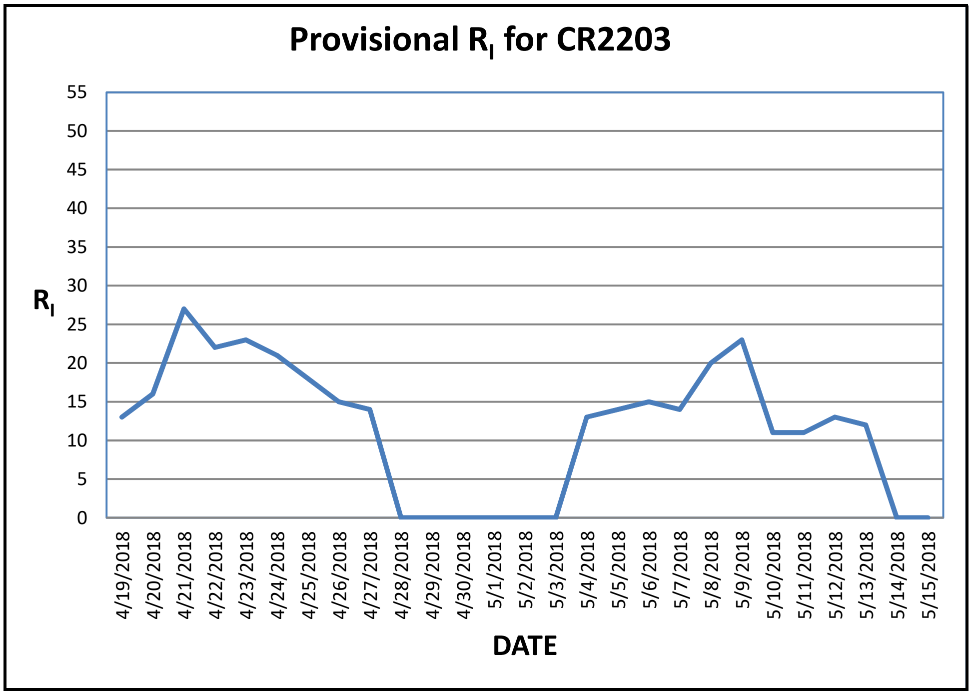
Ramakers showed the prominence in question on 4/13 at 14:10 UT along with another to the north (Figure 1). At this time, things were pretty quiet. A day later, Ramakers shows a beautiful feathery prominence just north of what might have been a tornadic prominence (Figure 2). Braga showed a bit more detail but again, we don't know if it was before or after the Ramakers image (Figure 3). On 4/16, there was a nice eruption from this prominence, but no one in the ALPO Solar Section caught it.

Carrington Rotation 2203

Dates: 2018 04 19.2188 to 2018 05 16.4562

Avg. R_I = 11.7
High R_I = 27 (4/21)
Low R_I = 0 (8 days)

Activity increased a little this rotation, though there were still eight days of zero spots and five designated regions. The reader needs to keep in mind how the sunspot number is derived on individual days. While the plots appear to show activity, the minimum daily sunspot number ($R_{(I)}$) possible is 11: 1 group (x10), which consists of 1 spot or 10+1=11. Add another group of one spot and you get $R_{(I)}$=22, but in actuality you only have two spots on the sun! So while it looks like there were two periods of good activity in this rotation, it really wasn't all that good.



Only the first maximum had a sunspot group over 100 millionth,s and that was AR 2706 which came on the disk on 4/19, the last day of the previous rotation, as a Bxo (beta) group of 20 millionths area. It was first spotted by Broxton in a w-l drawing at 08:25 UT. Our first high-resolution w-l image was from Tyler at 10:34 UT. It showed a group that was fairly well developed, more than the Bxo of 20 millionths that was the official listing, with two leader spots and a clear follower all in a network of faculae (Figure 4). At 22:10 UT, Levinthal noted it as a very complex region in H-alpha sitting in a large plage. The next day, Mangelsdorf at 02:41 UT noted the region as Bxo in a w-l drawing, though NOAA had bumped it up to Cao by then.

On 4/22, another Tyler w-l sub-arc-second image at 11:09 UT shows the leader consisting of two umbrae in a well-organized radial penumbra followed by four collections of small umbrae, several with some rudimentary penumbrae (Figure 5). His H-a image at 12:05 UT shows the site for the flaring activity was in the follower spots (Figure 6). Viladrich captured the region in CaK at 15:14 UT the same day showing the large plage of the region, the hottest or brightest portion of which, the site for flaring, was between the two largest follower spots (Figure 7).

AR 2706 attained a maximum development of 130 millionths area and Dao class (beta) on 4/23 with only half a dozen "B" class flares in a 48-hour period shown here in a w-l image at 07:34 UT by Carels (Figure 8). The follower spots were now just tiny naked umbrae just a little bigger than pores.

From this point, AR 2706 quickly dropped below 100 millionths, again producing only a few weak flares and by 4/27 was only a plage shown in a Ramakers H-a image at 14:22 UT that caught two nice filaments, one extending N and the other S (Figure 9). The region left the disk four days later.

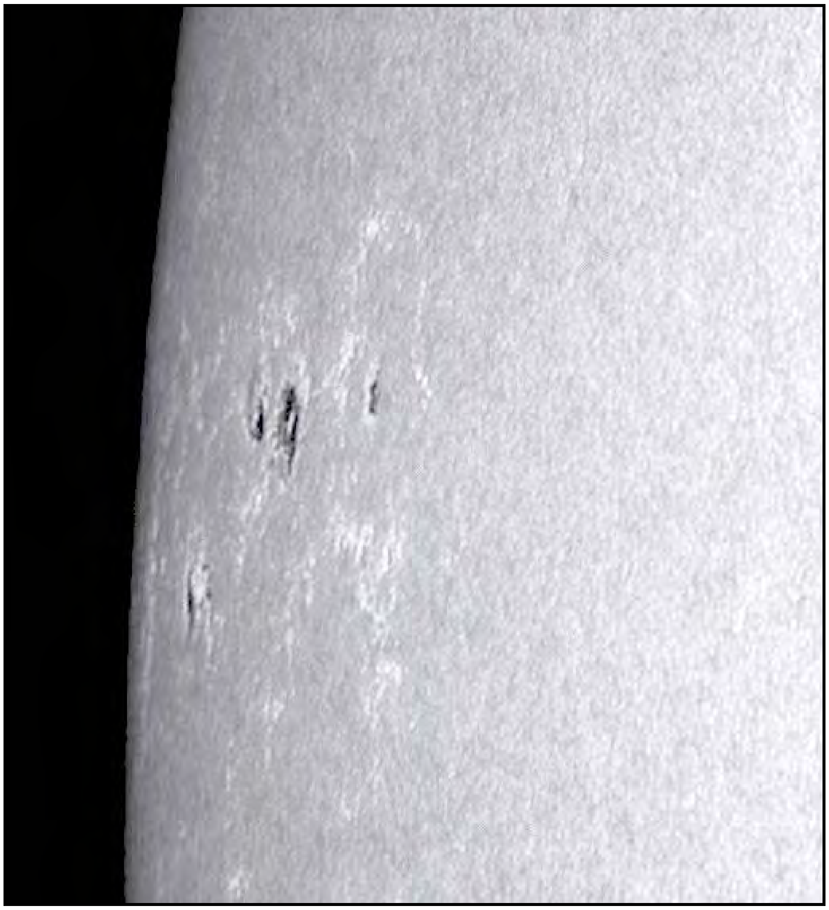


Figure 4. White-light image of AR 2706 by Tyler on 04/19 at 10:34 UT.

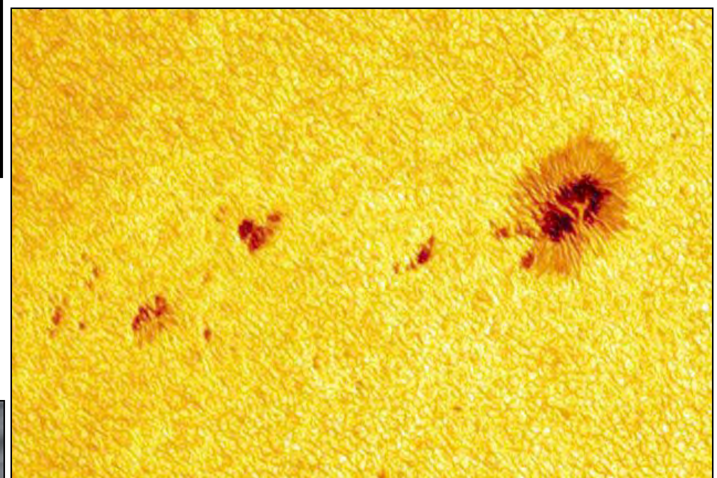


Figure 5. Colorized white-light image of AR 2706 by Tyler on 04/22 at 11:09 UT.

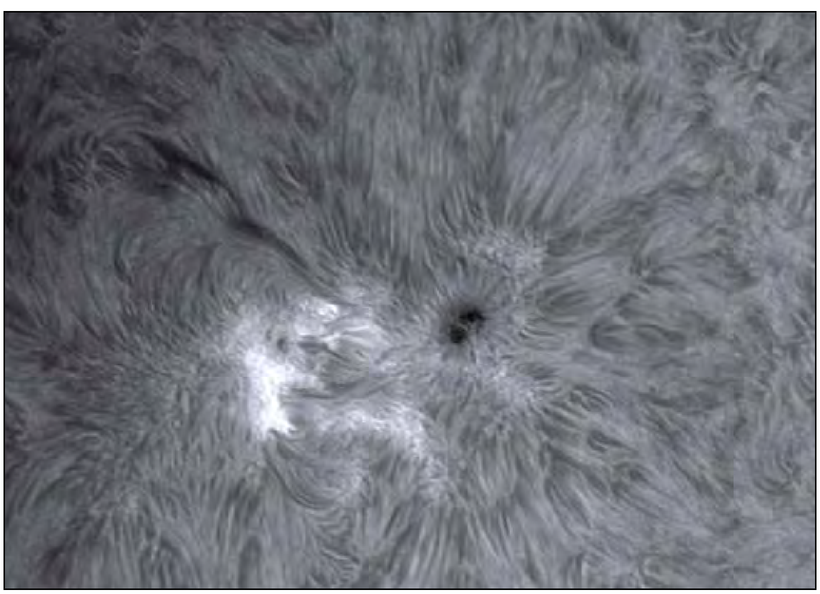


Figure 6. An H-alpha view of AR 2706 by Tyler on 04/22 at 12:05 UT.

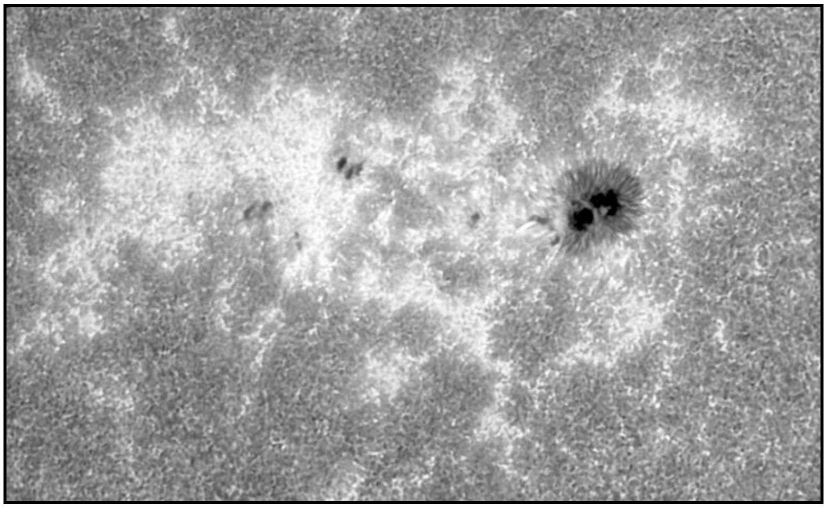


Figure 7. A CaK image of AR 2706 by Viladrich on 04/22 at 15:14 UT.

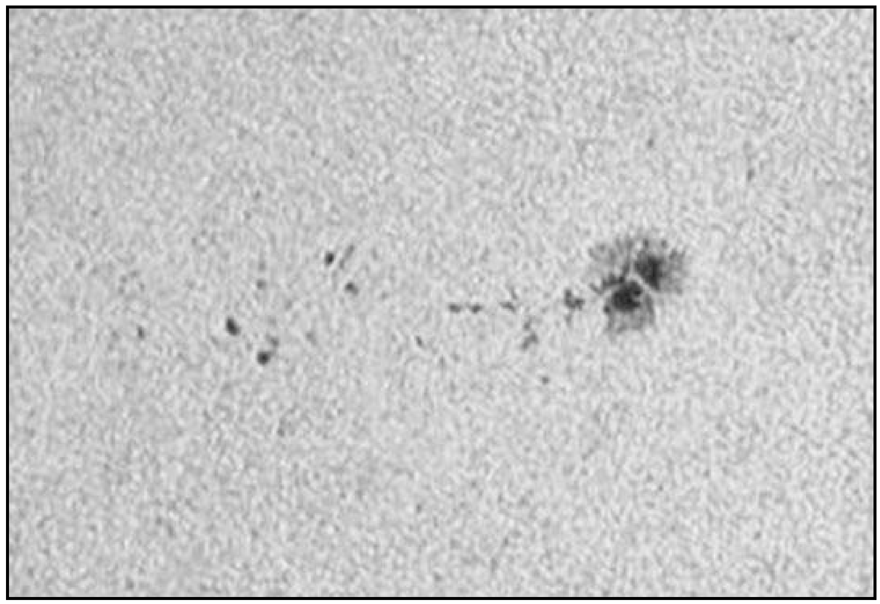


Figure 8. A white-light image of AR 2706 by Carels on 4/23 at 07:34 UT.

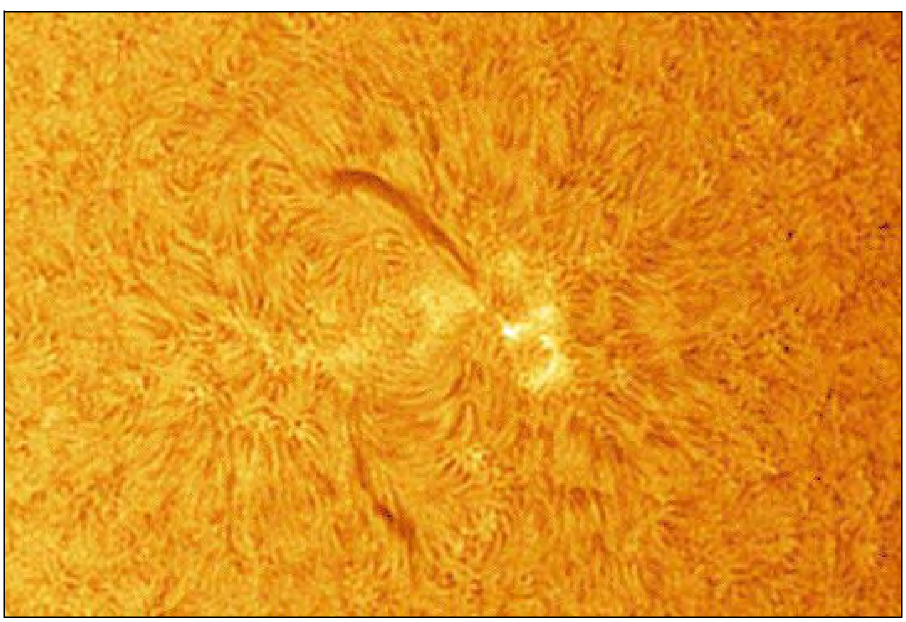
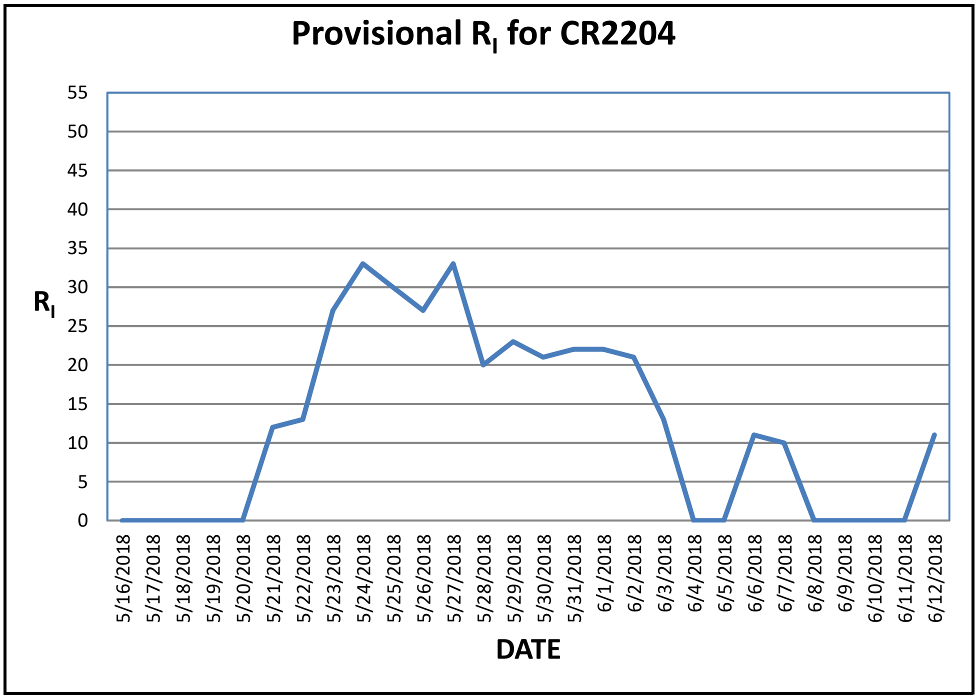


Figure 9. A Ramakers H-Alpha image of AR 2706 as a plage on 4/27 at 14:22 UT.



Carrington Rotation 2204

Dates: 2018 05 16.4562 to 2018 06 12.6625

Avg. R_I = 12.5
High R_I = 33 (5/24 & 5/27)
Low R_I = 0 (11 days)

Activity shown by the average R_I of 12.5 increased a tiny amount from the previous rotation. But the reader is referred to the previous discussion on how tiny this increase is, especially in light of an over 30% increase in zero spot days. With only three regions during this rotation, it was fairly easy to spot the most active one as feeble as that was.

AR 2712 came on the disk as a Cso group of 80 millionths area on 5/24. It was first noticed by Teske at 19:42 UT in a mixed w-l/H-a drawing at the same latitude where he noted a couple small prominences and a plage the day before. It dropped a little in area on 5/26; at 12:03 UT, Grassmann got a good CaK view of the northern hemisphere with three centers of activity. AR 2712 was the leftmost active region in the image (Figure 10).

Late on 5/28, it was a Csi (beta-gamma) group of 80 millionths, again with an average of one weak to moderate flare every four hours. Leventhal, in one of his combined w-l/H-a drawings at 22:40 UT, noted a "2N" flare that started at 00:30 UT on 5/29, peaking at 00:45 UT and ending by 01:00 UT.

By 6/1, it increased flare production by a factor of three and was a Dro group, though the area decreased to 60 millionths. It broke down from there as can be seen in a Ty H-a image on 6/3 (Figure 11). It left the disk on 6/5 as an Axx group of 10 millionths with only 6 "B" flares and on "C" flare in the last two days.

Carrington Rotation 2205

Dates: 2018 06 12.6625 to 2018 07 09.8597

Avg. R_I = 14.0
High R_I = 56 (6/20)
Low R_I = 0 (12 days)

This rotation showed the highest activity for the reporting period and the second highest number of zero spot days! Again, there were only three active regions designated by NOAA for this rotation, the most interesting of which was AR 2715.

AR 2715 formed on the disk as a Cro group of 30 millionths (beta) on 6/19 only 30 degrees east or preceding the meridian. We get a good look at this rapidly developing region on 6/10 in a w-l image by Ramakers at 12:18 UT (Figure 12). At this time, it was a Dai class group of 110 millionths (beta), producing about one flare every three hours, all "B" class.

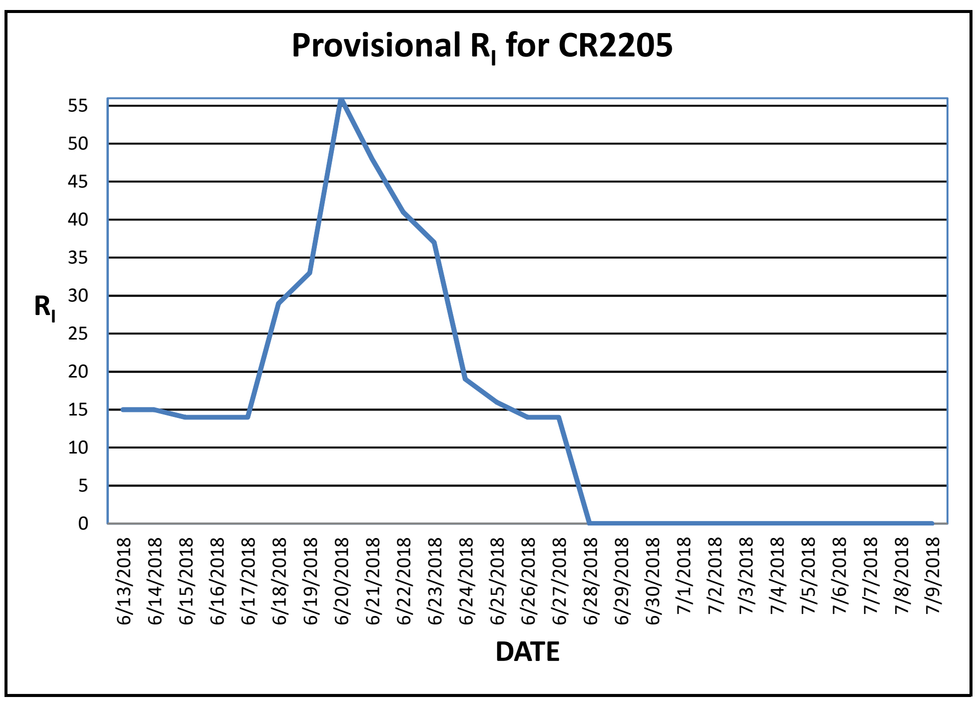


Figure 10. A CaK northern hemisphere image by Grassmann showing the activity on 05/26 at 12:02 UT.

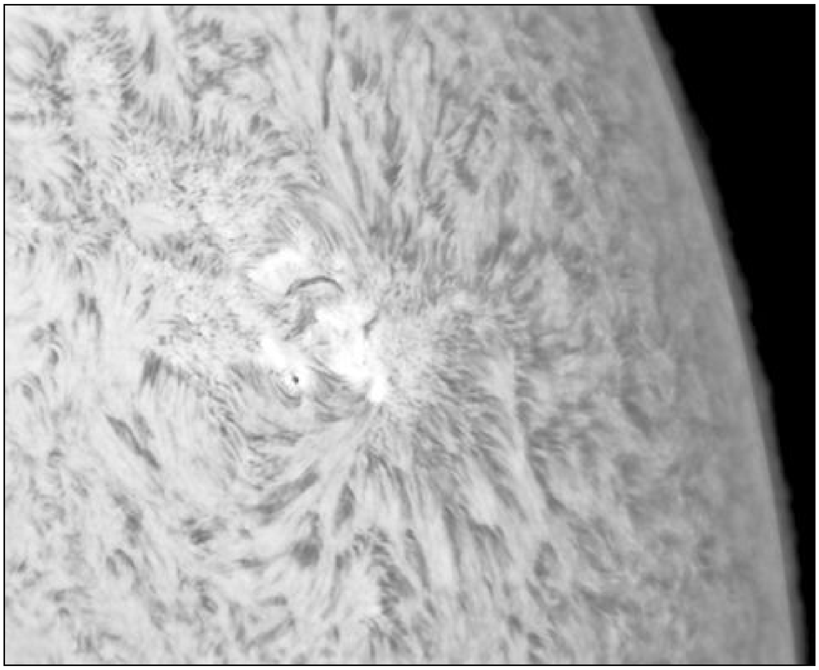


Figure 11. An H-alpha image of AR 2712 by Ty on 06/03 at 06:23 UT.

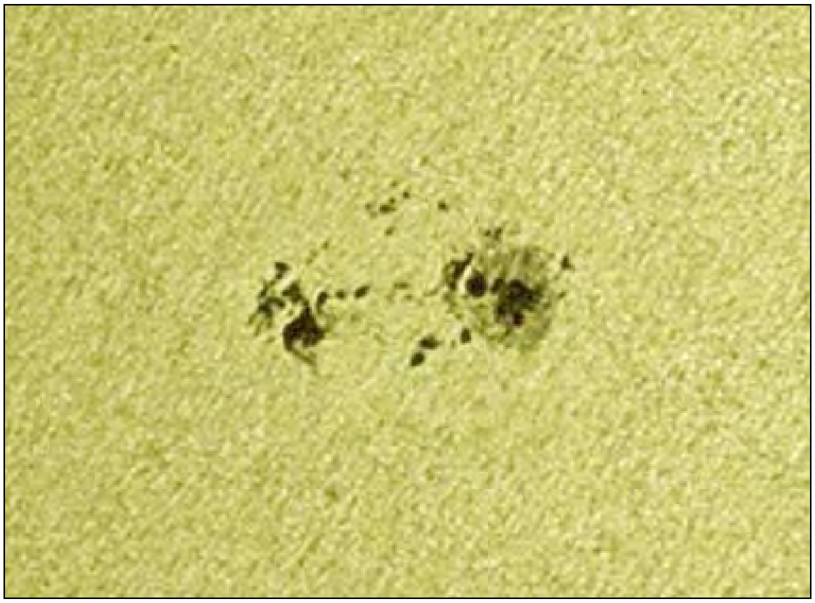


Figure 12. AR 2715 in a colorized white-light image by Ramakers at 06/20 at 12:21 UT.

On 6/21, Braga got a very good image of the group at 07:45 UT showing remarkable detail in the umbrae of the follower. The leader was a fragmented umbra in a roughly teardrop shape oriented E-W while the followers were 4-5 granulated umbrae oriented N-S (Figure 13). Later in the day, he got a CaK image that demonstrated the low activity of this group (Figure 14).

It achieved maximum development on 6/22 as it crossed the central meridian and was listed as a Dao group of 160 millionths (still beta). Our visual observers, Broxton, Levinthal and Mangelsdorf, all were in reasonable agreement with this classification. Ramakers showed a curious realignment, counterclockwise rotation of the umbrae in the follower, in a w-l image at 12:34 UT, where they were now lined up for the most part, in one rudimentary penumbra (Figure 15).

This appearance became more bizarre the next day when a Tyler w-l image at 08:42 UT captured the umbrae breaking down in a single, very rudimentary and disorganized penumbra. Normal fibrils and filaments were smeared as if they were out of focus but this was not the case, as the granulation was quite sharp. The classification was relatively unchanged at Dac of 110 millionths, but these signs indicated dissolution was beginning (Figure 16).

Another Ramakers image of 6/25 confirmed this as almost all penumbra was gone and we were left with two small umbrae surrounded by pores. The next day, it was a single spot and on 6/27, only a plage as it left the disk (Figure 17).

Conclusion

While activity was low during this reporting period, still we have not reached the lowest activity for this crossover from Cycle 24 to 25. Rotations with R_I=0 are very likely at the nadir.

As was pointed out, we may have seen some hints of the coming cycle but statistically, it means nothing as yet. Observers are encouraged to watch for high-latitude (+/- 40°) sunspots, plages and prominences and observe them diligently, as these could be early Cycle 25 features. With some professional solar researchers suggesting a possible extended and deep minimum, and the fleeting nature of some of these features, these observations could prove to be quite valuable.

Lastly, a word about the observations. We need observers to identify specific limbs observed in individual prominence images (NW, SE, etc). If you can identify the probable active region it's associated

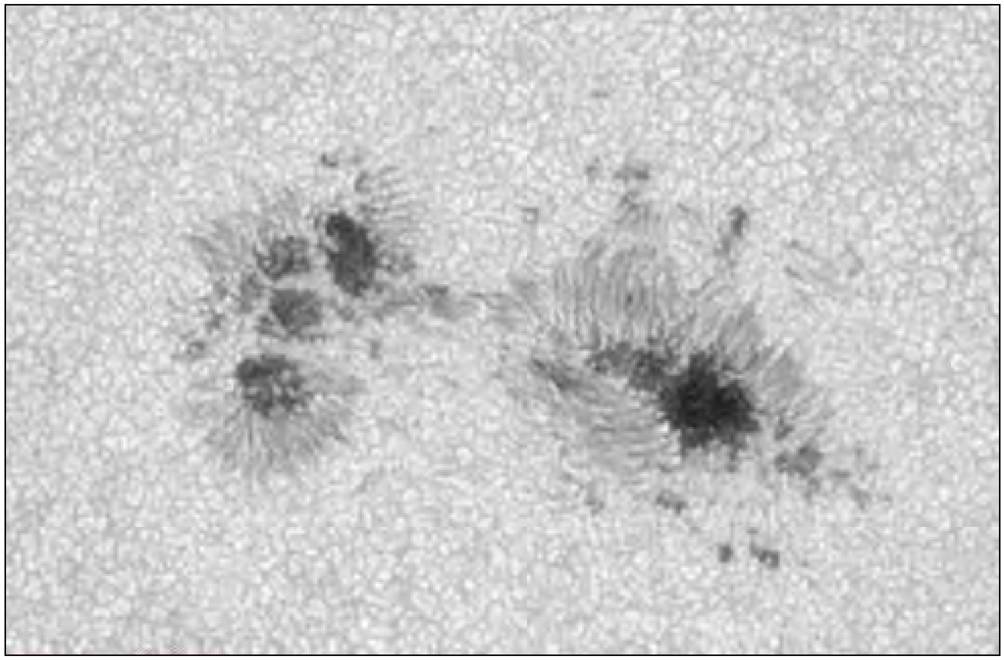


Figure 13. A Braga white-light image of AR 2715 on 6/21 at 07:45 UT.

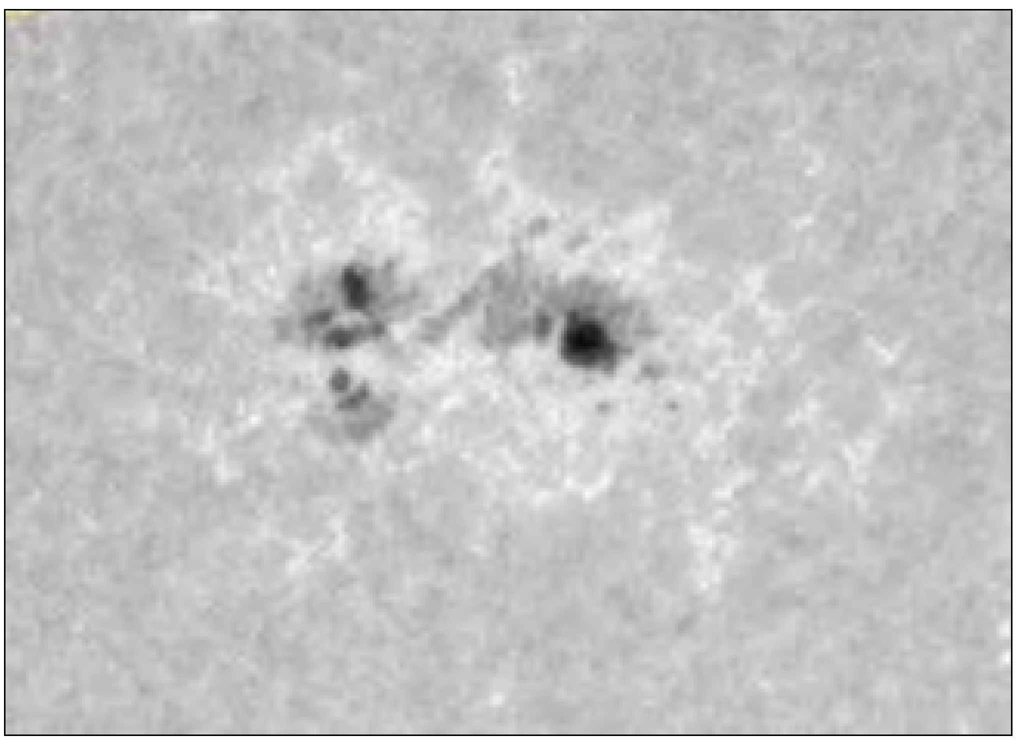


Figure 14. Another Braga image this time CaK showing AR 2715 on 06/21 at 15:33 UT.

with, so much the better! We had a number of good prominence images in this reporting period, but it was often too difficult to positively associate them with individual active regions or even a limb.

Observers are reminded that this is the time to hone techniques and modes for the upcoming solar maximum a few years from now. When we already have daily RI>120 is a bad time to start experimenting!

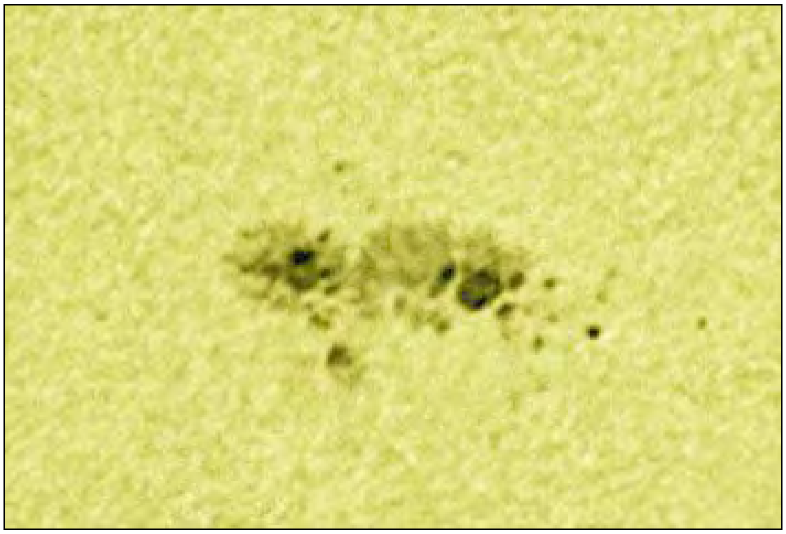


Figure 15. A colorized white-light image of AR 2715 by Ramakers on 06/22 at 12:34 UT.

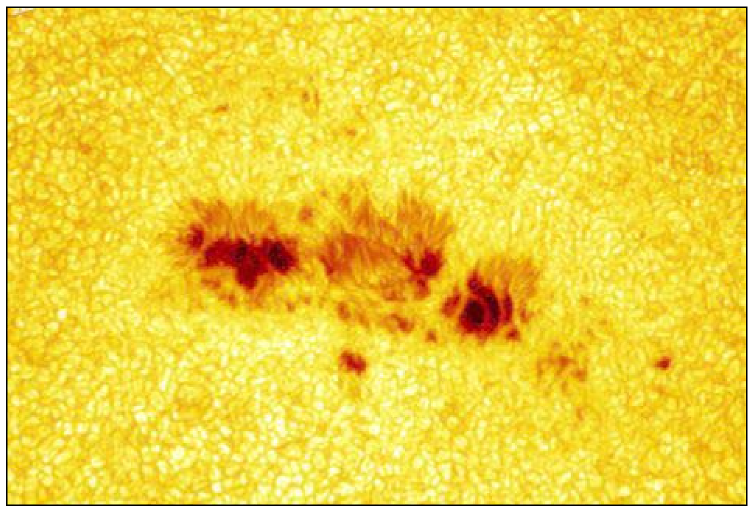


Figure 16. A colorized white-light image of AR 2715 by Tyler on 06/23 at 08:42 UT.

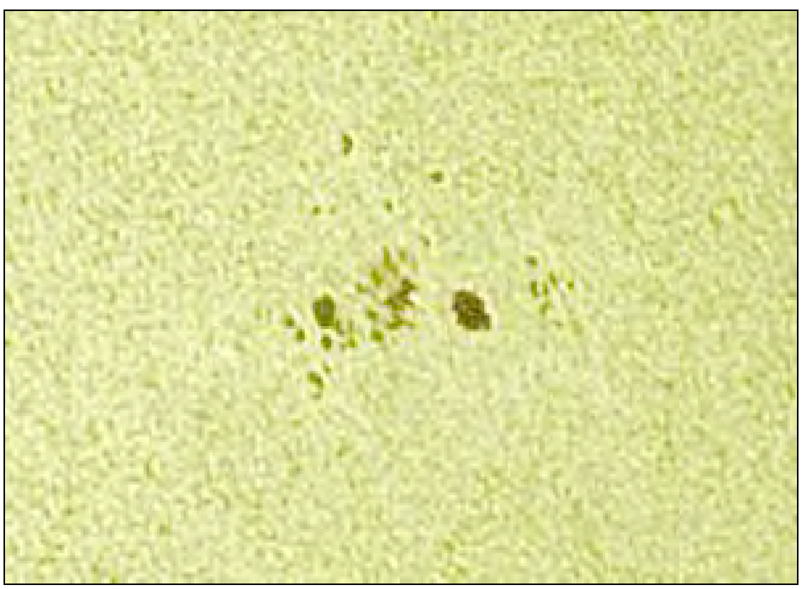


Figure 17. A Ramakers colorized white-light image of AR 2715 on 06/25 at 12:45 UT.

A.L.P.O. Solar Section

OBSERVER____

ADDRESS____

DATE/TIME____UT

SEEING____________ CLOUDS____________ WIND____________

APERTURE__________mm FOCAL LENGTH__________mm TYPE______

EYEPIECE_______mm FILTRATION_________________________

OBSERVATION: ***DIRECT*** OR ***PROJECTED***? (CIRCLE ONE)

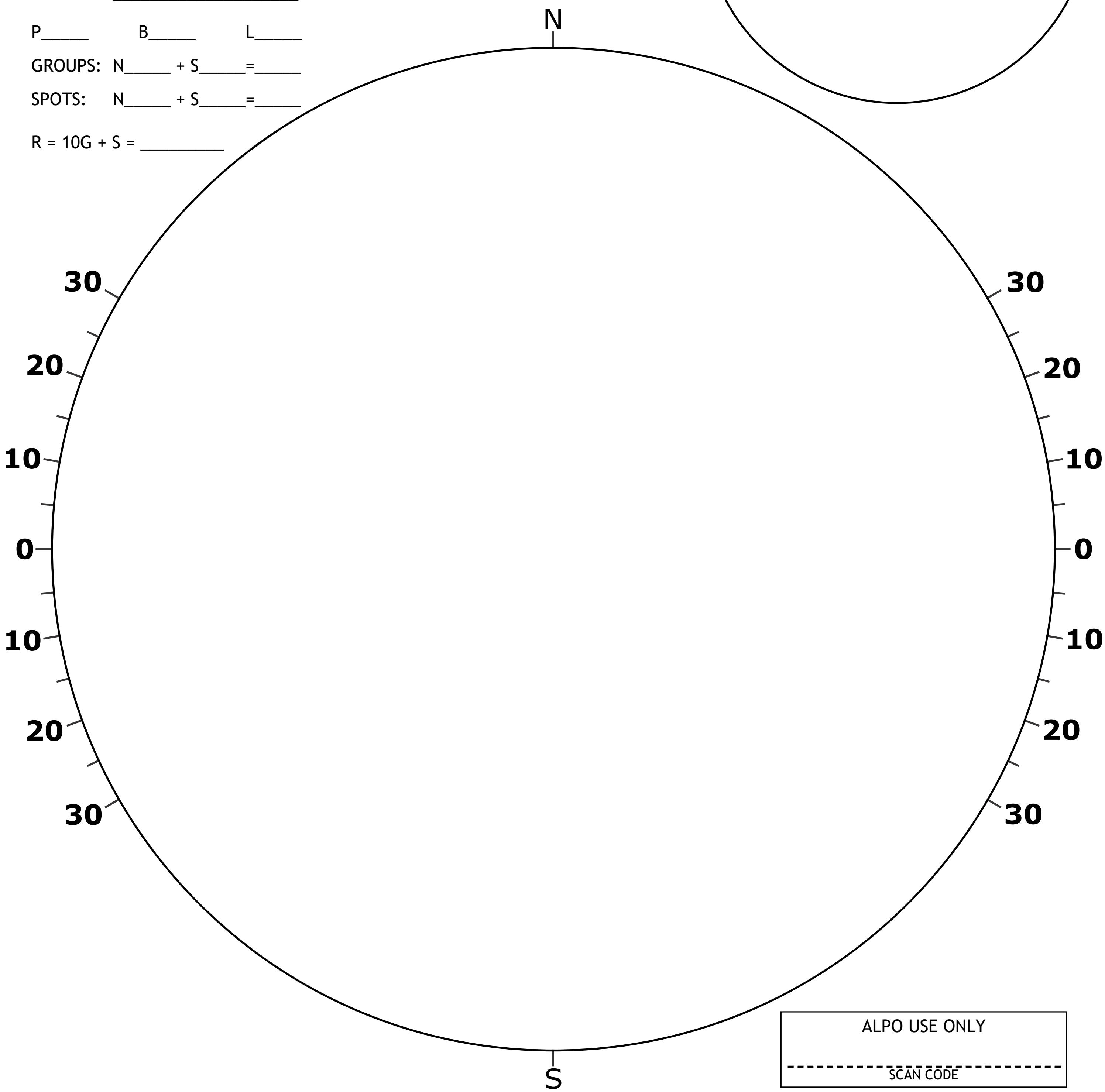
ROTATION_____________

P_____ B_____ L_____

GROUPS: N_____ + S_____=_____

SPOTS: N_____ + S_____=_____

R = 10G + S = _________



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SCAN CODE

A.L.P.O.SOLAR SECTION

ACTIVE REGION DRAWING REPORT FORM

SKY/SITE

Date/Time(UT) ____

Rotat.No. _______ A.R. __________ Cen.Meridian _________ Altitude _________

Sky cond. _____________ Seeing __________ Clouds _____________ Wind ________

Observatory type (circle one): roll off roof, roll off bldg., dome, none

TELESCOPE:

Inst. type ________________________ Mounting type ___________________________

Clock drive? ______ Type of drive ____

Full aperture ___________________________ Focal length ____________ f/________

Aperture stop/type ___________________________ Final f/_______________________

Address: Phone No. ( )area code_______________________

Papers & Presentations:

ALPO Observations of Mercury During the 2017 Apparitions

By Frank J Melillo, coordinator, ALPO Mercury Section
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Abstract

There were six apparitions of Mercury in 2017. There were only two observers who submitted a total of 8 images. They used telescopes with apertures of 250 mm (10 in.) and 360 mm (14 in.). The albedo features they detected have obvious correspondences with images from the MESSENGER flybys and with the 1971 albedo chart prepared by Murray, Smith and Dollfus (Murray, Smith and Dollfus, 1972; see Figure 1).

Introduction

An apparition of any planet is the period between two conjunctions with the Sun. Superior planets (Mars and beyond) have only superior conjunctions, while the inferior planets Mercury and Venus have both superior and inferior conjunctions that serve as dividers between their apparitions. We assign a year to each apparition of Mercury according to the year in which its greatest elongation occurs. Since there were three evening and three morning greatest elongations of Mercury in 2017, we speak of their corresponding apparitions as occurring in that year, though the first and last of the apparitions each spanned a change of year. We assign numbers to the apparitions of each year according to their order of appearance (see Table 1).

During 2017, the ALPO Mercury section received fewer observations than it received in recent years (Melillo, 2010, 2011a, 2011b, 2013, 2014, among others). The 2017 observations were made by two observers, one of whom is the section coordinator. The observers used telescopes of 250 mm (10 in.) and 360 mm (14 in.) aperture, respectively. The quality of the observations was very high. This author contributed the most

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:
Magnitude of the faintest star visible near Mercury when allowing for daylight and twilight

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

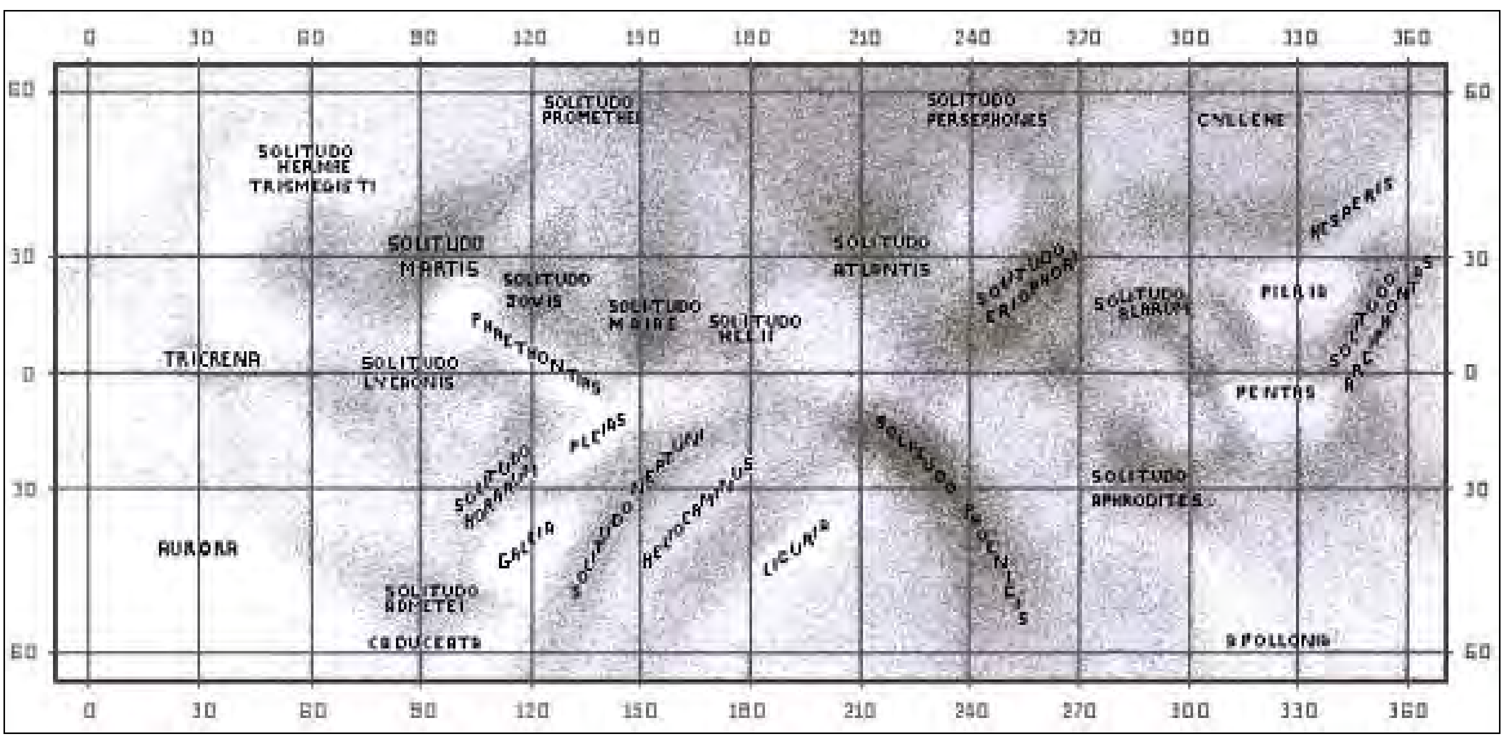

Figure 1. Albedo chart prepared by Murray, Smith and Dollfus

Table 1. Characteristics of the Apparitions of Mercury in 2017 (all dates UT)

Number & Type	Beginning Conjunction+	Greatest Elongation	Distance From Sun*	Magnitude*	Final Conjunction+
1. Morning	2016 Dec 28 (i)	Jan 19	24.1 degrees W	- 0.23	2017 Mar 6 (s)
2. Evening	2017 Mar 6 (s)	Apr 1	19.0 degrees E	-0.15	2017 Apr 19 (i)
3. Morning	2017 Apr 19 (i)	May 17	25.8 degrees W	+ 0.42	2017 Jun 21 (s)
4. Evening	2017 Jun 21 (s)	Jul 30	27.2 degrees E	+ 0.31	2017 Aug 26 (i)
5. Morning	2017 Aug 26 (i)	Sep 12	17.9 degrees W	- 0.41	2017 Oct 8 (s)
6. Evening	2017 Oct 8 (s)	Nov 24	22.0 degrees E	- 0.39	2017 Dec 13 (i)

+ (i) is Inferior conjunction, (s) is Superior conjunction. * At greatest elongation.

observations with seven webcam images with fair resolution (see Table 2).

Both observers contributed only "webcam lucky imaging" observations. Nowadays, lucky imaging yields the best results that can be had. The quality stems from the automated selection of only the clearest images from among many, and the stacking of the selected ones to average their errors and improve the signal-to-noise ratio. This author agrees with Boudreau that the use of a red filter such as a Wratten No. 25 (red) filter alone, or a red filter plus an IR filter such as a 610 nm long-pass filter, will improve the clarity of webcam images of Mercury (Boudreau, 2009).

Still, drawing is useful and trains the observer's eye. Mercury can reveal some of its secrets to visual observers using various colored filters. Furthermore, visual observing teaches one to observe with critical concentration, and the effort it involves causes one to remember much more of what he or she detects than does imaging.

Generally speaking, the limiting factor in the visual perception of detail is not the telescope type or size. Quality eyepieces are important. And color filters will limit the effect of atmospheric chromatic aberration when the planet is near the horizon. To limit the glare of the background sky when Mercury is studied in the daytime, a Wratten No. 21 (orange) filter has long been recommended. Some observers consider filtered daytime observations to reveal the most detail. Shading the telescope from the direct light of the Sun, either with a nearby building, tree, or with a home-made screen will reduce tube currents that can disturb the image (Melillo, 2004). Mercury has earned its reputation for being the most difficult planet to study whether by eye or by camera.

If an observer wishes to observe Mercury in the daytime and lacks a GoTo mount, hopping from the Moon or from Venus can be accomplished by the use of setting circles.

The global map made from images taken by the MESSENGER spacecraft serves as an excellent resource for comparison with our views through the eyepiece and our images. Such comparisons have proven that the most prominent features that ALPO observers detect on the surface of Mercury are bright ejecta blankets around craters. Also, some of these bright rayed craters are seen next to dark albedo features, which make a nice contrast. This is remeniscent of what we see on the Moon with the unaided eye -- the bright Kepler and Copernicus ejecta with darker areas nearby.

The 2017 observations of Mercury are presented and described in this article.

Apparitions 1, 4 and 6

No observations of these three apparitions were received.

Apparition 2: Evening, 6 Mar - 19 Apr

This was Mercury's best evening appearance of the year. The greatest elongation was only 19 degrees from the Sun, but the tilt of the ecliptic with respect to the dusk horizon at this time of year, coupled with Mercury's position north of the ecliptic, raised the height of the planet further above the horizon than did the other evening apparitions of the year (see Table 1). Therefore, it was more easily found and Earth's atmospheric interference was diminished for observers in Earth's northern hemisphere. This author noted that Mercury became easily visible with the naked eye as the sky darkened after sunset.

The author imaged Mercury the day after greatest elongation, 2 April at 23:02 UT, with the central meridian at 289 degrees.

Table 2. Observers of Mercury in 2017

Observer	Location	Instrument*	Number & Type of Observation**	Apparition(s) Observed
Goryachko, Yuri	Minsk, Belarus	360 mm Cass	1 W	3
Frank Melillo	Holtsville, NY, USA	250 mm SCT	7 W	2, 3 and 5

* Cass = Cassegrain, SCT = Schmidt-Cassegrain
** W = Webcam lucky imaging

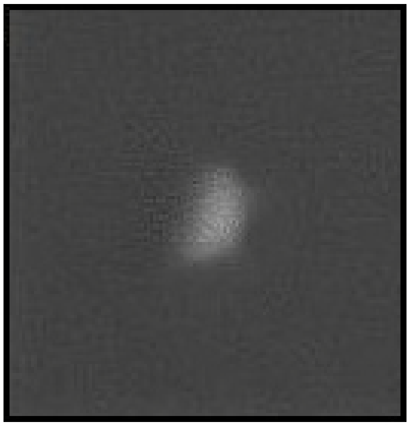

Figure 2. An image of Apparition 2. (In this and all other figures in this article, north is up and planetary east is to the right.) Image by Frank J Melillo, 2 Apr 2017, at 23:03 UT. CM was 289 degrees.

It appeared as a fat crescent in the image, which was taken right after sunset, so the planet was still fairly high in the sky. The seeing was poor, however, so that the surface details cannot be seen in the image (see Figure 2).

Apparition 3: Morning, 19 Apr - 21 Jun

Though the extent of elongation from the Sun was good during this apparition, the need to arise before dawn to see it may have limited the number of observations made. The three observations showed progressively increasing gibbous phases and are presented in Figure 3.

The author made his first observation on 4 June (CM = 290 degrees) while the phase was gibbous at 73% illuminated. The image shows surface details with fair resolution. A dark feature at its center is likely Solitudo Aphrodites. Also, three bright rayed crater ejecta deposits were captured toward the southeast section of the disk, arranged approximately in a north-south row. On 9 June (CM = 310 degrees), Yuri Goryachko made an excellent image with higher resolution, revealing much detail. The three rayed crater ejecta are clearly seen, and a number of less prominent bright spots are also demonstrated. The shape of the dark albedo feature suspected to be Solitudo Aphrodites is clear. This feature is thought to be the darkest part of the whole surface. The next day, 10 June (CM = 315 degrees), the author took another image under good conditions. The gibbous phase was at 86% illuminated. The two most prominent rayed crater ejecta are seen to have rotated closer to the center of the disk, and the dark Solitudo Aphrodites moved toward the terminator. All the albedo features that are demonstrated in these images match the MESSENGER global map very well.

Apparition 5: Morning, Morning, 26 Aug - 8 Oct

Due to the angle that the ecliptic makes with the horizon at this time of year for observers in the Earth's northern hemisphere, Mercury appeared higher above the dawn horizon than it did for other morning apparitions this year, and thus could be better observed despite the relatively poor distance of elongation which peaked at 17.9 degrees from the Sun. An interesting event during this apparition was a close conjunction with Mars. They were only a third of a degree apart before sunrise on 16 September, with closest approach of only 3.3 minutes of arc a few hours later in the bright morning sky. Mercury's magnitude that morning was -0.84 while Mars was at +1.8, a brightness ratio of 11.4, and though Mercury was a naked-eye object, binoculars were required to visualize Mars before dawn

The author is the only person known to have observed Mercury during this apparition, and his four images are presented in Figure 4. His image of 9 September (CM = 71 degrees) displayed a crescent shape of 34% illumination. It appears to show subtle, small albedo features, but these do not clearly correspond to known features. He made another image the next day, 10 September (CM = 77 degrees), revealing only the crescent shape, at a slightly larger phase of 38% illumination. These images suggest that surface details at such large phase angles are usually hard to capture on Mercury.

He imaged Mercury again on 23 September (CM = 139 degrees) and on 24 Sept (CM = 143 degrees). On these dates, Mercury displayed a broad gibbous phase, and better detail was detected despite the smaller apparent diameter of the planet. Both images show a large dark feature in the southern hemisphere consistent with Solitudo Maiae, or possibly a combination of the dark areas Solitudo Maiae and Solitudo Jovis seen as a single blurred feature. The 23 September image shows three faint rayed crater ejecta arranged northwest to southeast across the middle of the image that are less well seen in the 24 Sept image. He reports that the seeing was better on 23 September than on the 24th. In comparison with the global map of Mercury made from images taken by

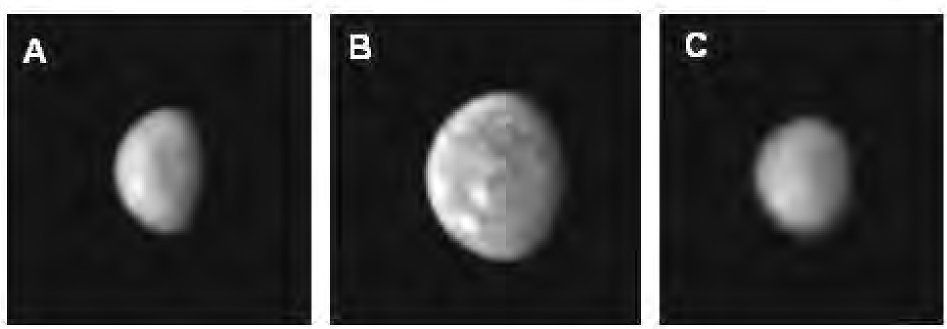

Figure 3. Three images of Apparition 3.
A. Image by Frank J Melillo, 4 Jun 2017, at 14:15 UT. CM was 290 degrees.
B. Image by Yuri Coryachko, 9 Jun 2017, 5:50 UT. CM was 310 degrees.
C. Image by Frank J Melillo, 10 Jun 2017, 14:30 UT. CM was 315 degrees.

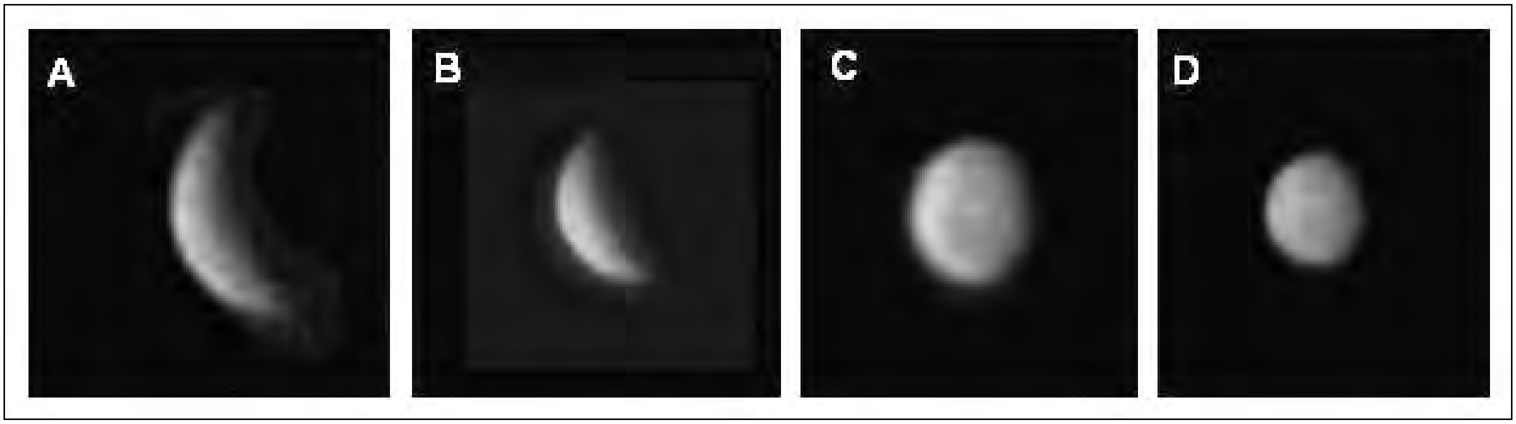

Figure 4. Four images of Apparition 5.
A. Image by Frank J Melillo, 9 Sept 2017, at 14:35 UT. CM was 71 degrees.
B. Image by Frank J Melillo, 10 Sept 2017, at 14:35 UT. CM was 77 degrees.
C. Image by Frank J Melillo, 23 Sept 2017, at 14:35 UT.CM was 139 degrees.
D. Imaged by Frank J Melillo, 24 Sept 2017, at 14:25 UT. CM was 143 degrees.

the MESSENGER spacecraft, the most prominent features in these images are verified as real.

Conclusions

Amateur observers of Mercury have demonstrated that superior images are produced by the use of webcam lucky imaging. With the stacking of many brief images, software can bring out remarkable details that had rarely been seen before lucky imaging techniques were discovered. Dark areas and areas of bright rayed crater ejecta can now be detected by amateurs. The use of a red filter enhances the detection of albedo details, presumably due to the lesser susceptibility of red light to atmospheric seeing effects, when compared with other visible colors. We expect to see more such images in the future. More observations are now being made by lucky imaging than visually.

Based on our 2017 observations, we suspect that images made of Mercury when in the crescent phase show less detail than those made during gibbous phase, despite the larger subtended diameter when crescentic. The reason for this is uncertain.

Our images can now be compared to the images made by the MESSENGER spacecraft (which is no longer in orbit) to assess the veracity of the details that are detected. We are optimistic that our Earth-based images will eventually be used to make a new, definitive map of the entire surface of Mercury that represents the best view obtainable from Earth.

Having said that, this writer must stress one thing: not everyone can image Mercury. Instead, a nice sketch or drawing will fill the gap where imaging is impossible.

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Papers & Presentations

Mars: The South Polar Hood and Hellas

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Abstract

The northern boundary of Mars' South Polar Hood (SPH) was measured from almost 700 Earth-based images made between 2001 and 2018. This analysis covers the late summer, autumn, winter and early spring for Mars' southern hemisphere. The conclusions of this study are:

- *The SPH developed gradually during the late summer, reached its maximum extent in autumn/winter and broke up afterwards.*
- *The mean northern borders of the SPH, in °S, for Ls = 20°-80° and Ls = 100°-160° at local times of 9h, 10h, 11h, 12h, 13h, 14h, 15h and 16h were: 37.4, 40.0, 41.2, 42.7, 44.0, 44.2, 44.6 and 43.6, respectively (these do not include Hellas).*
- *The bright Hellas area for Ls = 120°-140° underwent only minor changes while it was on the morning and afternoon sides.*
- *A dark spot often developed in Hellas during winter which may be the result of dust activity.*

Introduction

Common abbreviations are used in this report. These include "SPH" (South Polar Hood), "SPC" (South Polar Cap), the analogous abbreviations for the North Polar Cap/Hood, and "Ls" (areocentric longitude of the Sun as seen from Mars). The Ls value defines the seasons on Mars. Values of Ls = 0°, 90°, 180° and 270° are the beginning of autumn, winter, spring and summer for the south polar region, respectively. Hereafter, seasons are for Mars' southern hemisphere.

The SPH is a system of clouds which develops over the South Polar Region of Mars during late summer and lasts throughout most of the autumn and winter. Unlike the NPH, the SPH reaches its maximum extent when Mars is near aphelion. Furthermore, the SPH has a lower opacity than the NPH. For these reasons, our knowledge of it progressed at a slower pace until the late 1990s.

A brief historical review is hereby given first. The goals of this study are then stated and followed by a description of the method and software used. The results are then presented and discussed.

Historical Overview

William Herschel was the first to establish the orientation of Mars' rotational axis (Flammarion, 2015, p. 51). He also observed the SPH to grow between April 17 and 26, 1777, which was early winter (Flammarion, 2015, pp. 44-45) and correctly identified the polar bright spots as undergoing seasonal changes similar to Earth's ice caps (Flammarion, 2015, p. 51). Schröeter also observed the Polar Regions. He stated the southern patch was sometimes observed during the southern summer and sometimes during northern summer (southern winter). He attributed the polar patches to clouds and surface ice

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(Flammarion, 2015, p. 57-58). Therefore, he may have been the first to recognize the polar hoods.

Over the next century, several individuals drew white areas which were probably the SPH. For example, Beer and Mädler report a bright, south-polar spot changed size between February and March 1837 (Flammarion, 2015, p. 97). At this time, it was late autumn on Mars, meaning they undoubtedly observed the SPH. Green and Lohse both observed a large bright, south polar area in May and June of 1873 (Flammarion, 2015, pp. 188, 194-196). It was late autumn at this time and, hence, Green and Lohse probably observed the SPH. Lohse noted the SPH was not quite opposite to the NPC (Flammarion, 2015, pp. 194-196). His drawing on May 25, 1873, supports this and shows the SPH extending farther north on the morning side.

In the late 19th century, two important developments took place. Firstly, Trouvelot pointed out that clouds and polar ice could be mistaken for one another (Flammarion, 2015, pp. 312-313). This is an early suggestion of the existence of both the SPH and polar ice deposits. A second important development was photography. Pickering published photographs of Mars taken on April 9 and 10, 1890 (Flammarion, 2015, pp. 388-389). He noticed the bright area near the South Pole had grown several degrees in latitude in one day. He attributed this to snowfall (Flammarion, 2015, pp. 388-389). In April 1890, the southern hemisphere of Mars was in mid-winter. A more likely interpretation of these photographs is the SPH expanded.

During the first 70 years of the 20th century, several important SPH discoveries were made. De Vaucouleurs (1954, pp. 193-201) summarized the color filter work of Tikhoff and Scharonow who reported the SPH was bright in ultraviolet, violet, green and integrated light but faint or invisible in red and near-infrared light. He also mentioned its albedo was 0.3, which is less than that of pure ice. Dollfus (1961, p. 385) reported the SPH had a similar polarization curve in 1954 as the NPH had in 1958 based on measurements made by Focus. The SPH was also photographed extensively. Slipher (1962, p. 22) reported that we see an ice cap during the spring and summer and a "cloud mantle" during the autumn and winter. He also reported the cloud mantle may vary from day to day. Numerous photographs of the SPH are shown in his plate section. He pointed out the SPH was very large in a December 19, 1960, photograph shown in his plate XV (Slipher, 1962, p. 22). In this photograph, the SPH extended to about 40° N. It was early Martian autumn at that time. Glasstone (1968, p. 139) summarized our knowledge of the SPH in 1968 as a cloud system which develops in early autumn and dissipates enough just before the vernal equinox to reveal the edge of the South Polar Cap; furthermore the SPH is less brilliant than the SPC and is made up of minute crystals of water and carbon dioxide ice.

From 1969 to the early 1990s, additional spacecraft and the Hubble Space Telescope (HST) yielded new information on the SPH. In 1969, Mariners 6 and 7 recorded the temperatures and infrared spectra of Mars' surface and atmosphere. Clouds of water ice and carbon dioxide ice were detected (Collins, 1971, p. 20). Mariner 9 imaged the SPH during autumn. Haze and wave clouds were imaged (Briggs and Leovy, 1974, p. 292). James et al. (1992. p. 948) report the Viking Infrared Thermal Mapper yielded temperatures below that of dry ice near the South Pole. Based on temperature measurements, it was suggested the SPH has water ice and carbon dioxide ice crystals in it (James et al., 1992, p. 948), (Zurek et al., 1992, p. 865). James et al. (1994, p. 89) reported HST images, made near Ls = 60° (autumn), are consistent with the SPH extending to 45° S. Smith (2008, p. 204) used temperature data to suggest both carbon dioxide and water ice crystals form in the winter polar hoods.

Earth-based observers after 1982 also made brief, but valuable, studies of the SPH. McKim (1985, pp. 44-47; 1987, pp. 145, 148, 153-154; 1989, pp. 230-232; 1991, p. 280; 2006, pp. 180, 186; 2009, pp. 131-133; 2010, p. 352 and 2012, pp. 276-278) reported this feature was visible during autumn and winter and it usually cleared enough to reveal the southern boundary of the SPC by the beginning of spring. In 1986, 2001 and 2003, the SPH had usually cleared to the point of revealing a sharp SPC by about Ls = 175° (McKim 1989, pp. 230-232; 2009, p. 133; 2010, p. 352). There is evidence clouds may have developed beyond the SPC edge. For example, Beish noted the SPC north edge was hazy and he drew white extensions beyond the SPC on May 29, 1986 (Ls = 178°); he also drew a small extension beyond the SPC one day earlier (McKim, 1989, p. 223).

Furthermore, the writer drew a northward projection beyond the SPC on April 25, 1988, near 270° W (Ls = 184°) in an unpublished drawing. This may have been part of the SPH extending beyond the SPC. During 1987-89, Beish et al. (1991, p. 57) reported clouds were observed 46% of the time in the South Polar Region during autumn. This would have been when Mars was far from the Earth in late 1987. The writer observed the SPH on three dates between March 19-22, 1988 (Ls = 163°-165°) and it extended to about 45° S. He also drew both the SPH and the NPH (or NPC) on October 26, 1992 (Ls = 346°). The NPH (or NPC) was brighter than the SPH. Venable (2018, pp. 90, 92-93) summarized the early stages of the SPH in late 2007 and early 2008. He pointed out the SPH was thin and its visibility was dependent on the filter and processing technique used. He also observed the SPH was thinner over darker albedo features. He suggested sunlight warmed the dark albedo features to the point of warming up the atmosphere and preventing the formation of ice particles.

Starting in the late 1990s, our knowledge of the SPH increased as a result of a new generation of Mars Orbiters. Wang and Ingersoll (2002, p. 4) reported global maps of Mars' SPH between May 1999 (Ls = 135°) and January 2001 (Ls =111°). These show the extent of the SPH at different longitudes during autumn and winter at a local time of ~15h. Essentially, the SPH started forming north of 60° S at Ls = 0°-10° (early autumn) and reached maximum extent a few weeks later. By late fall, Hellas brightened. There also appears to be a small northward bulge in the SPH at 40° W which is near the Argyre basin. Horne and Smith (2009, pp. 118, 123) summarized Mars Global Surveyor Thermal Emission Spectrometer (TES) measurements of the South Polar Region. Their study covered the time span from March 1, 1999 to August 31, 2004. They reported graphs showing seasonal and latitudinal changes in surface temperature, ice and dust aerosols. They also reported the water ice optical depth dropped during much of the winter in Mars Year 26 (Gregorian calendar years 2002-2004). Therefore, there is a possibility the SPH may undergo year-to-year changes. Benson et al. (2010, p. 1) analyzed observations from the Mars Climate Sounder onboard the Mars Reconnaissance Orbiter mainly in the 12 micron (µm) channel. This channel was used to study water ice clouds. They conclude the atmospheric temperature has a larger effect on the SPH than water vapor abundances. They show the SPH can form or dissipate rapidly from temperature changes. They also report the SPH forms as a cloud belt during Ls = 10°-70° and Ls = 100°-200°. The SPH becomes discontinuous or absent during Ls = 70°-100°. Furthermore, their results are consistent with the SPH extending farther north during the morning than in the afternoon. Finally, they report H_2O cloud opacities of 0.075 to 0.15 for Ls = 10-70° and 0.125-0.25 for Ls = 100-200°. These are much lower than the reported opacities (0.5 to 1) for the NPH (Christensen and Zurek, 1984, p. 4587), (Akabane et al., 1995, p. 595).

Schmude (2014, p. 109) carried out an analysis of Hellas using Earth-based images and those from the MARCI camera onboard the Mars Reconnaissance Orbiter (MRO). He reported Hellas had the same size at its northern end when the central meridian longitude was east of 283° W and west of 300° W. He also reported mean northern latitudes for the bright Hellas region between 272.5° W and 317.5° W.

Purpose and goals

One goal of this work is to record how the SPH develops in late summer and to measure its northerly latitudes at different local times during late summer, autumn and winter. To the best of my knowledge, the change in SPH size, at different local times, has not been measured before. The size and behavior of the SPH will also be compared to the NPH. Hellas is treated separately from the SPH because ice, and not clouds, may be responsible for its bright appearance during Ls = 20°-160°. Therefore, the goal of the Hellas studies is to determine the role of ice and hood clouds in its appearance. Essentially the change in size between when it is on the morning, noon and evening sides of Mars during Ls = 120°-140° is examined. The difference between morning and afternoon will be greater here than what was examined in Schmude (2014, p. 116). Furthermore, the analysis will be based on the local time of the center of Hellas instead of the location of the central meridian.

Methods and Materials

The prime meridian and longitude values are the same as in my NPH paper (Schmude, 2018). The northern boundary of the SPH was measured from blue, green and color images made from Earth. The software package *WinJUPOS* was used in making all latitude and longitude measurements. Recognizable surface features and the phase defect were used in orienting the grid. Images from the *ALPO Japan Latest Mars* website were used in this study (alpo-j.asahikawa-med.ac.jp/Latest/Mars.htm).

As in the previous study (Schmude, 2018), the two factors which guided measurements were the local Mars time and grid placement. These have already been discussed (Schmude, 2018). One difference, though, is that I did not record measurements of Hellas between Ls = 20°-160°. Before Ls = 80°, Hellas was not uniformly bright, but there may have been ice in its southern portion. After Ls = 80°, Hellas brightened to the point where it was not possible to distinguish the SPH from the surface. This area is treated separately. Late in the winter (Ls = 160°-170°), Hellas darkened to the point where the SPH could be distinguished from the ground and, hence, measurements of the SPH over this area resumed.

The "Horizons web-interface" website at https://ssd.jpl.nasa.gov/horizons.cgi was used in determining orbital and positional characteristics of Mars.

The uncertainties in this study are similar to those in Schmude (2018). The mean standard deviation for all measurements between Ls = 20°-160° in Table 1 is 4.3° compared to 4.6°, the analogous value of the NPH (Schmude, 2018).

The t-test is used for all statistical comparisons of mean values. A two-tailed test at a level of significance of = 0.05 (or a 95% confidence level) is used (Larson and Farber, 2006, pp. 416-418).

Results

Figure 1 shows images of the SPH made between 2007 and 2018. Images are arranged by the seasonal date (Ls) and illustrate seasonal progression. This hood appears small in Figure 1A because it has not fully developed. There is also a cloud farther north which may be a mixture of ice and dust. By Ls = 20°-40°, it is at its full size and extends farther north on the right (morning) side (see Figure 1B). The Hellas area is shown in Figures 1C, 1G and 1N. The SPH or possibly a thin layer of ice covers only the southern portion of that feature in Figure 1C. Later in autumn, Hellas grows bright. This makes it difficult to measure the southern border of the SPH there. Figures 1D-1F illustrate the changing visibility of the SPH during Ls = 80°-100°. The SPH is visible in Figure 1D but is not visible in Figure 1E. Clouds are only visible on the afternoon side of the South Polar Region in Figure 1F. The SPH may grow smaller in just a few days as is illustrated in

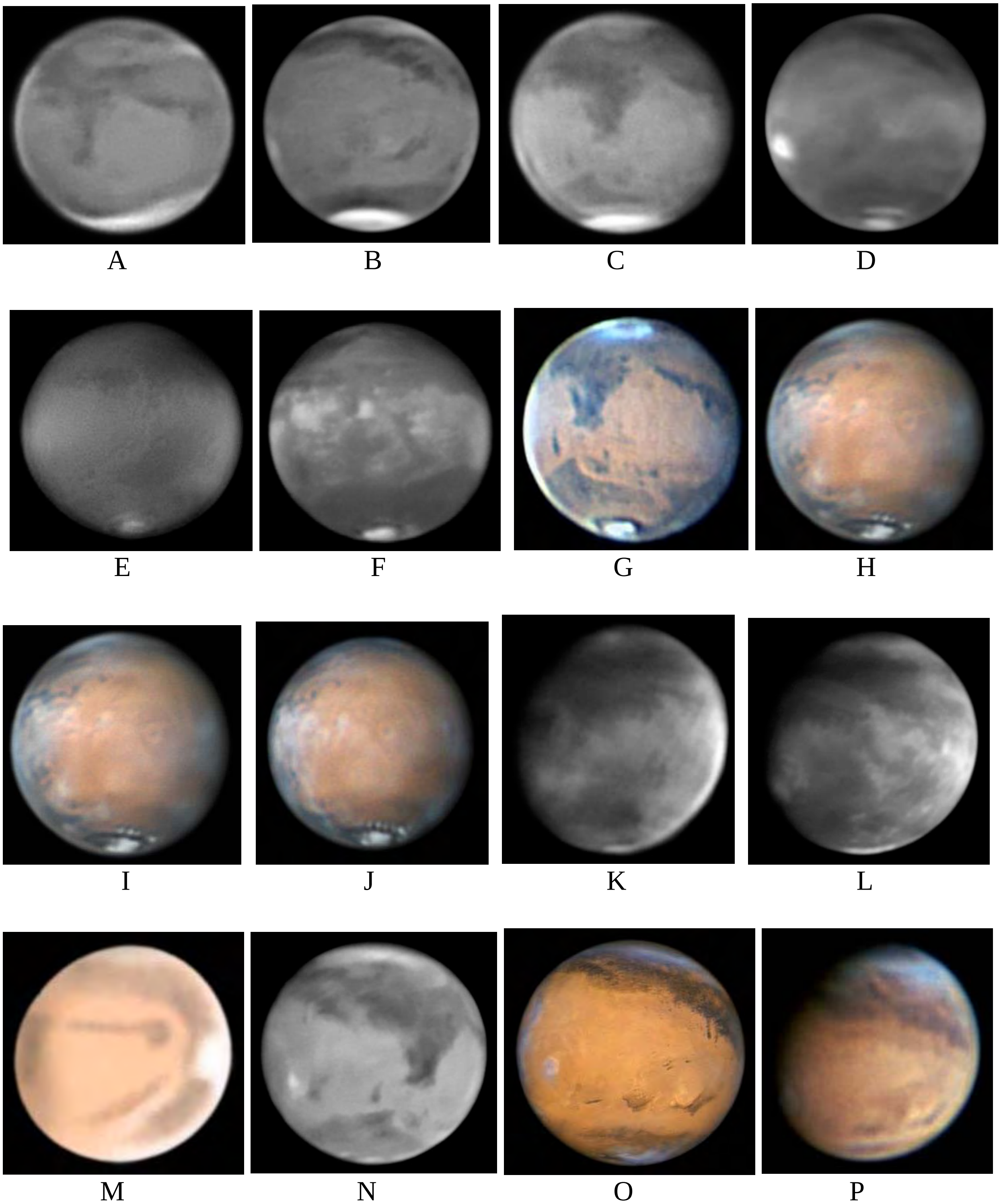

Figure 1. Images of the South Polar Hood arranged by Ls value. In all cases, south is at the top. Descriptions of the images are as follows: **A** - Dec. 21, 2007 (3:59 UT) Ls = 6° by D. Parker, B filter; **B** - Jan. 19, 2008, (2:08 UT) Ls = 20° by D. Parker, G filter; **C** - Feb. 18, 2010 (4:38 UT) Ls = 53° by G. Stelmack, G filter; **D** - March 14, 2012 (3:24 UT) Ls = 83°, D. Parker, B filter; **E** - March 14, 2012 (14:19 UT) Ls = 83°, by C. Go, B filter; **F** - March 14, 2012 (21:41 UT) Ls = 83°, by D. Peach, B filter; **G** - April 1, 2012 (21:41 UT) Ls = 91° by J Beltran; **H** - March 19, 2016 (8:19.2 UT) Ls = 125° by D. Peach, G filter; **I** - May 7, 2014 (20:02.1 UT) Ls = 127° by C. M. Zamelli; **J** - May 10, 2014 (22:27 UT) Ls = 129° by C. M. Zamelli; **K** - March 24, 2016 (2:51.2 UT) Ls = 127° by C. Foster, G Filter; **L** - March 27, 2016 (6:32.2 UT) Ls 129° by D. Peach, B filter; **M** - March 29, 2016 (2:03 UT) Ls = 129° by P. Abel, drawing; **N** - May 11, 2016 (23:41.2 UT) Ls = 151° by C. Foster, G filter; **O** - May 20, 2016 (23:33 UT) Ls = 156° by J. L. Dauvergne, E. Kraaikamp and F. Colas; **P** - April 18, 2018 (18:05 UT) Ls = 162° by M. Lonsdale.

Figures 1I and 1J. In this case, its northern edge, at 12h, moved from 35° S to 40° S in just three days. One may also see that it is not directly opposite the NPC. This was noted by Lohse in 1873 (Flammarion, 2015, pp. 194-196). The SPH also has brighter features in it as shown in Figures 1H and 1K. Venable (2018, p. 91) also reported the SPH often had brightness irregularities. In addition to this, it appears fainter at the highest southern latitudes in Figures 1L and 1O. In both cases, it became fainter southward of ~60° S. The low contrast of the SPH northern border is evident in several images including Figures 1K and 1M. As winter draws to a close, the SPC may become visible as illustrated in Figure 1P.

Table 1 summarizes measurements of the SPH made between 2001 and 2018. Mean values, based on at least 20 measurements, were used in statistical analyses. Mean values based on between 10 and 19 measurements are listed. These were not included in statistical analyses but were used in determining the northern border of the SPH at different local times. Four different seasonal times are described which are late summer, early fall (Ls = 0° to 20°), fall and winter (Ls = 20° to 160°) and late winter/early spring (Ls = 350°-20°).

In all cases, measurements were made under nearly-free dust conditions; or in other words, no global dust storm was taking place. The results of Hellas are presented separately in this paper.

Late Summer

Images made in 2005 and 2007 best illustrate the South Polar Region in late summer. In November, 2005 (Ls = 326°) Mobberley imaged clouds in the South Polar Region. Yunoki imaged a blanket of clouds on December 6, 2005 (Ls = 336°) which covered the SPC. During the next few weeks, the cloud blanket changed in brightness (Schmude, 2017,

Table 1. Boundaries of the South Polar Hood at Different Times of the Day*
(Listed for different increments of the Sun's areocentric longitude, Ls.)

Year	Ls range	Local Time									Total Images
		8h	9h	10h	11h	12h	13h	14h	15h	16h	
2007-08	350-0°	–	–	–	56.4° S [5.2°, 30]	60.6° S [4.9°, 33]	62.0° S [4.0°, 33]	62.4° S [2.3°, 33]	59.9° S [3.9°, 33]	55.9° S [3.9°, 28]	33
2007-08	0-20°	42.5° S [5.8°, 14]	48.2° S [8.8°, 38]	51.3° S [8.9°, 37]	53.2° S [10.0°, 42]	55.3° S [12.0°, 45]	54.0° S [12.0°, 40]	53.5° S [11.3°, 32]	46.8° S [8.6°, 19]	–	45
2010	20-40°	–	–	–	38.0° S [2.7°, 20]	40.8° S [3.7°, 37]	42.4° S [3.2°, 40]	42.4° S [3.5°, 38]	43.0° S [4.4°, 30]	43.3° S [4.7°, 10]	40
2010	40-60°	–	38.9° S [5.1°, 26]	41.1° S [4.4°, 48]	43.2° S [4.5°, 54]	43.8° S [4.9°, 61]	44.0° S [4.6°, 51]	43.0° S [4.6°, 34]	42.2° S [2.7°, 15]	–	65
2012	60-80°	–	–	–	38.3° S [4.5°, 31]	40.7° S [2.2°, 34]	41.5° S [2.9°, 35]	41.4° S [3.0°, 28]	–	–	36
2014	100-120°	–	–	38.7° S [4.4°, 29]	39.2° S [4.4°, 54]	41.3° S [2.7°, 57]	41.1° S [2.9°, 53]	39.4° S [4.0°, 33]	–	–	60
2014	120-140°	–	38.8° S [6.2°, 45]	41.3° S [2.8°, 58]	41.1° S [3.0°, 56]	39.4° S [6.2°, 42]	–	–	–	–	61
2016	120-140°	–	–	–	39.8° S [3.6°, 39]	42.9° S [4.0°, 58]	44.3° S [4.5°, 59]	46.0° S [4.3°, 58]	45.1° S [4.5°, 31]	–	65
2016	140-160°	–	35.1° S [3.4°, 43]	38.5° S [4.8°, 64]	43.3° S [5.6°, 78]	44.6° S [5.0°, 81]	46.1° S [4.2°, 83]	46.2° S [4.0°, 74]	44.6° S [3.7°, 55]	42.3° S [4.3°, 43]	90
2018	140-160°	–	–	–	42.6° S [7.4°, 26]	46.0° S [6.5°, 33]	47.1° S [5.8°, 33]	46.8° S [5.2°, 31]	46.9° S [4.8°, 27]	47.3° S [6.7°, 16]	38
2001	160-170°	–	–	41.1° S [5.9°, 14]	45.6° S [6.2°, 28]	48.5° S [4.4°, 30]	50.1° S [3.9°, 30]	50.1° S [3.1°, 30]	49.6° S [2.8°, 27]	48.9° S [3.7°, 22]	30
2016	160-170°	37.8° S [3.3°, 34]	41.3° S [4.2°, 51]	44.6° S [5.3°, 51]	45.8° S [4.1°, 50]	47.6° S [4.0°, 47]	47.7° S [3.6°, 48]	46.8° S [3.6°, 34]	–	–	53
2018	160-170°	–	–	–	44.7° S [5.6°, 24]	48.9° S [4.0°, 23]	49.2° S [3.6°, 22]	49.3° S [2.8°, 22]	49.7° S [3.4°, 22]	50.3° S [3.1°, 21]	26

* Local noon (12h) is defined as the time when the Sun transits the local meridian. The standard deviation and number of measurements are given in brackets. The total number of images examined for each Ls increment are given in the last column on the right.

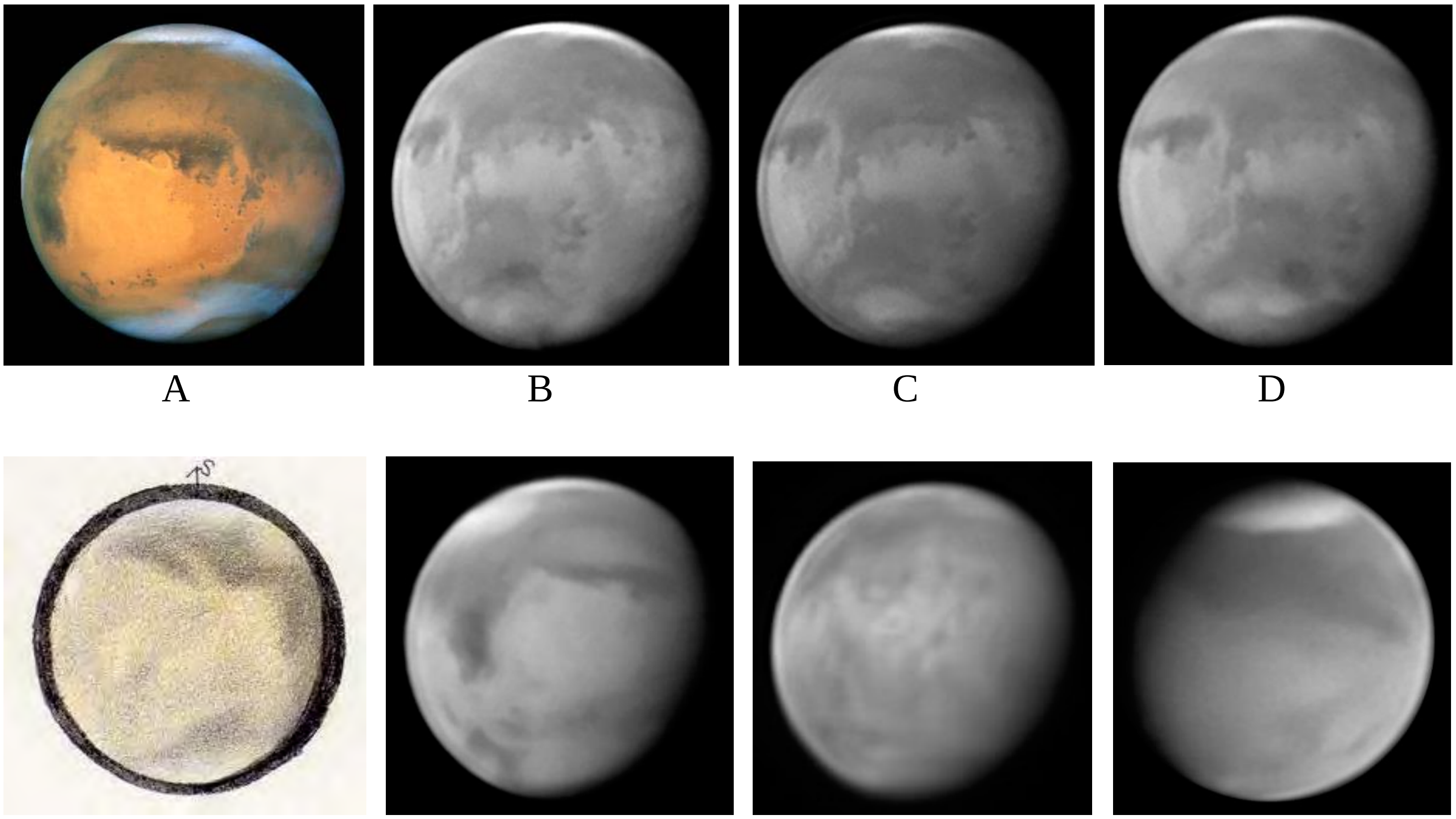

Figure 2. Images of the SPC and SPH clouds during early spring. In all cases, south is at the top. **A** - June 26, 2001 image made by the Hubble Space Telescope; note clouds north of the SPC in the upper right, Credit: NASA/The Hubble Heritage Team (STScI/AURA); **B** - July 4, 2016 (17:51.9 UT) by C. Foster, Green filter; **C** - July 5, 2016 (17:54.9 UT) by C. Foster, Green filter; **D** - July 6, 2016 (17:54.9 UT) by C. Foster, Green filter; **E** - July 11, 2016 (11:15 UT) drawing by M. Adachi; he labeled the bright area in the south polar region as the "SP hood"; **F** - July 13, 2016 (17:36 UT) by C Foster, Green filter; **G** - July 14, 2016 (02:58.6 UT) by G. Walker, Green filter; **H** - May 26, 2018 (18:29.4 UT) by R. Iwamasa, Green filter.

p. 67). Observations were not made after January 31, 2006 because of insufficient resolution. In late 2007, Mars' sub-Earth latitude was less favorable, being near 6° N compared to 19° S on December 1, 2005. Parker imaged a thin SPH on November 4, 6 and 10 (Ls = 342°-345°) at central meridians of between 25° W and 72° W. It was brighter on the morning side than on the afternoon side and it grew more distinct for Ls = 350°-0°. This is probably because temperatures dropped, thereby creating a larger and thicker hood. Its mean latitude at 15h local time was 59.9° S. This is consistent with the negative results for Ls = 344°-0° in Wang and Ingersoll (2002, p. 4).

Early Autumn: Ls = 0°-20°

The SPH grew several degrees farther south during early autumn. The standard deviations are twice as large as the corresponding values after Ls = 20°. This is consistent with this cloud system undergoing rapid day-to-day changes. Therefore, it should be carefully imaged in 2022 and 2024 with the aim of understanding its changing appearance. The hood extended farther north during the morning than at local noon. This is similar to the NPH and is consistent with lower temperatures causing more extensive clouds.

Autumn and Winter: Ls = 20°-80° and Ls = 100°-160°

The SPH boundaries were fairly consistent during this time. For example, the nine mean latitudes at 12h local time ranged from 39.4° S to 46.0° S. The SPH had a similar trend for other local times. The mean latitudes, at local times between 9h and 16h, are reported in the abstract. These were computed by giving each measurement an equal weight in the same way as was done for the NPH (Schmude, 2018). Of the 42 mean values listed in Table 1 for Ls = 20°-160°, 40 of them are within one standard deviation of the mean latitudes. Therefore, I believe the values in the abstract are

Table 2. Mean Northern Latitudes of the Bright Hellas Region Made for Ls = 120°-140°*

Longitude Range °W	Morning Local Noon < 260° W	Noon Local Noon between 282.5° W & 297.5° W	Afternoon Local Noon > 320° W
	Mean Latitude, σ, n	Mean Latitude, σ, n	Mean Latitude, σ, n
265-270	36.4, 5.2, 21	36.3, 4.5, 21	–
270-275	35.4, 3.6, 26	33.7, 2.9, 24	32.2, 2.3, 15
275-280	32.8, 3.2, 26	31.6, 3.5, 25	30.5, 2.4, 22
280-285	30.1, 2.9, 26	29.5, 1.9, 26	27.8, 1.6, 23
285-290	28.4, 2.9, 24	27.1, 2.0, 26	27.2, 1.4, 23
290-295	27.7, 2.6, 23	28.1, 1.3, 26	28.2, 1.5, 25
295-300	28.8, 2.5, 20	28.7, 1.3, 26	28.9, 1.9, 28
300-305	30.3, 2.4, 19	29.9, 1.2, 26	30.4, 2.3, 27
305-310	31.1, 2.8, 17	31.5, 1.1, 26	32.3, 2.2, 27
310-315	33.8, 3.0, 11	33.8, 1.5, 26	35.6, 2.7, 27
315-320	–	38.7, 2.6, 21	39.5, 3.0, 20

* The values are broken into three categories: Morning (the time when local noon is west of 260° W), Noon (the time when the local noon is between 282.5°-297.5° W) and afternoon (the time when the local noon is east of 320° W). Therefore when local noon is east of 260° W, the central longitude of Hellas is at least 30° west of 260° W, meaning that it is no later than 10h local time. The "Morning", "Noon" and "Afternoon" columns include the mean latitude in °S, the standard deviation (σ) in degrees of latitude and "n" (number of points).

representative of the SPH during most of the autumn and winter.

Earth-based images between March 8 and April 22, 2012 (Ls = 80°-100°) were examined for the presence of a SPH. When possible, blue filter images were examined. Figures 1D-1F are a good representation of (Ls = 80°-100°). Essentially, some images showed a bright limb over the South Polar Region while others did not. In some cases, the South Polar Region would appear brighter in red than in blue light. There is a chance that SPH clouds form at just some longitudes. In addition to this, carbon dioxide ice clouds may also account for the bright limb arc since Benson et al. (2010) only considered water ice clouds. For these reasons, it is concluded that Earth-based images are inconclusive on the existence of a SPH during Ls = 80°-100°. Here is an opportunity to image the South Polar Region in the late 2020s with the aim of imaging the SPH at different longitudes. Three projects which future observers can focus on for Ls = 80°-100° are:

- The presence of SPH clouds at different longitudes.
- Year-to-year changes in the SPH.
- Whether the SPH exists at latitudes north of 60° S.

Late Winter and Early Spring

The SPH shrunk after Ls = 340°. Its mean latitude for Ls = 340°-350° in 2001, 2016 and 2018 at local noon (12h) was 48.3° S which is almost six degrees south of the Ls = 20°-160° mean. The writer was interested to see if there was a statistical difference between the SPH latitudes for the three apparitions. Therefore, the values were compared to each other using a t-test. There was no statistical difference for the six common values for 2001 and 2018. There was, however, a statistical difference for two of the four common values between 2001 and 2016. One complicating factor during this time was the SPC. It was nearly fully formed and on several occasions could be seen through the hood. Its northern edge was near 54° S.

Can the SPH extend beyond the SPC during early spring? In order to answer this question, the writer examined images at (alpo-j.asahikawa-med.ac.jp/Latest/Mars.htm) and *https://photojournal.jpl.nasa.gov*. Figure 2A shows a Hubble Space Telescope image made on June 26, 2001 (*https://photojournal.jpl.nasa.gov*). It shows clouds extending beyond the SPC on the far right. Since this image was made near opposition, the central meridian is near local noon (12 h) and, hence, these clouds are at local times before ~8h. Figures 2B-2G were made several weeks after opposition in 2016 and, hence, the central meridian longitude is between 9h and 10h local time. The clouds on July 14 (Ls = 185°) extended about 13° beyond the SPC edge at local times of 8h and 9h but by local time, 10.5h or later, there were no visible clouds beyond the SPC. Morning limb hazes near the SPC were often visible for Ls = 180°-190° and less for Ls = 190°-200°. Figure 2C shows a bright feature near the central meridian which is probably clouds over the Argyre Basin. This feature was also bright on August 2, 2016 (image by Milika-Nicholas). Therefore, clouds may form here during early spring. Figure 2H shows an image made on May 26, 2018. It does not show obvious clouds because the central meridian is on the afternoon side at a local time of between 14h and 15h.

Do evening SPH clouds extend beyond the SPC during early spring? To answer this question, the writer examined images made between May 23 and June 8, 2018 (Ls = 180°-190°), when the central meridian was on the afternoon side (between a local time of 14h to 15h). Almost all of these showed a sharp SPC border near the evening terminator. Exceptions are Argyre on May 31, 2018 and a drawing made by M. Adachi on June 2. He notes a "slight bright" spot just north of the SPC next to the evening terminator. There were occasional morning clouds on these same images. Therefore, the 2016 and 2018 images are consistent with the SPH being more likely of extending beyond the SPC during local times of 6h to 9h than from 15h to 18h in early spring.

Hellas

Figure 3 illustrates images of Hellas made in 2014 and 2016. In Figures 3A-3F, one or more dark areas are inside this basin. These will be considered shortly. Figure 3G shows it without a large dark area. Figure 3H shows bright streaks extending beyond its eastern edge. These are probably clouds.

Schmude (2014, pp. 115-116) suggested that ice develops in Hellas during autumn and winter. Thermal inertia data are consistent with at least the northern portion of this feature covered with CO_2 ice during late winter and early autumn (Putzig and Mellon, 2007, pp. 77, 83).

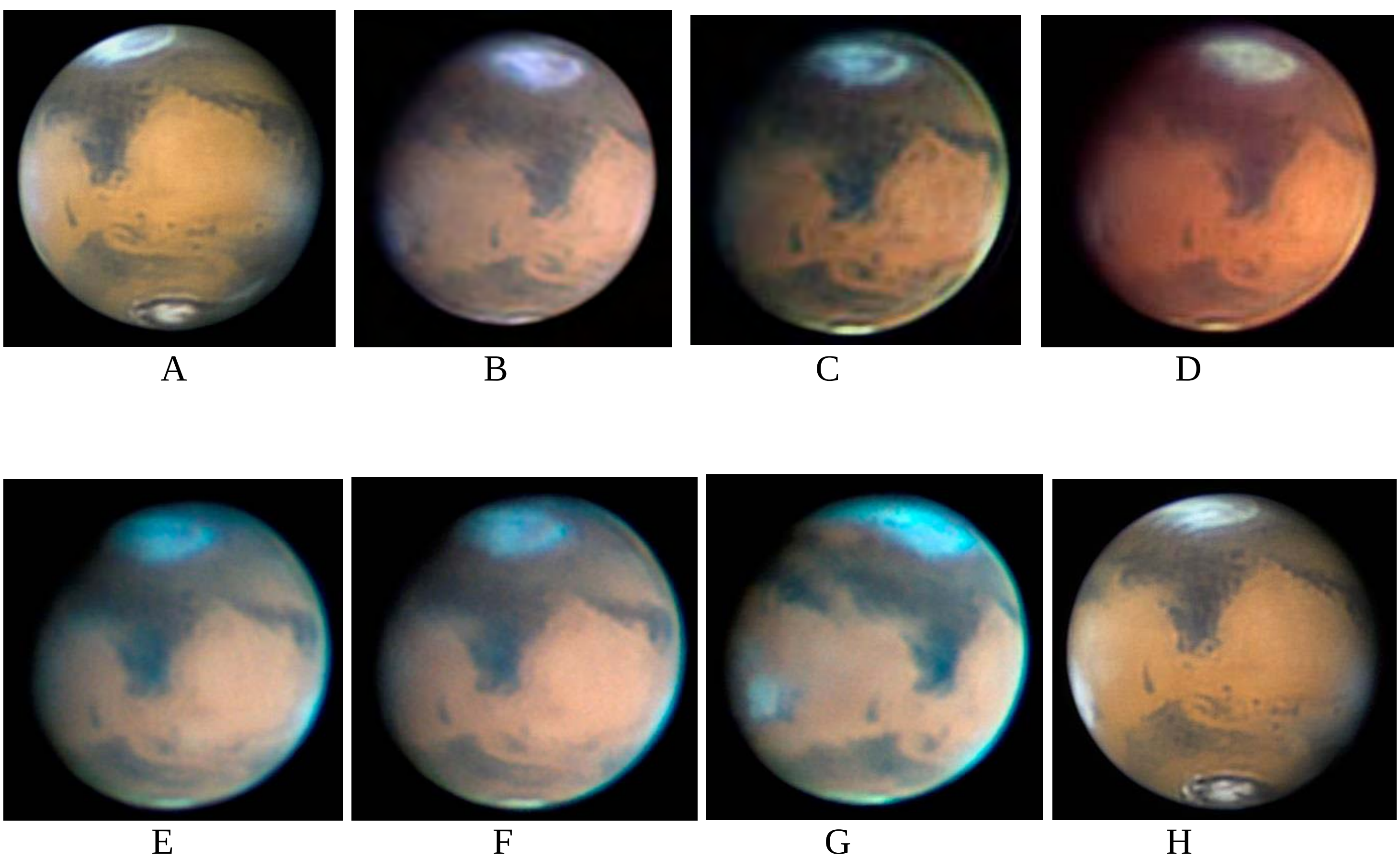

Figure 3. Selected images of Hellas showing the dark spot inside (A-F), the absence of the dark spot (G) and clouds on the eastern edge of Hellas (H). In all cases, south is at the top. Descriptions of the observations are as follows: **A** - April 24, 2014 (1:07.4 UT) by D. Peach; **B** - March 23, 2016 (18:34.9 UT) by A. Wesley; **C** - March 23, 2016 (19:34) by C. Go; **D** - March 25, 2016 (20:06 UT) by C. Go; **E** - April 4, 2016 (3:12.5 UT) by C. Foster; **F** - April 5, 2016 (3:48.5 UT) by C. Foster; **G** - April 8, 2016 (3:15.6 UT) by C. Foster; **H** - April 26, 2014 (1:15.3 UT) by D. Peach.

Table 3. Mean SPH Latitudes for Different Increments of Longitude*

Longitude Range °W	Mean Latitude °S	Standard Deviation in Degrees	Number of Measurements
0-45	40.75	4.31	80
45-90	42.22	4.08	69
90-135	42.90	4.37	55
135-180	42.18	3.21	73
180-225	41.27	2.95	45
225-270	42.09	3.79	32
315-360	48.91	4.76	41

* The longitudes between 270°-315° W are not included. This is because it was not possible to distinguish between the SPH and ice in Hellas for Ls = 80°-160° W.

What is causing the central portion of Hellas to darken? One fact is it changed in appearance (compare Figures 1G, 3A and 3F). For example, it was at the center of Hellas in Figure 1G but was on the western side in Figure 3F. The dark area was a thin circle in Figure 3A but was a large dark area in Figure 1G. Finally, its right side was much thicker in Figure 3C compared to 3D. It was also darker than surrounding areas in blue, green, red and near infrared filters. It also had a similar appearance as a dust storm over the NPC (Schmude, 2014, p. 114). Finally, it usually did not resemble the classical dark area Zea Lacus (Antoniadi, 1930, 1975, p. 93). The most likely explanation is either a dust cloud or a dust coating on ice. Dust clouds are darker than polar frosts (Schmude, 2014, pp. 113-114) and, hence, should also be darker than an ice-covered Hellas. Hopefully observers will be able to measure the amount of polarized light of the dark Hellas area in the 2020s. Dust clouds have a different amount of polarized light than ice (Dollfus, 1961, p. 382), (Ebisawa and Dollfus, 1993, p. 675).

What is the role of condensate clouds extending beyond Hellas? To answer this question, the size of the bright Hellas area was measured for three different local times for Ls = 120°-140°. (Although Hellas extends ~50 degrees of longitude, its central longitude is ~290° W and, therefore, I have treated it based on this value.) The three different local times are when local noon was east of 260° W, between 282.5°-297.5° W and west of 320° W. These correspond to local times of before 10h, near 12h and after 14h for 290° W and will be called "morning", "noon" and "afternoon", respectively. Mean latitudes of the bright Hellas spot for 10 longitude intervals starting with 265°-270° W were measured. In many cases, faint bright extensions were measured beyond the brightest portions of Hellas and this created uncertainty. The mean latitudes, standard deviations and number of data points for the three time periods are in Table 2. A t-test was carried out between each of the mean values between morning/noon, morning/afternoon and noon/afternoon. In the vast majority of cases, there was no statistical difference. There was a statistical difference between the data for morning and afternoon values at 270°-285° W. In this case, the Hellas white area extended further north on the afternoon side. This is consistent with clouds forming beyond that feature in the late afternoon (see Figure 3H). Therefore, clouds generally do not extend beyond Hellas at latitudes north of ~37° S except during the afternoon at 270°-285°W.

Discussion

Size of SPH and NPH

Smith (2004, p. 148) reported Mars had less dust, cooler temperatures and more water vapor for Ls = 0°-180° than Ls = 180°-360° during 1999-2003. He also pointed out there was less year-to-year variability overall during Ls = 0°-180°. On the other hand, he reported Mars had more dust, less water vapor and higher temperatures during Ls = 180°-360°. These factors undoubtedly affected the characteristics of the polar hoods. During 2001-2018, the SPH had about the same daytime size as the NPH even though temperatures were cooler. One possible reason why the SPH was not larger may have been lower amounts of water vapor in the southern hemisphere. Smith (2008, p. 207) reported the globally averaged water vapor at 60° S was about two-thirds of what it is at 60° N between 1999 and 2003.

Diurnal Variation of the SPH

The mean SPH latitude at 9h was over seven degrees farther north than at 15h for Ls = 20°-160°. This is probably caused by lower morning temperatures. The NPH displayed similar behavior (Schmude, 2018). Benson et al. (2010, p. 1) reported the SPH extended about 15° farther north during the night than during the day for Ls = 140°-200°. This is also consistent with the hood getting larger as temperatures drop. Finally, the fact that the SPH is more likely to extend beyond the SPC in the morning than in the late afternoon during early spring is consistent with it being more likely to form at lower temperatures since morning temperatures are expected to be lower.

Size of the SPH at Different Longitudes

Does the SPH extend farther north at some longitudes? The NPH does (Schmude, 2018) and, hence, an appropriate study was carried out for the SPH. The measured latitudes, at local time 12h, for Ls = 20°-160° were placed into seven 45° longitude ranges starting with 0°-45° W. The 270°-315° W range was not considered since it corresponds to Hellas. Mean SPH latitudes were computed and the results are listed in Table 3. There is little or no statistical difference for mean SPH latitudes between 0° W and 270° W. This is based on t-tests carried out for adjacent mean values. There is a statistically significant difference between the SPH latitude at 315°-0° W and 0°-45° W. The SPH was farther south (smaller) for 315°-0° W. This was also the case in 1999-2001 (Wang and Ingersoll, 2002, p. 4). The surface elevation (Barlow, 2008, Fig. 3.6), (Batson et al., 1979, p. 85, 89), water vapor (Smith, 2008, p. 207) and thermal inertia (Barlow, 2008, Fig. 4.22) are all nearly the same for 315°-0° W than for 0°-270° W. At 45° S, the predominant wind direction is from west to east (Barlow, 2008, p. 178) and, hence, Hellas should not affect the 315°-0° W area. The surface albedo for 315°-0° W at ~45° S is not unusually low (Venable, 2018, p. 52) and hence this is also not a factor. Therefore, something else must be responsible.

Comparison with Spacecraft Studies

The trends described in this study are consistent with spacecraft results. The SPH is consistent with the trends reported at 15h local time by Wang and Ingersoll (2002, p. 4). The SPH is less bright and presumably less opaque than the NPH and this is evident in the images in Figure 1 compared to similar figures of the NPH (Schmude, 2018). The lower opacities of the SPH are consistent with spacecraft measurements reported elsewhere (Benson et al., 2010, p. 1), (Christensen and Zurek, 1984, p. 458), (Akabane et al., 1995, p. 595). Benson et al. (2010) report the northern boundary of the SPH for Ls = 111.05°-157.38° in Mars Year 28 (Gregorian calendar year 2006) and Ls = 22.91°-161.62° in Mars Year 29 (Gregorian calendar year 2008). Their mean AM and PM boundaries are 37° S and 42° S, respectively. These are consistent with the mean values in the abstract and with the SPH extending farther north during the morning hours.

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Papers & Presentations

ALPO Observations of the Remote Planets in 2017-2018

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Abstract

This report summarizes brightness and other observations of the remote planets during their 2017-2018 apparitions. The mean U-filter brightness result is similar to that in the previous apparition. The mean B- and V-filter values, however, are ~0.03 magnitudes brighter than those in 2016-2017. Based on an eclipse measurement involving Neptune's Moon Triton, it is concluded that body had a thin atmosphere extending ~100 km above its surface which is similar to that of Pluto. Red and near-infrared images of both planets, show albedo features.

Introduction

Uranus and Neptune were well placed in the evening sky during the last third of 2017. One important event which occurred in late 2017 was the occultation of the magnitude 12.6 star UCAC4 410-143659 by Neptune's Moon Triton (Dunham (2018, p. 13).

The characteristics of both planets are summarized in Table 1. Table 2 summarizes the individuals who submitted observations to the writer or to the ALPO Japan Latest website (alpo-j.asahikawa-med.ac.jp/Latest).

Whole-Disk Photoelectric Photometry

All brightness measurements reported here are on the stellar magnitude system. Brightness values may be converted to units like Watts/m^2 using the appropriate procedures (Shepard, 2017, pp. 62-63).

Fox and the writer made 75 brightness measurements of Uranus and 47 of Neptune. The comparison and check stars used for these measurements are in Table 3. The measured magnitudes are summarized in Tables 4 and 5. All measurements were corrected for atmospheric extinction and color transformation in the same way as described in Hall and Genet (1988, p. 199). Secondary extinction coefficients of $k_U'' = -0.03$, $k_B'' = -0.03$ and $k_V'' = 0.00$ were used (Hall and Genet, 1988, p. 195). The same equipment used in the previous apparition (Schmude, 2018a, p. 80) was used here. The transformation coefficients were also the same as in the previous apparition (Schmude, 2018a, p. 79).

Since late 2014, the writer has measured the extinction coefficient in the U filter near Barnesville, Georgia, (elevation of ~250 meters). The mean of 23 measurements is 0.56 magnitudes/air mass with a standard deviation of 0.15 magnitudes/air mass.

Fox and the writer used check stars for their measurements. Mean discrepancies for the U-, B- and V-filter results were 0.064, 0.045 and 0.026 magnitudes, respectively for Uranus. The corresponding discrepancies for Neptune were 0.036, 0.089 and 0.032 magnitudes. These values are larger than expected and, hence, uncertainties for the mean normalized magnitudes are larger than in the previous apparition (Schmude, 2018a, p. 83).

Since the planet-Sun and planet-Earth distances affect brightness, the measurements were normalized using:

$$U(1, \alpha) = U - 5\text{Log}[r \times \Delta] \quad (1)$$

where $U(1, \alpha)$ is the normalized magnitude for the U filter, U is the measured brightness, r is the planet-Sun distance and Δ is the planet-Earth distance. Both r and Δ are in astronomical units - the mean distance between the Earth and Sun. Normalized magnitudes for the B and V filter measurements were computed in a similar manner. The normalized magnitudes are also given in Tables 4 and 5.

The selected normalized magnitudes are summarized in Table 6. The U-filter results are similar to those in the previous apparition, but those in the B and V filters are ~0.03

Table 1. Characteristics of the 2017-2018 Apparitions of Uranus and Neptune[a]

Parameter	Uranus	Neptune
First conjunction date	April 14, 2017	March 2, 2017
Opposition date	October 19, 2017	September 5, 2017
Angular diameter (opposition-arc seconds)	3.7	2.4
Sub-Earth latitude (opposition)	38.7° N	25.8° S
Right Ascension (opposition)	1h 39m	22h 58m
Declination (opposition)	9.7° N	7.6° S
Second conjunction date	April 18, 2018	March 4, 2018

[a]Data are from the Astronomical Almanac for the years 2017 and 2018.

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Table 2. Contributors to the ALPO Remote Planets Section in 2017-2018 (Note that the country is the location of where data were recorded and not necessarily the nationality of the observer.)

Observer (country)	Type[a]	Instrument[b]	Observer (country)	Type[a]	Instrument[b]
R. Bosman (The Netherlands)	I	0.36 m SC	P. Miles (Australia)	I	0.51 m RL
F. Colas (France)	I	1.05 m C	D. Peach (France, Chile)	I	1 m
M. Delcroix (France)	I, V	1.05 m C	C. Pellier (USA)	I	0.25 m G
C. Foster (South Africa)	I	0.36 m SC	R. Schmude, Jr. (USA)	PP	0.20 m MC
J. Fox (USA)	PP	0.25 m SC	C. Sprianu (France)	I	1.05 m C
R. Hueso (France)	I	1.05 m C	R. Tatum (USA)	I	0.30 m SC
M. Kardasis (Greece)	I	0.35 m SC	G. Therin (France)	I	1.05 m C
E. Kraaikamp (France)	I	1.05 m C	A. Wesley (Australia)	I, V	0.41 m RL
F. Melillo (USA)	I	0.25 m SC			

[a]Type of Observation: I = image, PP = photoelectric photometry, V = video

[b]Telescope type: C = Cassegrain; MC = Maksutov-Cassegrain; SC = Schmidt-Cassegrain; G = Gregorian; RL = Reflector

In addition to those individuals listed above, the following individuals submitted observations to the ALPO Japan Latest website: M. Abgarian (Belarus), P. Abel (UK), T. Akutsu (Japan), A. Casely (Australia), C. Ceracchini (Italy), A. Elia (Cypress), B. Estes (USA), L. J. Fernandez (Spain), C. Gargiulo (Italy), Y. Goryachko (Belarus), P. D. Gregorio (Italy), D. Gray (UK), M. Guidi (Italy), D. Kolovos (Greece), A. Lasala (Spain), M. Lewis (UK), S. Maksmowicz (France), A. Maniero (Italy), W. Martinsj (Brazil), Milika-Nicholas (Australia), K. Morozov (Belarus), L. Morrone (Italy), A. Obukhov (Russia), T. Olivetti (Thailand), P. Prokop (Czech Republic), E. Purizo (Italy), J. Rallo (Spain), O. Russo (Italy), J. Sussenbach (The Netherlands), C. Triana (Columbia), A. Vaccaro (Italy), and K. Wildgoose (UK).

Table 3. Comparison and Check Stars Used in the 2017-2018 Apparitions of Uranus and Neptune

Star	Star Brightness in Magnitudes			Right Ascension	Declination	Source for Star Magnitudes
	U filter	B filter	V filter			
π-Psc	5.924	5.88[a]	5.56	1h 37.1m	12.23° N	Mermilliod et al. 1991 cited in Westfall (2008)
HD 012140	6.354	6.260	6.070	1h 59.5m	12.30° N	Mermilliod et al. 1991 cited in Westfall (2008)
ο-Psc	–	5.22	4.26	1h 46.4m	9.25° N	Iriarte et al. (1965)
85-Aqr	–	6.69	6.69	23h 06m	7.94° S	MICA v. 2.0 USNO
σ-Aqr	4.64	4.79[b]	4.825[b]	22h 31m	10.91° S	Iriarte et al. 1965 (U) & SIMBAD (B & V)
ι-Aqr	3.907	4.191	4.266	22h 06m	13.87° S	Mermilliod et al. 1991 cited in Westfall (2008)
HD 217877	–	7.260	6.68	23h 04m	4.80° S	MICA v. 2.0 USNO
HD 010262	6.682	6.729	6.33	1h 41m	8.76° N	Mermilliod et al. 1991 cited in Westfall (2008)
91-Aqr	6.364	5.339	4.232	23h 16m	9.09° S	Mermilliod et al. 1991 cited in Westfall (2008)
93-Aqr	3.71	4.26	4.40	23h 18m	9.18° S	Iriarte et al. (1965)

(a) Jim Fox cites "MICA, v2.0, USNO" as his source for the B filter magnitude of π-Psc along with the brightness values for 85-Aqr and HD 217877.

(b) Jim Fox took the B and V values from SIMBAD in about 2013.

magnitudes brighter. Brightness measurements were measured over a range of phase angles for Uranus (0.14° to 2.83°). The phase angle is the distance between the observer and the Sun measured from the target in degrees. The normalized magnitudes were plotted against the phase angle and linear equations were determined from Microsoft Excel. The resulting equations are:

$$U(1, 0) = -6.296 - 0.0017\alpha \quad r = 0.126, n = 22 \tag{2}$$

$$B(1, 0) = -6.629 + 0.0064\alpha \quad r = 0.451, n = 22 \tag{3}$$

$$V(1, 0) = -7.166 + 0.0022\alpha \quad r = 0.157, n = 31 \tag{4}$$

In these equations, α is the phase angle in degrees. The correlation coefficient (r) and the number of data points (n) are given next to each equation. A two-tailed t-test (95% confidence level) for the correlation coefficient (r) was carried out for each equation (Larson and Farber, 2006, pp. 466-467). There is no statistically significant change for the U(1, α) and V(1, α) values, but there is for the B(1, α) values. It will be interesting to see if the phase change for the B filter occurs in future apparitions.

Triton Eclipse

On October 5, 2017, Lugi Morrone measured the combined brightness of the star UCAC4 410-143659 and Neptune's moon Triton. In addition to this, Martin Lewis and John Sussenbach recorded images every minute or two of the eclipse. Morrone noted a drop in brightness at 23:46 UT. The brightness dropped for about 15 seconds. About 2.5 minutes later, the brightness started to rise and after, 15 seconds it was at maximum value. These measurements are in agreement with the images made by Lewis and Sussenbach. The 15-second drop and rise in brightness are consistent with Triton having an atmosphere extending for ~100 km. Morrone did not observe a central flash as reported by Dunham (2018) and, hence, he was not at the center line of the eclipse. The drop in brightness as Triton moved in front of the star was similar to when Pluto moved in front of a 12th magnitude star on June 29, 2015 (Beatty, 2015). Therefore, the thickness and extent of Triton's atmosphere appears to be similar to that of Pluto.

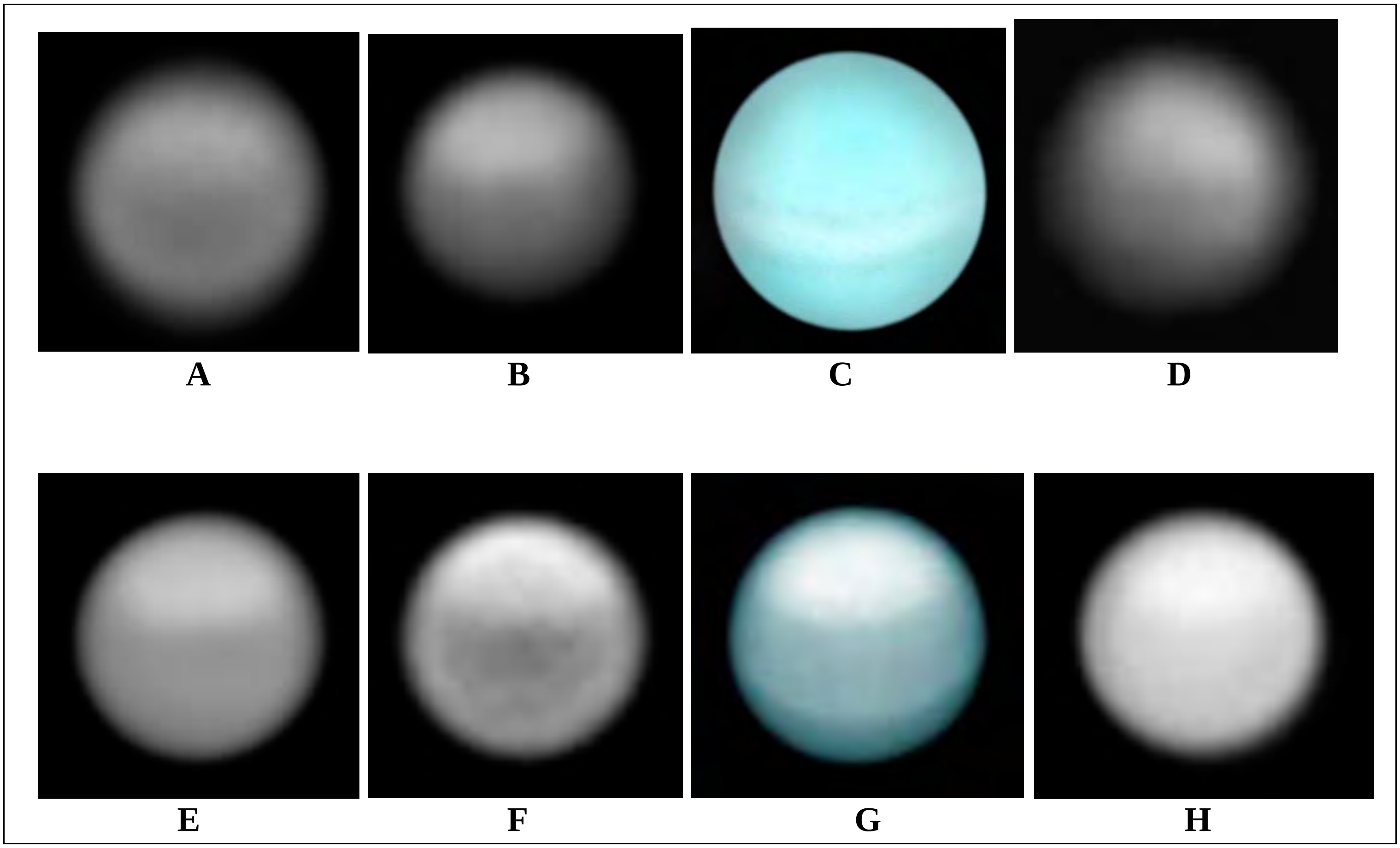

Figure 1. Images of Uranus made in late 2017. In all cases, North is at the top. **A**-June 12, 2017 (3:40.3 UT) by M. Delcroix, E. Kraaikamp, D. Peach, G. Therin, C. Sprianu, R. Hueso and F. Colas, IR 685 filter, 1.05 m Cassegrain; **B**-Aug. 9, 2017 (1:55.1 UT) by L. Morrone, R+IR filter, 0.28 m SC, **C**-Aug. 9, 2017 (22:55-23:06 UT) by P. G. Abel, 0.51 m Dall-Kirkham, **D**-October 11, 2017 (4:50 UT) by F. Melillo, 610 nm filter, 0.25 m SC; **E**-October 25 (21:35 UT) by A. Obukhov, Baader 610 nm filter, 0.25 m RL; **F**-Nov. 13 (21:57 UT) by C. Pellier, IR 685 filter, 0.31 m RL; **G**-Dec. 16 (1:13.5 UT) by D. Peach, IR 685 filter, 1.0 m telescope in Chile; **H**-Dec. 22, 2017 (13:02.3 UT) by T. Olivetti, Red filter, 0.41 m DK.

Disk Appearance

Once again, individuals were able to image albedo features on both Uranus and Neptune in red and near-infrared light. Figures 1 and 2 show images of Uranus and Neptune made in 2017. The bright North Polar region of Uranus was consistently imaged. The equatorial belt shows up in higher resolution images (See Figures 1D and 1G). Schmude (2018b) has already reviewed the latitudes of the two bright cloud belts on Uranus. Neptune had isolated bright spots instead of cloud belts (See Figure 2). Milika-Nocholas recorded several images of a bright spot on Neptune. They compiled a video of this spot showing its movement.

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Table 4. Measured Magnitudes of Uranus Made During the 2017-18 Apparition.
(All measurements were corrected for atmospheric extinction and color transformation.)

Date	Filter	X (+)	X(1,α) (–)	Comp. Star	Date	Filter	X (+)	X(1,α) (–)	Comp. Star
2017					**2017**				
Jul. 14.354	V	5.828	7.174	a	Nov. 26.199	B	6.274	6.630	π-Psc
Jul. 14.381	V	5.817	7.185		Nov. 28.130	V	5.754	7.152	
Jul. 14.394	V	5.831	7.171		Nov. 28.130	B	6.282	6.624	
Jul. 31.300	U	6.674	6.297	π-Psc	Dec. 9.113	V	5.790	7.131	
Jul. 31.320	U	6.660	6.311		Dec. 9.114	B	6.333	6.588	
Jul. 31.335	U	6.653	6.318		Dec. 20.122	V	5.772	7.167	
Jul. 31.350	U	6.662	6.309		Dec. 20.122	B	6.308	6.631	
Jul. 31.363	U	6.660	6.311		Dec. 29.100	V	5.791	7.164	
Sept. 27.122	V	5.733	7.155	a	Dec. 29.101	B	6.344	6.611	
Sept. 27.147	V	5.737	7.151		Dec. 30.122	V	5.792	7.165	
Sept. 27.156	V	5.710	7.178		Dec. 30.123	B	6.323	6.634	
Oct. 9.176	V	5.731	7.150	π-Psc	**2018**				
Oct. 9.177	B	6.269	6.613		Jan. 6.138	V	5.820	7.150	
Oct. 11.204	V	5.736	7.145		Jan. 6.138	B	6.382	6.588	
Oct. 11.205	B	6.254	6.626		Jan. 8.101	V	5.809	7.164	
Oct. 13.080	V	5.671	7.209	a	Jan. 8.101	B	6.363	6.611	
Oct. 13.092	V	5.708	7.172		Jan. 12.108	V	5.841	7.140	
Oct. 13.108	V	5.701	7.179		Jan. 12.108	B	6.382	6.599	
Oct. 15.068	U	6.602	6.275	π-Psc	Jan. 13.141	V	5.824	7.158	
Oct. 15.079	U	6.604	6.276		Jan. 13.142	B	6.379	6.604	
Oct. 15.093	U	6.578	6.302		Jan. 14.101	V	5.819	7.166	
Oct. 15.104	U	6.584	6.296		Jan. 14.102	B	6.377	6.608	
Oct. 15.118	U	6.595	6.285		Jan. 20.090	V	5.825	7.171	
Oct. 17.187	V	5.724	7.156		Jan. 20.090	B	6.366	6.630	
Oct. 17.187	B	6.249	6.630		Feb. 1.026	U	6.767	6.250	
Oct. 18.091	U	6.579	6.300		Feb. 1.041	U	6.722	6.295	
Oct. 18.101	U	6.564	6.316		Feb. 1.060	U	6.700	6.317	
Oct. 18.117	U	6.571	6.308		Feb. 1.071	U	6.744	6.273	
Oct. 18.131	U	6.575	6.304		Feb. 1.077	V	5.865	7.152	
Oct. 26.187	V	5.717	7.162		Feb. 1.078	B	6.388	6.630	
Oct. 26.187	B	6.243	6.638		Feb. 3.025	U	6.727	6.294	
Oct. 28.163	V	5.715	7.166		Feb. 3.037	U	6.702	6.319	
Oct. 28.163	B	6.252	6.628		Feb. 3.050	U	6.716	6.305	
Oct. 30.188	V	5.719	7.162		Feb. 3.061	U	6.718	6.303	
Oct. 30.188	B	6.261	6.620		Feb. 5.112	V	5.886	7.139	
Nov. 6.146	V	5.724	7.161		Feb. 5.113	B	6.416	6.609	
Nov. 6.147	B	6.263	6.622		Feb. 8.121	V	5.874	7.156	
Nov. 26.199	V	5.732	7.172		Feb. 8.122	B	6.433	6.596	

(a) The comparison star is HD010262.

Table 5. Measured Magnitudes of Neptune Made During the 2017-18 Apparition (All measurements were corrected for atmospheric extinction and color transformation.)

Date	Filter	X (+)	X(1,α) (–)	Comp. Star	Date	Filter	X (+)	X(1,α) (–)	Comp. Star
2017					**2017**				
Aug. 1.200	U	8.237	6.465	σ-Aqr	Oct. 26.156	V	7.722	6.995	a
Aug. 1.222	U	8.261	6.441		Oct. 26.156	B	8.098	6.619	
Aug. 1.240	U	8.227	6.475		Oct. 27.018	U	8.269	6.449	σ-Aqr
Aug. 19.120	V	7.691	7.001		Oct. 27.034	U	8.294	6.424	
Aug. 30.218	V	7.669	7.020	a	Oct. 27.054	U	8.278	6.440	
Aug. 30.219	B	8.093	6.596		Oct. 28.135	V	7.713	7.006	a
Sept. 11.228	V	7.717	6.973		Oct. 28.135	B	8.090	6.629	
Sept. 11.228	B	8.083	6.607		Nov. 3.103	V	7.703	7.022	
Oct. 7.151	V	7.646	7.055		Nov. 3.103	B	8.118	6.607	
Oct. 7.151	B	8.055	6.646		Nov. 6.120	V	7.725	7.004	
Oct. 8.162	V	7.687	7.014		Nov. 6.121	B	8.083	6.646	
Oct. 8.163	B	8.088	6.613		Nov. 26.063	V	7.746	7.007	
Oct. 9.151	V	7.655	7.047		Nov. 26.064	B	8.123	6.630	
Oct. 9.151	B	8.059	6.643		Nov. 28.065	V	7.739	7.016	
Oct. 11.177	V	7.719	6.985		Nov. 28.066	B	8.113	6.642	
Oct. 11.178	B	8.068	6.636		Dec. 9.085	V	7.774	6.995	
Oct. 17.160	V	7.690	7.018		Dec. 9.085	B	8.141	6.628	
Oct. 17.161	B	8.115	6.593		Dec. 20.078	V	7.825	6.957	
Oct. 19.047	U	8.290	6.421	σ-Aqr	Dec. 20.078	B	8.150	6.632	
Oct. 19.060	U	8.259	-6.451		Dec. 21.063	V	7.802	6.982	
Oct. 26.019	U	8.303	6.414		Dec. 21.064	B	8.151	6.633	
Oct. 26.043	U	8.278	6.439		Dec. 30.063	V	7.791	7.003	
Oct. 26.060	U	8.286	6.431		Dec. 30.063	B	8.125	6.689	
Oct. 26.074	U	8.262	6.455						

(a) The comparison star is HD217877.

Table 6: Selected Photometric Constants of Uranus and Neptune for Their 2017-2018 Apparitions

Planet	U(1,α) [n]	B(1,α) [n]	V(1,α) [n]	B – V
Uranus	–6.30 ± 0.04 [22]	–6.62 ± 0.04 [22]	–7.16 ± 0.03 [31]	0.54 ± 0.05
Neptune	–6.44 ± 0.03 [12]	–6.63 ± 0.05 [17]	–7.01 ± 0.03 [18]	0.38 ± 0.06

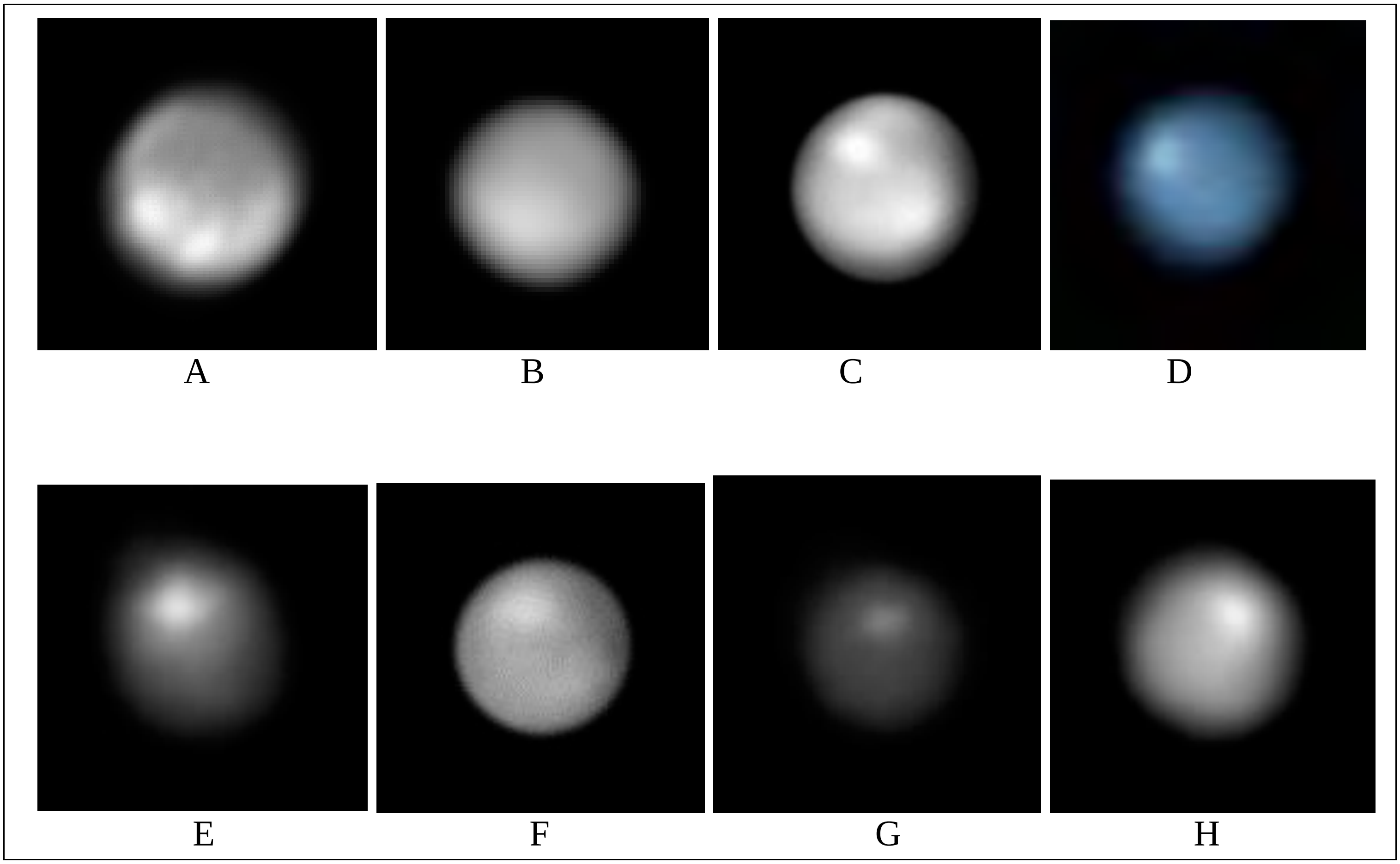

Figure 2: Images of Neptune made in 2017. In all cases, North is at the top. **A**-June 12, 2017 (2:39.6 UT) by M. Delcroix, E. Kraaikamp, D. Peach, G. Therin, C. Sprianu, R. Hueso and F. Colas, IR 685 filter, 1.05 m Cassegrain; **B**-Sept. 2, 2017 (21:25 UT) by A. Obukhov, Baader >610 nm filter; **C**-Oct. 18, 2017 (21:22.9 UT) by M. Kardasis, 610 nm+ filter, 0.35 m telescope; **D**-Oct. 26, 2017 (4:36.9 UT) B. Estes, Baader IR 685 filter, 0.36 m Schmidt-Cassegrain; **E**-Nov. 4, 2017 (20:10.7 UT) by C. Foster, Baader IR filter, 0.36 m Schmidt-Cassegrain; **F**-Nov. 7, 2017 (19:20 UT) M. Kardasis, RIR 610 nm filter, 0.35 m telescope; **G**-Nov. 10, 2017 (18:51.5 UT) by C. Foster, Baader IR 685, 0.36 m Schmidt-Cassegrain; **H**-Dec. 9, 2017 (17:37 UT) C. Foster, Baader IR 685 filter, 0.36 m Schmidt-Cassegrain.

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ALPO Publications

The Monograph Series

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Publications too lengthy for publication in *The Strolling Astronome*r. All are available online as a pdf files. NONE are available any longer in hard copy format. There is NO CHARGE for any of the ALPO monographs.

- **Monograph No. 1.** *Proceedings of the 43rd Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, August 4-7, 1993. 77* pages. File size approx. 5.2 mb.
- **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.*

ALPO Resources

People, publications, etc., to help our members

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 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;
  Schmidt0810.pdf, approx. 31.1 mb;
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  Schmidt1416.pdf, approx. 28.2 mb;
  Schmidt1719.pdf, approx. 22.2 mb;
  Schmidt2022.pdf, approx. 21.1 mb;
  Schmidt2325.pdf, approx. 22.9 mb;
  SchmidtGuide.pdf,approx. 10.2 mb

ALPO Observing Section Publications

Order the following directly from the appropriate ALPO section recorders; use the address in the listings pages which appeared earlier in this booklet unless another address is given.

- **Solar:** *Guidelines for the Observation of White Light Solar Phenomena*, *Guidelines for the Observing Monochromatic Solar Phenomena* plus various drawing and report forms available for free as pdf file downloads at http://www.alpo-astronomy.org solarblog.
- **Lunar & Planetary Training Section:** *The Novice Observers Handbook* $15. An introductory text to the training program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. Available as pdf file via e-mail or send check or money order payable to Timothy J. Robertson, 195 Tierra Rejada Rd., #148, Simi Valley, CA 93065; e-mail cometman@cometman.net.
- **Lunar:** (1) *The ALPO Lunar Selected Areas Program Handbook* (hardcopy, $17.50). Includes full set of observing forms. (2) *Observing forms*: Send a SASE for a hardcopy of forms. Both the Handbook and individual observing forms are available for download (as pdf files) at moon.scopesandscapes.com/alpo-sap.html. Use of observing forms will ensure that all requested information is included with observations, but are not required. Various lists and forms related to other Lunar section programs are also available at moon.scopesandscapes.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 lunar SAP section. Observers should make copies using high-quality paper.
- **Lunar**: *The Lunar Observer*, official newsletter of the ALPO Lunar Section, published monthly. Free at http://moon.scopesandscapes.com/tlo.pdf or send SASE to: Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080.
- **Venus (Benton):** Introductory information for observing Venus, the comprehensive *ALPO Venus Handbook*, as well as all observing forms and ephemerides, can be conveniently downloaded as pdf files at no cost to ALPO members and individuals interested in observing Venus as part of our regular programs at http://www.alpo-astronomy.org/venus.
- **Mars:** Free resources are on the ALPO website at www.alpo-astronomy.org . Click on "Mars Section" in the left column; then on the resulting webpage, look for links to resources in the right column including "Mars Observing Form", and "Mars Links". Under "Mars Links", click on "Mars Observers Cafe", and follow those links to The New "Internet Mars Observer's Handbook."
- **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*, from the Astronomical League Sales, temporarily out of stock. (2) *ALPO_Jupiter*, the ALPO Jupiter Section e-mail network; to join, send a blank e-mail to *ALPO_Jupiter-subscribe@yahoogroups.com* (3) *Jupiter Observer's Startup Kit*, $3 from Richard Schmude, Jupiter Section Coordinator.

ALPO Resources

People, publications, etc., to help our members

- **Saturn (Benton):** Introductory information for observing Saturn, including all observing forms and ephemerides, can be conveniently downloaded as pdf files at no cost to ALPO members and individuals interested in observing Saturn as part of our regular programs at http://www.alpo-astronomy.org/saturn. The former *ALPO Saturn Handbook* was replaced in 2006 by *Saturn and How to Observe It* (authored by Julius L. Benton) and it can be obtained from book sellers such as Amazon.com.

- **Meteors:** (1) *The ALPO Guide to Watching Meteors* (pamphlet). $3 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 stamps, 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.

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THE ASSOCIATION
OF LUNAR & PLANETARY OBSERVERS (ALPO)

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

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

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

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

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