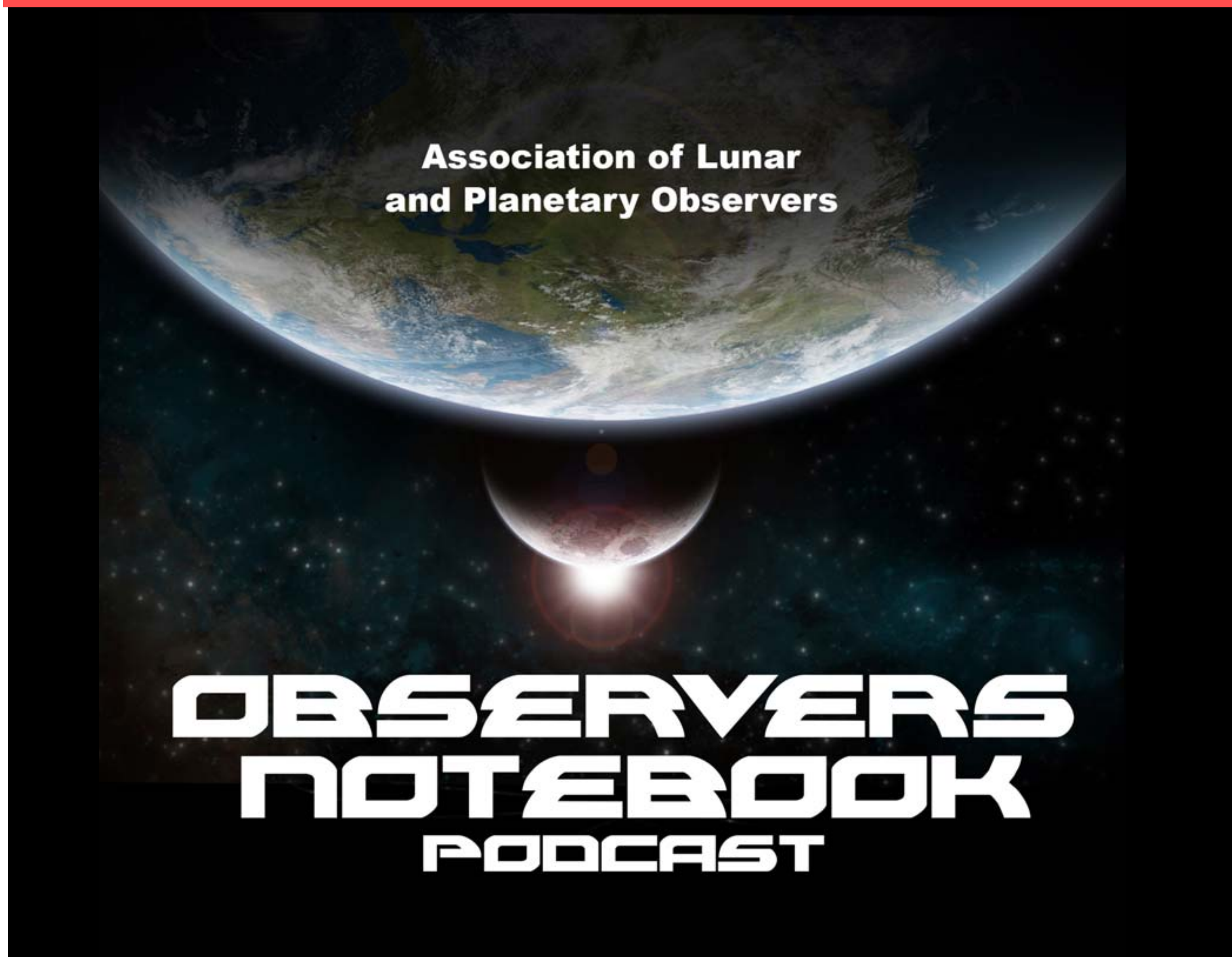
ISSN-0039-2502

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 59, Number 3, Summer 2017
Now in Portable Document Format (PDF) for
Macintosh and PC-compatible computers
Online and in COLOR at http://www.alpo-astronomy.org

Founded in 1947



Now beaming out to the entire universe. See page 3 for details.

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 59, No.3, Summer 2017
This issue published in June 2017 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.

For membership or general information about the ALPO, contact:

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

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

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

Founded in 1947

Inside the ALPO

Papers & Presentations

ALPO Resources

Inside the ALPO
Member, section and activity news

Association of Lunar & Planetary Observers (ALPO)

Point of View
The Eclipse is Coming! Make Way!

By Ken Poshedly, your Journal editor

With this being the last issue of *The Strolling Astronomer* before the upcoming "Solar Eclipse of the Century" (at least for those of us reasonably close to the path of totality), we urge you to PLEASE do the following:

1. Make sure that, if at possible, your eclipse travel plans are solid and firm.

2. Make sure to set aside some good images (or sketches, if that's your thing) of the event.

3. Send the items from No. 2 to Mike Reynolds and Rik Hill so they have what's needed for a wrap-up article in JALPO60-1.

As for item 1, if you're lucky enough to be with only a few hours' driving distance from the totality path, it's pretty much a no-brainer. Simply pack your stuff and head out for a chosen location many hours early enough so you don't get bogged down in heavy traffic.

Here in metro Atlanta, many folks are planning to head up either to the small city of Clayton in the northeast corner of Georgia or even cross the state line into Tennessee, North Carolina or South Carolina, view the event that afternoon, then head back the same afternoon to catch the evening news.

But I'll bet that for perhaps the first time, U.S. 441/U.S. 23 will be simply clogged with cars most of the day — just like normal traffic in and around Atlanta itself.

About items 2 and 3: We realize that *Astronomy* and *Sky & Telescope* magazines have much bigger readerships. But this is still YOUR organization, so please support it by contributing your good works to us! And don't forget complete descriptions to accompany the images. Data such as the imaging/sketching location, time of day, equipment used (be very specific with these), names of any software used, estimates of the sky conditions, and your own personal comments about what you saw in the sky and of those around you will add greatly to what we publish. Were Baily's Beads prominent? Say so. Was there a Diamond Ring effect or was it missing? Say so. Just tell it like it is.

Finally, The last installment of Mike Reynolds' great series on travelling to, viewing and imaging the eclipse appears later in this issue. The first three installments appeared in the past three issues of this Journal. If you misplaced your hard copies or

Inside the ALPO
Member, section and activity news

News of General Interest

Our Cover: The Observers Notebook- The Official Podcast of the ALPO

This issue's cover announces the latest endeavor by the ALPO to literally reach the widest audience possible with "podcasts".

What IS a podcast, you ask?

Well, a podcast is an episodic series of digital media files which a user can set up so that new episodes are automatically downloaded via the world wide web to the user's own local computer or portable media player (for instance, a cell phone). It's a form of media that started way back in 2004; today, though, there are literally thousands of free podcasts available via iTunes and other media outlets.

To date I have recorded over 20 podcasts with various members of the ALPO, mostly section coordinators to highlight their chosen programs. While the average length of a podcast is about 30 minutes, the longest podcast thus far, however, is about 1 hour and 20 minutes. Even longer podcasts can be done because the hosting service that I am using has unlimited space available for podcasts.

The podcast hosting service is not free, however. So to keep our podcast service alive, I've set up an online method for supporters to donate a monthly amount. The service is called "Patreon", and we currently have three supporters - two of whom are NOT even members!

You can support the podcast by giving as little as $1 a month. But for $5 monthly, you'd receive early access to the podcast before it goes public; for a $10 monthly donation, you'd receive a copy of the ALPO Lunar & Planetary Training Section's "Novice Observer's Handbook"; and for a $35 monthly donation, you'd receive producer credits on the podcast and a year's membership in the ALPO. You can help us out by going to the link below:

https://www.patreon.com/ObserversNotebook

The podcasts currently online include the following:

- A conversation with Matt Will about the history of the ALPO.
- Wayne Bailey talks about the Lunar Section programs.
- Rik Hill on the Solar section.
- Ken Poshedly gives us an update and history of the JALPO.
- A chat with Steve Tzakis, a graduate of the ALPO Lunar & Planetary Training Section. Mike Reynolds gives some valuable insights into the 2017 Total Solar Eclipse.
- Julius Benton and I have a chat about both the Venus and Saturn sections in two separate podcasts.
- Bob Lunsford tells me all about the Meteors Section.
- Jerry Hubble from the Lunar Topographical Studies Section enlightened us on the workings and observations within his section.

And in our longest podcast so far, I had a very in-depth discussion with Astronomy Historian Tom Williams on the history of amateur astronomy in the U.S.

Upcoming topics that have already been recorded include podcasts on the Remote Planets Section and the Jupiter Section with Richard Schmude, the Comets Section with Carl Hergenrother, the Lunar Transient Phenomena with Tony Cook, Changes in Amateur Astronomy with John Westfall, the Minor Planets Section with Fredrick Pilcher, the Mercury section with Frank Melillo, and Dolores Hill gives a very interesting perspective on the ALPO Meteorites Section. Plus many more are in the making.

A new podcast is released every two weeks, and if you subscribe to it via

Inside the ALPO
Member, section and activity news

iTunes it will automatically be downloaded to your device.

The podcast will also be used to get the word out on any breaking news about the ALPO, astronomy or events happening in the sky. I am also planning to produce member profile pieces so we get to know something about the members of our fine organization.

Finally, suggestions for future podcasts are always welcome. So please let me know if you have any breaking news or topic that you want covered.

You can hear the podcast on iTunes, Stitcher, and Goggle Play. Just search for "Observers Notebook". Or you can listen to it at the link below:

https://soundcloud.com/observersnotebook

Thanks for listening.

Staff Info Updates

Assistant Comets Section Coordinator Gary Kronk's new e-mail address — *gkronk@gmail.com*

Online Section Coordinator Larry Owens' preferred e-mail address — *larry@ceastronomy.org*.

Minor Planets Section Scientific Advisor Petr Pravec's complete postal address — Ondrejov Observatory, Astronomical Institute, Academy of Sciences, Cz-25 165 Ondrejov, Czech Republic

Minor Planets Section Scientific Advisor Alan Harris' complete postal business address — Space Science Institute, 4750 Walnut St, Suite 205, Boulder, CO 80301

Reminder: DJALPO Now Available to All ALPO Members

All ALPO members are now free to download the full-color digital version of this Journal, complete with its electronic bookmarks and hyperlinks.

Thus, all members will now receive a formal e-mail notification as the newest issue is made available. The e-mail will include a hyperlink on which to click. After clicking on the hyperlink, a"pop-up window" will appear. Simply provide the requested data as requested to begin the download.

Reminder: The ALPO Publications Section Gallery

The ALPO Publications Section Gallery has been updated to include all ALPO Journals from 2015 back to 2001 and various indexes to the Journals.

The pre-2001 Journals back to issue No. 1 (1947) and additional indexes will be posted in the coming weeks and months.

These Journals are available to all to access, with no password required to open them.

The ALPO Publications Section gallery replaces the old online repository where some Journals were still password-protected. That online location will be deleted.

The Journals for calendar year 2016 remain available only to ALPO members and will be posted to the new location as their individual one-year anniversaries of release are reached.

Besides the ALPO journals, the Publications Section Gallery also includes various observing forms and monographs, all of which will be upgraded as new versions are made available.

To begin your own exploration of the Publications Gallery:

1. Go to the ALPO home page at *http://www.alpo-astronomy.org/*, then click on the "ALPO Section Galleries" link at the top-right of the screen.

2. Click on the icon for the "Publications Section".

3. Click on the icon for the "Digital Journals of the ALPO."

4. Click on the icon for any of the various years.

5. Click on the icon for any of the Journals in the chosen year.

6. Click on the "Download document" link near the center of the screen.

Then either save the document to your own computer or just read it

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS ALPO Founded in 1947

Inside the ALPO
Member, section and activity news

online without saving it. Saving the document to your own terminal allows you to access it at any time, even if online access is not available.

Call for JALPO Papers

The ALPO appreciates articles for publication and encourages its membership to submit written works (with images, if possible).

As with other peer-reviewed publications, all papers will be forwarded to the appropriate observing section or interest section coordinator.

Thus, the best method is to send them directly to the coordinator of the ALPO section which handles your topic.

A complete list of ALPO section coordinators and their contact information can be found in the *ALPO Resources* section of this Journal.

ALPO Interest Section Reports

ALPO Online Section

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

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*

Inside the ALPO
Member, section and activity news

Computing Section

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

Important links:

- To subscribe to the ALPOCS yahoo e-mail list, *http://groups.yahoo.com/group/alpocs/*
- To post messages (either on the site or via your e-mail program), *alpocs@yahoogroups.com*
- To unsubscribe to the ALPOCS yahoo e-mail list, *alpocs-unsubscribe@yahoogroups.com*
- Visit the ALPO Computing Section online at *www.alpo-astronomy.org/computing*

Lunar & Planetary Training Program

Tim Robertson, program coordinator
cometman@cometman.net

The ALPO Lunar & Planetary Training Program currently has 0 active students. And in the past 12 months we had orders for 11 copies of the *Novice Observers Handbook*.

The ALPO Lunar & Training Program is a two-step program, and there is no time requirement for completing the steps. But I have seen that students who 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.

Our 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 by members for the purposes of scientific research. Therefore, it is the responsibility of our organization to guide prospective contributors toward productive and meaningful scientific observations.

The course of instruction for the Training Program is two-tiered. The first tier, the "Basic Level", includes reading the *ALPO's Novice Observer's Handbook* and mastering the fundamentals of observing. These fundamentals include performing simple calculations and understanding observing techniques. After the student has successfully demonstrated these skills, he or she can 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 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.

For more information on the ALPO Training Program, contact

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

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

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

Inside the ALPO
Member, section and activity news

ALPO Observing Section Reports

Eclipse Section

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

February's Penumbral Lunar Eclipse
I received from ALPO members reports and some images of the 11 February 2017 penumbral lunar eclipse. Most report of easily observing and following the penumbral shadow, especially at mid-eclipse. Howard Eskildsen and Dan Llewellyn submitted excellent images of mid-eclipse.

Totality: At Last!
After many years of anticipation and planning, the 21 August 2017 Total Solar Eclipse is upon us. Please submit reports, photos, observations, etc. following the eclipse. I will compile an Eclipse Section Report for the Journal on observations made by ALPO members. This also includes those ALPO members who will _not_ be traveling to the center line; please submit your report on your partial eclipse observations.

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

Mercury / Venus Transit Section

John Westfall, section coordinator
johnwestfall@comcast.net

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

Left — Image by Dan Llewellyn during the February 11, 2017 partial lunar eclipse. Equipment: 240 mm f/6.3 lens with a Sony A7R2 camera, single shot, ISO 50, 1/320 second exposure. No location or time data provided.
Right — Image of the same event by Howard Eskildsen, Ocala, Florida. Equipment: Canon 60D camera. No other details provided.

Meteors Section

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

As I write this, we are just learning the results of the recent Lyrid shower and gearing up for the eta Aquariids. It has been slow during the past few months, which is normal for meteor observers. The first quarter of the year is always the slowest time for meteors, especially in the northern hemisphere.

After the eta Aquariids, we will have to endure another two months of low rates until the real meteor season begins in mid-July.

2017 promises to be a good year for meteor observing as the phases of the moon cooperate more with the meteor timetable, much more so than in 2016.

I look forward to hearing from all our meteor observers as we gear up for warmer weather and many more meteors!

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

This report includes new meteorite approvals from February 1, 2017 to April 26, 2017 from the Meteoritical Society's Nomenclature Committee.

The ALPO Meteorite Section consults with members about meteorites to educate and promote research. ALPO members who collect meteorites are encouraged to report unusual features in their meteorite samples. We received email inquiries of suspected

Inside the ALPO
Member, section and activity news

meteorites, all of which appear terrestrial including a magnetite nodule from Arizona and probable chert rock. ALPO member Randy Tatum is studying possible impact spherules in various samples. He connected with impact cratering researchers Dr. David Kring of the Lunar and Planetary Institute in Houston, Texas, and Dr. Jay Melosh at Purdue University (West Lafayette, Indiana).

Total of 65,166 records in the Meteoritical Bulletin: 902 ordinary chondrites; 46 HEDs; 88 carbonaceous meteorites; 6 enstatite chondrites; 1 aubrite; 4 achondrites (stony); 8 IAB irons; 1 IIAB iron; 2 IIIAB irons; 3 R chondrites; 16 lunar; 6 Martian; 11 ureilites; 1 acapulcoite; 4 lodranites; 5 meosiderites; 1 pallasite; 1 enstatite achondrite. For more information: *https://www.lpi.usra.edu/meteor/metbull.php*

Meteoritical Bulletin 106 (2017) contains 1,107 new meteorite entries for this period. They range in mass from 0.1 g Miller Range 13238 CM2 carbonaceous chondrite to the 105 kg Maghidet 001 L6 melt breccia from Libya. New falls approved include LL6 "Dingle Dell" (Australia), a single stone, that fell on October 31, 2016, in a farm paddock and recorded by the Desert Fireball Network, H5 "Aquile" (Bolivia) strewnfield of many stones and the H5 "Degtevo" (Russia) meteorite that fell near a farm with reports of a loud whistling.

Do you have meteorites and a camera? Are you looking for an easy Pro-Am collaboration? We received inquiries from two asteroid researchers at NASA-JPL and NASA-Ames who are interested in high-resolution images of meteorite cross-sections. They are investigating different aspects of meteorite analogs for fracturing of rocks and particles during thermal cycles on asteroid surfaces over long and short time scales and estimating the strength of meteoroids and asteroids as they collide with Earth's atmosphere. High-resolution images could help researchers better understand properties of near-Earth asteroids. Contact Dolores Hill at *dhill@lpl.arizona.edu* if you are interested in this project.

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

Comets Section

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

The current crop of visible comets have shown us a little of everything over the past few months. While none of them reached naked eye brightness, comets 41P/Tuttle-Giacobini-Kresak, C/2015 ER61 (PANSTARRS) and C/2017 E4 (Lovejoy) all came close at 6th magnitude. C/2015 ER61 (PANSTARRS) and periodic comet 315P/LONEOS experienced outbursts. 73P/Schwassmann-Wachmann 3 underwent a splitting event. Newly discovered C/2017 E4 (Lovejoy) also displayed signs of splitting and eventually disintegrated as it approached perihelion.

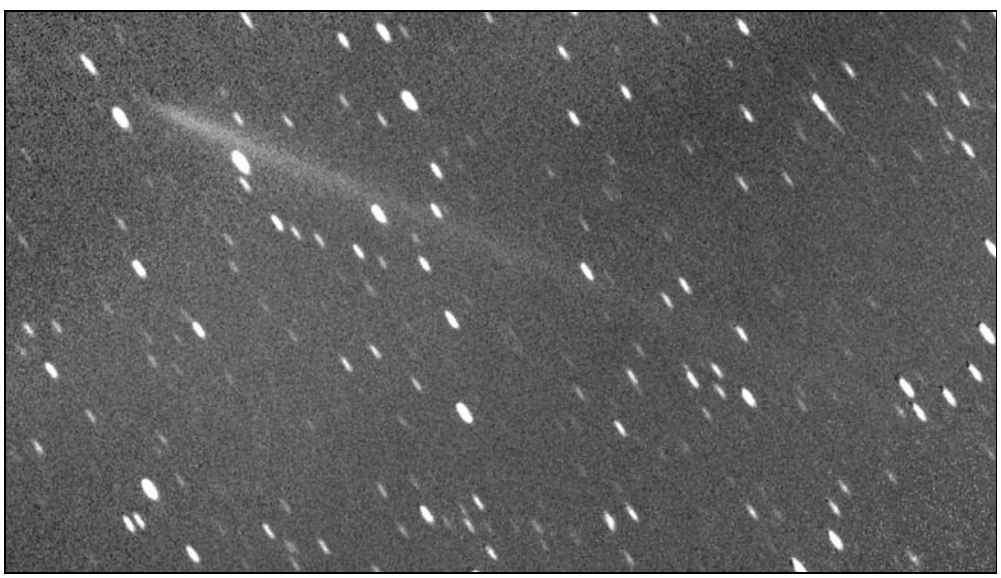


Image of Comet C/2017 E4 Lovejoy taken 30 April 2017 at 11:25 UT. This image above comes from the average of six, 60-second exposures unfiltered and remotely collected using the 16-inch, f/3.75 Tenagra III ("Pearl") robotic unit, which is part of Tenagra Observatories in Arizona. The image scale is 2.4" / pixel. East is up, north at left. The comet was 2.4 degrees above the horizon at dawn. *Images by Gianluca Masi (Virtual Telescope Project) and Michael Schwartz (Tenagra Observatories Ltd.).*

Inside the ALPO

Member, section and activity news

Contributors Salvador Aguirre, Carl Hergenrother, John D. Sabia and Willian Souza submitted visual observations for comets 2P/Encke, 41P/Tuttle-Giacobini-Kresak, C/2015 ER61 (PANSTARRS), C/2015 V2 (Johnson) and C/2017 E4 (Lovejoy). CCD observers Charles Bell, John Chumack, Carl Hergenrother, Manos Kardasis, Gianluca Masi, William Owens, Efrain, Morales Rivera, John D. Sabia, Chris Schur and Michael Schwartz contributed images of 41P/Tuttle-Giacobini-Kresak, 45P/Honda-Mrkos-Pajdusakova, 71P/Clark, 73P/Schwassmann-Wachmann 3, 315P/LONEOS, C/2015 ER61 (PANSTARRS), C/2015 V2 (Johnson) and C/2017 E4 (Lovejoy).

The summer months of 2017 (June through September) should see four comets at 10th magnitude or brighter.

- After approaching within 0.14 au of Earth on April 1 and reaching 6th magnitude, short-period comet 41P/Tuttle-Giacobini-Kresak will be rapidly fading as June begins. During that month, 41P will fade from magnitude 9.0 to 11.2. By the end of September it will be a difficult object to detect even for CCD imagers.
- Another observable short-period comet this summer is 71P/Clark which will peak at 10th magnitude in June. Southern observers will have an easier time following 71P as it starts June at a declination of -27 degrees and slowly moves south during the rest of the summer.

Ephemerides for Comets 41P/Tuttle-Giacobini-Kresak, 71P/Clark, C/2015 ER61 (PANSTARRS) and C/2015 V2 (Johnson)

Date	R.A.	Decl.	r (au)	d (au)	Elong (degrees)	m1	MaxEl (40°N)	MaxEl (40°N)
41P/Tuttle-Giacobini-Kresak								
2017 Jun 01	18 14.22	+16 40.9	1.227	0.281	134	9.0	67	33
2017 Jun 11	18 10.64	+09 21.6	1.298	0.328	144	9.7	59	41
2017 Jun 21	18 06.28	+02 53.5	1.375	0.388	153	10.4	53	47
2017 Jul 01	18 02.94	-02 37.6	1.456	0.463	157	11.2	47	53
2017 Jul 11	18 01.80	-07 10.2	1.539	0.555	155	11.9	42	58
2017 Jul 21	18 03.21	-10 48.3	1.625	0.663	150	12.7	39	61
2017 Jul 31	18 07.21	-13 39.8	1.711	0.788	142	13.4	36	64
2017 Aug 10	18 13.59	-15 52.8	1.797	0.928	135	14.1	34	66
2017 Aug 20	18 21.95	-17 34.6	1.883	1.082	128	14.7	32	68
2017 Aug 30	18 31.99	-18 51.0	1.968	1.249	120	15.3	31	69
2017 Sep 09	18 43.39	-19 46.3	2.053	1.427	113	15.9	30	70
2017 Sep 19	18 55.83	-20 24.0	2.136	1.613	107	16.4	29	70
2017 Sep 29	19 09.11	-20 46.6	2.218	1.808	100	16.9	29	69
71P/Clark								
2017 Jun 01	16 35.86	-27 08.0	1.611	0.598	174	10.2	23	77
2017 Jun 11	16 31.22	-29 35.5	1.597	0.590	167	10.1	20	80
2017 Jun 21	16 28.08	-31 49.6	1.589	0.599	158	10.1	18	82
2017 Jul 01	16 28.22	-33 43.2	1.586	0.625	149	10.2	16	84
2017 Jul 11	16 32.84	-35 14.4	1.590	0.664	141	10.3	15	85
2017 Jul 21	16 42.16	-36 23.3	1.599	0.716	134	10.5	13	87
2017 Jul 31	16 55.94	-37 10.6	1.613	0.779	127	10.8	12	87
2017 Aug 10	17 13.50	-37 37.2	1.633	0.852	121	11.1	12	88
2017 Aug 20	17 33.95	-37 43.2	1.658	0.935	116	11.4	11	88
2017 Aug 30	17 56.51	-37 28.9	1.688	1.027	111	11.8	12	87
2017 Sep 09	18 20.37	-36 55.4	1.722	1.127	107	12.2	12	87
2017 Sep 19	18 44.86	-36 03.8	1.759	1.237	102	12.6	13	83
2017 Sep 29	19 09.50	-34 55.8	1.800	1.355	98	13.0	15	77
C/2015 ER61 (PANSTARRS)								
2017 Jun 01	00 58.98	+11 47.5	1.106	1.375	52	8.1	10	25
2017 Jun 11	01 31.64	+14 52.2	1.171	1.443	53	8.5	12	24
2017 Jun 21	02 01.01	+17 20.4	1.253	1.506	55	8.9	16	24
2017 Jul 01	02 27.14	+19 16.6	1.348	1.562	58	9.4	20	24
2017 Jul 11	02 50.10	+20 45.3	1.451	1.607	62	9.8	26	24
2017 Jul 21	03 09.90	+21 51.2	1.561	1.642	67	10.3	33	24
2017 Jul 31	03 26.50	+22 37.9	1.675	1.665	72	10.7	40	25
2017 Aug 10	03 39.82	+23 08.4	1.791	1.677	79	11.0	48	25
2017 Aug 20	03 49.75	+23 25.2	1.909	1.680	86	11.4	56	26
2017 Aug 30	03 56.14	+23 29.7	2.028	1.676	94	11.7	64	26
2017 Sep 09	03 58.87	+23 22.7	2.147	1.670	103	12.0	71	27
2017 Sep 19	03 57.91	+23 04.5	2.265	1.664	113	12.2	73	27
2017 Sep 29	03 53.40	+22 34.8	2.384	1.666	124	12.5	73	27
C/2015 V2 (Johnson)								
2017 Jun 01	14 44.30	+22 37.7	1.644	0.814	127	7.2	72	28
2017 Jun 11	14 28.33	+11 44.2	1.637	0.819	126	7.2	60	39
2017 Jun 21	14 17.99	+00 40.5	1.641	0.864	121	7.4	46	50
2017 Jul 01	14 13.14	-09 26.0	1.656	0.945	115	7.6	32	60
2017 Jul 11	14 13.21	-18 04.9	1.682	1.056	108	7.9	21	69
2017 Jul 21	14 17.54	-25 16.5	1.717	1.187	102	8.2	12	76
2017 Jul 31	14 25.63	-31 14.1	1.761	1.332	96	8.5	5	77
2017 Aug 10	14 37.06	-36 13.2	1.814	1.487	91	8.8	0	73
2017 Aug 20	14 51.55	-40 26.0	1.874	1.647	86	9.2	-4	67
2017 Aug 30	15 08.94	-44 01.8	1.940	1.811	81	9.5	-7	62
2017 Sep 09	15 29.06	-47 06.8	2.012	1.976	77	9.8	-10	57
2017 Sep 19	15 51.80	-49 44.6	2.088	2.141	73	10.0	-11	53
2017 Sep 29	16 17.04	-51 57.3	2.169	2.305	69	10.3	-13	50

Inside the ALPO
Member, section and activity news

Two long-period comets will also be observable. Both C/2015 ER61 (PANSTARRS) and C/2015 V2 (Johnson) were discovered back in 2015. Predicting the brightness of any comet is difficult, so the magnitudes shown in this report may be off by a magnitude or so in either direction. Both of these comets have proven difficult to predict, though for different reasons.

- In early April, C/2015 ER61 (PANSTARRS) was observed to undergo a 2+ magnitude outburst as it brightened from magnitude 8.5 to 6.0. It remained bright for much of the rest of April though as May begins it has returned to its predicted brightness of magnitude 8.0. With perihelion on May 9 at 1.04 au, the comet will be fading this summer (barring any other outbursts) from magnitude 8.1 on June 1 to 9.4 on July 1, 10.7 on August 1 and 11.8 on September 1.
- The other bright long-period comet is Comet Johnson, which passes perihelion on June 12 at 1.64 au from the Sun. Estimates of its brightness in April have ranged from magnitude 7.7 to 10. Assuming it really is as bright as magnitude 7.7, Johnson will still be 7th magnitude in June and early July. Northern observers will lose sight of the comet by early August as it races south. Southern observers will still be able to follow it for the rest of the summer as it fades to 10th magnitude in late September.

Accompanying this report are ephemerides for the four comets discussed above. The ephemerides are for 10 day intervals and contain the comet's Right Ascension (R.A.), Declination (Decl.), heliocentric distance in au (r), geocentric distance in au (d), phase angle in degrees (Ph.A.), Elongation from the Sun in degrees (Elong), total V magnitude (m1), and maximum elevation in degrees at the start or end of astronomical twilight for latitude +40 north and -40 south (Max El).

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*

Please consider reporting all your comets observations, past and present, to ALPO Comets Section Coordinator Carl Hergenrother at the email address listed at the beginning of this report.

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

Solar Section

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

Solar activity declined further this last quarter, but the ALPO Solar Section did pick up a few more contributing observers: Brennerad Damacenco from Sao Paolo, Brazil; Raffaello Braga from Milano, Italy; and Kevin James Kevin Ty of Manila, Philippines. This brings the section to 28 observers contributing over the last year.

In the Carrington Rotation solar activity report in this issue (CR 2184-87), a total of 1,186 images, drawings and reports were contributed and added to the ALAPO Solar Section Archives.

Regular short reports on activity are posted on our website and on FaceBook at the end of each rotation to keep observers up on the current level of activity. As of this writing, the formal reports on activity published in the Journal are only about two or three rotations behind current, due to the submission of data by observers and the publishing of final daily sunspot numbers (Ri) by WDC-SILSO (World Data Center - Solar Index and Long Term Solar Observations) at the Royal Observatory of Belgium.

Pam Shivak continues to do regular postings of solar observations and news on FaceBook and other social media. She says there was a great turnout on the solar observing field at NEAF 2017 in Suffern, New York, this year where she represented us.

Rick Gossett maintains the e-mail list, where members can post daily observations. All are invited to do so and should add their solar observations to the ALPO Solar Section Archive by e-mailing them to: *solarimages@alpo-astronomy.org*.

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*

Inside the ALPO
Member, section and activity news

Mercury Section

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

Hopefully, many of you had a good glimpse of Mercury last March and April after sundown. As you read this, it is poorly visible in the morning sky, on its way to superior conjunction with the Sun on June 21. Mercury will slowly climb into the evening sky. But at the same time, the ecliptic will start to be very shallow and Mercury will stay closer to the western horizon. The best time to see it will be from mid- to late-July.

Mercury's greatest elongation will occur on July 29 as the planet will be about 27 degrees east of the Sun. That is perhaps the furthest distance from the Sun as seen from Earth. Unfortunately, as mentioned above, Mercury will be a lot lower in the sky and will set just over an hour after sunset. If you observe Mercury successfully through a telescope, it will display a half-phase with a disk diameter of 7.6 arc seconds. Also, it will shine an average brightness of +0.4 magnitude.

Will Mercury be visible to the naked eye during the total eclipse of the Sun on August 21? Normally, brighter planets are the first ones visible during the eclipsed Sun. Jupiter will be at the lower left side and Venus will be on the opposite side. Mars will be visible faintly at about 7 - 8 degrees west (right side) of the eclipsed Sun, close to a 2nd magnitude object. Unfortunately, Mercury will be far dimmer than the three other planets and it will approach inferior conjunction with the Sun on August 26. Mercury will still be at the evening side and it will be located about 10 - 11 degrees southeast of the eclipsed Sun. It will shine faintly at +3.3 magnitude and it will display an exceedingly thin crescent of 5% illumination, nearly 11 arc seconds in diameter!

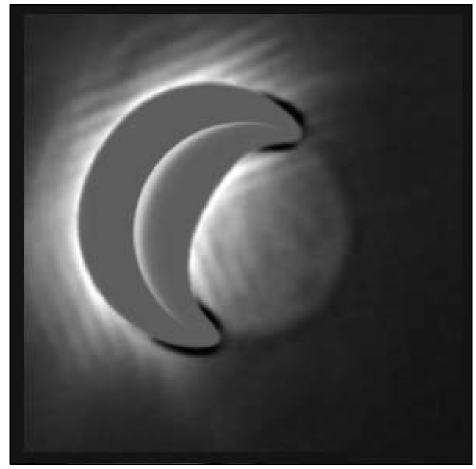
Good luck observing the eclipse and the surrounding area! And please send in your observations to the Mercury section!

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

Venus Section

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

Venus appears in the morning sky before dawn reaching greatest elongation west of 46° on June 3, 2017, roughly one day prior to theoretic dichotomy on June 4. During the current 2017-18 Western (Morning) Apparition, observers are witnessing Venus as it passes 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 by the time it reaches superior conjunction on January 9, 2018.



John Boudreau of Saugus, MA, contributed this excellent image of the thermal emission of Venus at 1000nm (near-IR) on March 12, 2017 at 23:35 UT employing at a 28.0 cm (11.0 in.) SCT in rather poor seeing conditions (numerical values for seeing and transparency were not specified). This remarkable image shows detail on otherwise dark and invisible hemisphere of Venus, whereby the darker patches easily seen inside the thermal glow at 1000nm wavelength correspond to highland features (mountains) of Venus that are colder and emit less infrared light, thus appearing darker in the IR image. The apparent diameter of Venus is 55.7", phase (k) 0.063 (6.3% illuminated), and visual magnitude 4.3. South is at top of image.

As of this writing, observers were still submitting observations in the form

Geocentric Phenomena of the 2017-18 Western (Morning) Apparition of Venus in Universal Time (UT)

Inferior Conjunction	2017	Mar 25^d 10^h (angular diameter = 59.8 arc-seconds)
Greatest Illuminated Extent		Apr 30 04 UT (m_v = –4.8)
Greatest Elongation (West)		Jun 03 13 (46°)
Predicted Dichotomy		Jun 04.26 (Venus is predicted to be exactly half-phase)
Superior Conjunction	2018	Jan 09 10 (angular diameter = 9.7 arc-seconds)

Inside the ALPO
Member, section and activity news

of drawings and images following closure of the 2016-17 Eastern (Evening) Apparition on March 25, 2017, for which an apparition report will appear in this Journal in the near future.

The accompanying Table of Geocentric Phenomena in Universal Time (UT) is included here for the convenience of observers for this apparition.

During the 2017-18 Western (Morning) Apparition, it may be useful for observers to wait until the planet gains altitude and the background sky brightens considerably, allowing Venus to be readily followed into daylight. It is perfectly desirable to observe Venus during daylight hours when most of the prevailing glare associated with the planet is gone or reduced. Note, however, that observing Venus too far into the daylight hours can become a problem as solar heating produces turbulent air and resulting poor seeing.

While it may seem difficult to look for Venus in daylight, it should be recalled that the planet is comparatively bright, and in practice, the observer can usually find Venus if knowledge of exactly where to look is obtained before the observing session. It is worth mentioning that observers find that the presence of a slight haze or high cloud often stabilizes and reduces glare conditions while improving definition.

Readers of this Journal are likely 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 Venus Express (VEX) mission that began in 2006 and concluded in 2015. It was a tremendously successful Pro-Am effort involving ALPO Venus observers around the globe.

Despite the fact that the mission has already ended, it is still not too late during 2017-18 for those who want to send their images to the ALPO Venus Section and the VEX website to do so. These observations remain important for further study and will continue to be analyzed for several years to come as a result of this endeavor.

The VEX website is at:

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

A follow-up effort on Pro-Am effort is underway with Japan's (JAXA) *Akatsuki* mission that began full-scale observations back in April 2016, and although the mission is continuing in 2017-18, the website for *Akatsuki* mission has "gone live"so that interested and adequately equipped ALPO observers can register and start submitting images.

More information will emerge in forthcoming reports in this Journal.

It is extremely important that all observers participating in the programs of the ALPO Venus Section always 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 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 wishing to register to participate in the coordinated observing effort between the ALPO and Japan's (JAXA) *Akatsuki* mission should use 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

Inside the ALPO
Member, section and activity news

Lunar Calendar for July thru September 2017

2017		UT	Event
Jul	01	00:51	First Quarter
	01	07:28	Moon-Jupiter: 2.9° S
	06	04:27	Moon Apogee: 405900 km
	07	03:34	Moon-Saturn: 3.6° S
	08	10:49	Moon Extreme South Dec.: 19.4° S
	09	04:07	Full Moon
	16	19:26	Last Quarter
	19	23:37	Moon-Aldebaran: 0.4° S
	20	11:13	Moon-Venus: 2.7° N
	21	17:09	Moon Perigee: 361200 km
	21	22:11	Moon Extreme North Dec.: 19.4° N
	23	09:46	New Moon
	25	08:49	Moon-Mercury: 0.9° S
	25	10:14	Moon-Regulus: 0°
	28	20:15	Moon-Jupiter: 3.4° S
	30	15:23	First Quarter
Aug	02	17:55	Moon Apogee: 405000 km
	03	07:31	Moon-Saturn: 3.8° S
	04	18:17	Moon Extreme South Dec.: 19.4° S
	07	18:11	Full Moon
	07	18:22	Partial Lunar Eclipse
	15	01:15	Last Quarter
	16	06:39	Moon-Aldebaran: 0.4° S
	18	06:50	Moon Extreme North Dec.: 19.4° N
	18	13:14	Moon Perigee: 366100 km
	19	04:45	Moon-Venus: 2.3° N
	21	18:30	New Moon
	25	13:00	Moon-Jupiter: 3.7° S
	29	08:13	First Quarter
	30	11:25	Moon Apogee: 404300 km
	30	14:23	Moon-Saturn: 3.9° S
Sep	01	02:03	Moon Extreme South Dec.: 19.4° S
	06	07:03	Full Moon
	12	12:09	Moon-Aldebaran: 0.4° S
	13	06:25	Last Quarter
	13	16:04	Moon Perigee: 369900 km
	14	13:00	Moon Extreme North Dec.: 19.4° N
	17	18:28	Moon Ascending Node
	18	00:56	Moon-Venus: 0.6° N
	18	04:32	Moon-Regulus: 0.1° S
	20	05:30	New Moon
	22	07:51	Moon-Jupiter: 4° S
	27	00:09	Moon-Saturn: 3.8° S
	27	06:49	Moon Apogee: 404300 km
	28	02:54	First Quarter
	28	10:06	Moon Extreme South Dec.: 19.5° S

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

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

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/*

Inside the ALPO
Member, section and activity news

Lunar Section

Lunar Topographical Studies / Selected Areas Program
Report by Wayne Bailey, program coordinator
wayne.bailey@alpo-astronomy.org

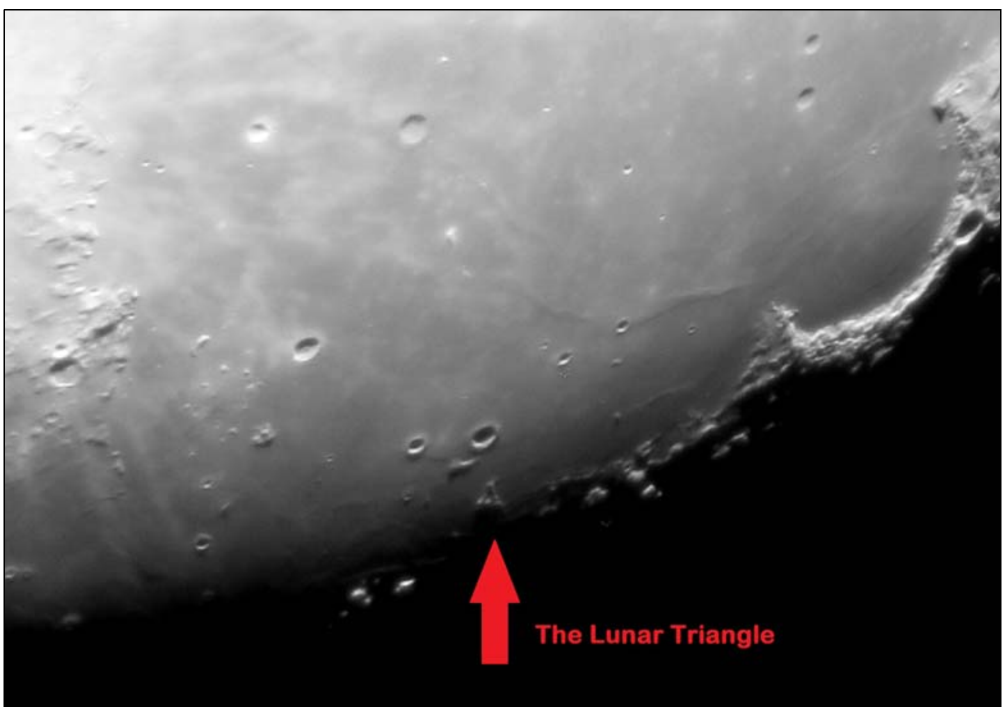
The ALPO Lunar Topographical Studies Section (ALPO LTSS) received a total of 144 new observations from 14 observers during the January-March quarter.

Fourteen contributed articles were published in addition to numerous commentaries on images submitted. The *Focus-On* series continued, under Jerry Hubbell, with articles on the Montes Taurus & the Taurus-Littrow Valley, and Rupes Recta. Upcoming *Focus-On* subjects will be: Concentric Craters; Messsier & Messier A-Oblique Craters; and Lunar Domes

We are continuing our consideration whether to make any changes to the Lunar Topographic Studies/Selected Areas programs. Anyone with suggestions for additional programs, changes to existing programs, or suggested eliminations is welcome to send them to me at the e-mail above. So far, I have received responses indicating an interest in spectroscopy, polarimetry and steep slopes/mass wasting.

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

Visit the following online web site for more info (including current and archived issues of *The Lunar Observer*): *moon.scopesandscapes.com*



From the June issue of *The Lunar Observer* newsletter, an image by Marcelo Gundlach of Cochabamba, Bolivia, taken May 6, 2017 at 23:55 UT of a close grouping of small craters that form an apparent triangle on Mare Imbriuim. Seeing 8/10, transparency 5/6. Equipment: 150mm,

Lunar Meteoritic Impacts
Brian Cudnik, program coordinator
cudnik@sbcglobal.net

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

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

Only one LTP has been detected so far this year, and my thanks to Alexandre Amonrim for alerting me to this report:

West of Herodotus: 2017 Feb 08 at 01:45 UT Antonio Martini Jr (Botucatu, Sao Paulo, Brazil), using a 10" SCT & ASI 120 MC camera (with IR filter), noticed on the computer screen a 0.5-second duration flash of a relative brightness of 7 to Aristarchus (10) and the blackness of the terminator (0). Unfortunately he was not recording at the time, but noted its position to be at 23.5N, 54.5W. This has been assigned an ALPO/BAA weight of 2.

We welcome new observers, whether they are experienced visual observers, or high resolution lunar imagers, in order to solve some past historical lunar observational puzzles.

Inside the ALPO
Member, section and activity news

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

Mars Section

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

The 2015-2017 apparition is nearly over. Most of us are eagerly awaiting the next apparition which will be the best since 2003. Look for an introductory article about the coming apparition in these pages soon.

As the next apparition begins, please join more than 1,400 interested persons on the Yahoo Mars observers list at https://groups.yahoo.com/neo/groups/marsobservers/info .

Be sure to browse the posted observations of other observers while you are there. When you make an observation, please either share it with the group by posting it in the photos section of the Yahoo list, or send it directly to me at rjvmd@hughes.net

Also, drop in to the Mars Section online and explore the Mars Section's recent observations at www.alpo-astronomy.org/mars . Be sure to check out the Mars Observers' Cafe — look for the link in the list on the right side of the Mars page on the ALPO website.

Minor Planets Section

Frederick Pilcher, section coordinator
pilcher35@gmail.com

Some of the highlights published in the *Minor Planet Bulletin*, Volume 44, No. 2, 2017 April-June, are presented. These represent the recent achievements of the ALPO Minor Planets Section.

CCD photometry is the cheapest and most widely used method to evaluate the properties of asteroid satellites. The asteroid satellite may occult/transit its primary, analogous to eclipsing binary eclipses, causing periodic dips in brightness (henceforth termed satellite events), and it will have its own rotational lightcurve. Both of these phenomena produce brightness changes that are superposed upon the rotational lightcurve of the primary. However, both satellite rotation and revolution periods can be found only rarely in the same object. Dual period software can identify and separate the two different periodicities.

Robert Stevens and Brian Warner report for (24465) 2000 SX155 a primary rotation period of 2.6608 hours and revolution period 9.252 hours. This is the shortest revolution period yet found for an asteroid satellite.

Vladimir Benishek and collaborators have found for 3792 Preston a primary rotation period of 2.9276 hours, amplitude 0.20 magnitudes. A 23.84 hour secondary periodicity of barely detectable amplitude 0.03 magnitudes may be the rotational lightcurve of a satellite, or might also be tumbling (to be discussed below) of the primary. Several observed additional dips in the lightcurve are possible satellite events, but there are insufficient data to find a period of revolution. This object is only a probable binary.

Brian Warner has found for (252793) 2002 FW5 a primary rotation period of 61.2 hours, amplitude 0.25 magnitudes, and secondary rotation period of 8.33 hours, amplitude 0.10 magnitudes. But no dips due to satellite events were observed.

For the large Trojan asteroid 884 Priamus, Robert Stevens has constructed a spin/shape model after obtaining lightcurves at several oppositions well-distributed around the sky. He finds a sidereal rotation period 6.86137 hours, two equally likely locations of the rotational pole near celestial longitude 0 degrees, celestial latitude -32 degrees, or celestial longitude 180 degrees, celestial latitude -32 degrees, and an irregular shape with elongation about 1.5.

A massive collision, or perhaps some other event, may cause tumbling behavior, or simultaneous rotation about two different axes with two different periods. Tumbling damps out into principal axis rotation on a time scale which becomes much longer with longer period and smaller size. Tumbling is observed only in very long period rotators or very small objects in near-Earth approaches.

Frederick Pilcher found for 319 Leona a principal rotation period of 430 hours, amplitude 0.6 magnitudes, and smaller amplitude tumbling period of 1,084 hours,

Inside the ALPO
Member, section and activity news

based on 4 months of observations. For 341 California, he found a principal rotation period 318 hours, amplitude 0.7 magnitudes, and smaller amplitude tumbling period 250 hours, based on 6 months of observations. Robert Stephens found for 2045 Peking a principal rotation period 82 hours and strong evidence of tumbling. But he was unable to obtain sufficient data to find the tumbling second period.

In addition to asteroids specifically identified above, lightcurves with derived rotation periods are published for 146 other asteroids as listed below:

361, 396, 398, 422, 428, 461, 478, 555, 604, 895, 949, 958, 999, 1108, 1172, 1173, 1245, 1264, 1297, 1439, 1497, 1529, 1530, 1554, 1555, 1563, 1723, 1751, 1777, 1806, 1848, 2022, 2064, 2241, 2246, 2407, 2420, 2483, 2536, 2741, 2893, 2937, 3025, 3067, 3077, 3200, 3352, 3415, 3416, 3637, 3679, 3923, 4742, 4775, 4871, 4895, 4945, 5059, 5112, 5130, 5143, 5368, 5397, 5399, 5403, 5464, 5579, 5593, 5653, 5823, 5909, 6244, 6618, 6729, 7333, 7487, 7774, 7778, 10150, 10704, 11087, 12044, 12326, 12538, 15505, 16143, 16808, 16927, 19034, 23681, 23997, 25320, 26274, 26761, 31817, 36236, 40329, 41588, 42286, 49385, 55043, 56982, 62408, 64679, 66391, 82163, 87811, 88263, 118633, 137032, 162142, 171819, 188216, 193449, 204517, 220124, 222317, 225416, 248083, 257838, 275611, 326683, 331471, 345705, 347813, 348400, 357024, 378610, 413002, 462959, 467963, 469581, 470510, 477327, 1999 VT, 2006 UM, 2006 XD2, 2007 VM184, 2009 UG, 2011 UU106, 2016 LX48, 2016 NL15, 2016 PZ66, 2016 TL2, 2016 WJ1, 2016 XH1.

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/mpbdownloads.html*.

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

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

Jupiter Section

Report by Ed Grafton, section coordinator
ed@egrafton.com

Jupiter reached opposition for the 2016-2017 apparition on April 7th 2017. At opposition Jupiter was at a distance of 4.46 AU and had apparent diameter of about 44 arc-seconds while shining at magnitude -2.5.

This apparition developed a mid-south equatorial outbreak which has not occurred since the 2010-2011 apparition. Such outbreaks consist of convective storms. Other outbreaks were observed to have occurred in the north equatorial belt and north temperate belt this apparition.

With the 2013-2014 Jupiter apparition report having been published in the spring issue of this Journal (59-2), Jupiter Section Assistant Coordinator Richard Schmude anticipates beginning work on the 2014-2015 apparition Jupiter report sometime later this year.

Jupiter Section Assistant Coordinator John McAnally is coordinating central meridian (CM) transit timings of Jupiter's atmospheric features. Measuring CM transit times is an excellent way to become familiar with Jupiter's features and adds to the data base of when particular features or visible. Transit timing observations may be sent to John directly at *CPAjohnM@aol.com*

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

Inside the ALPO
Member, section and activity news

Galilean Satellite Eclipse Timing Program

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

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

Saturn Section

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

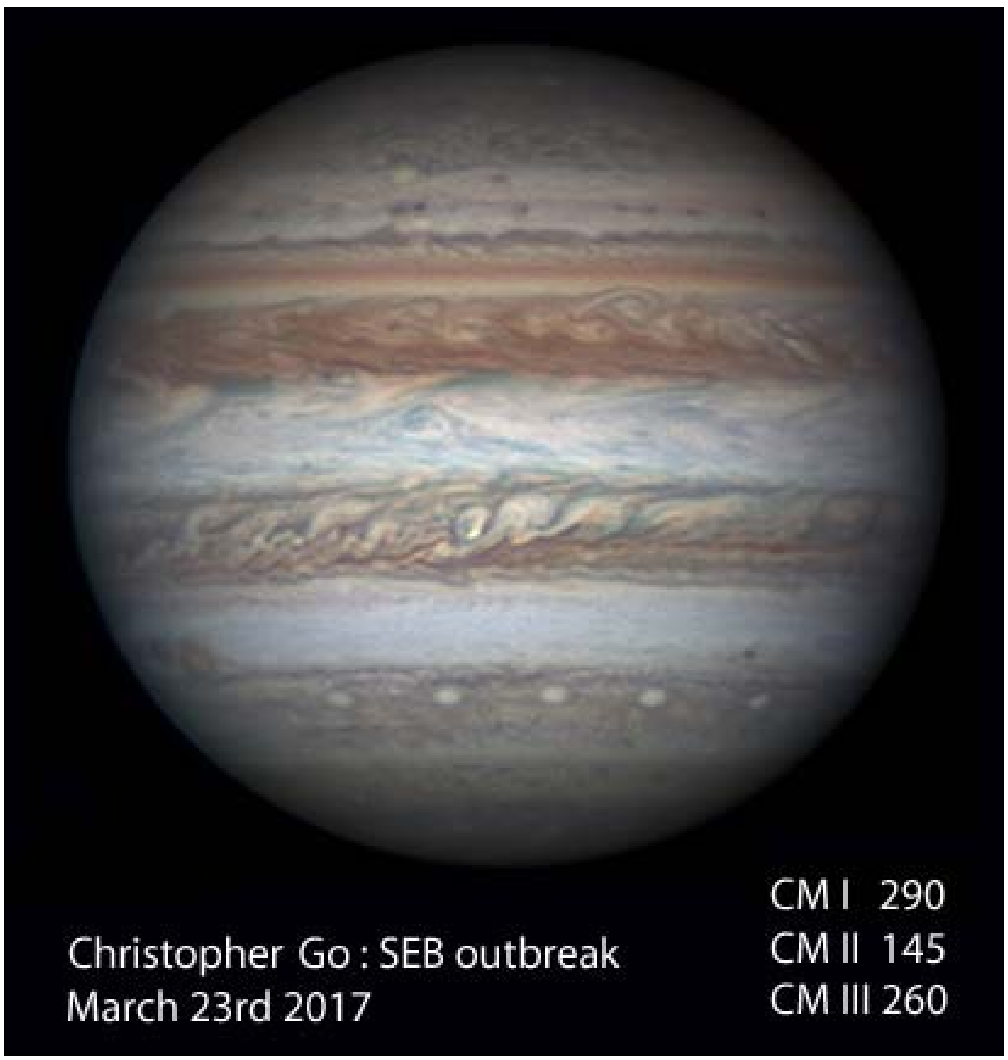
The 2016-17 apparition of Saturn continues throughout the summer months, becoming progressively well-placed for viewing and digital imaging most of the night despite its southerly declination of about -22° for northern hemisphere observers. The planet reaches opposition on June 15, 2017.

The accompanying Table of Geocentric Phenomena for the 2016-17 Apparition in Universal Time (UT) is included here for the convenience of observers.

As of this writing, the ALPO Saturn Section has already received numerous images of Saturn at visual and infrared wavelengths. Some observers are already reporting (and imaging) discrete atmospheric phenomena in Saturn's northern hemisphere atmosphere, such as a white spot at saturnigraphic latitude +6.5° EZn (northern half of the Equatorial Zone) and another small white spot in the NEBZ (North Equatorial Belt Zone) at +24.0°, both best seen in images at 685nm IR wavelength.

As the apparition progresses, it will be extremely important to continue to monitor the aforementioned features and determine if atmospheric activity reported during the immediately preceding 2015-16 apparition has carried over into the 2016-17 observing season.

For instance, preliminary indications are that the EZn white spot already imaged in early 2016-17 might be the same long-enduring feature that was tracked within EZn during 2015-16. Observers are also alerted to be watchful for any new atmospheric phenomena that might suddenly appear. With the rings now reaching a maximum of +27° towards our line of sight from Earth by mid-October



Jupiter as imaged by Christopher Go on March 23rd 2017 at 16:19 UT showing the mid-SEB outbreak at its full extent. Several white ovals are present and Oval BA is seen rising.

Inside the ALPO
Member, section and activity news

2017, observers are experiencing near-optimum views of the northern hemisphere of the globe and north face of the rings during the 2016-17 apparition.

Geocentric Phenomena for the 2016-17 Apparition of Saturn in Universal Time (UT)

Conjunction	2016 Dec 10^d UT
Opposition	2017 Jun 15^d
Conjunction	2017 Dec 21^d
Opposition Data:	
Equatorial Diameter Globe	18.3 arc-seconds
Polar Diameter Globe	16.3 arc-seconds
Major Axis of Rings	41.5 arc-seconds
Minor Axis of Rings	18.5 arc-seconds
Visual Magnitude (m_v)	0.0
B =	+26.5°
Declination	-22.0°
Constellation	Ophiuchus

More on Saturn: A Special Saturn Cassini Mission Pro-Am Note

Pro-Am cooperation with the ongoing *Cassini* mission continues during the 2016-17 apparition. Saturn observers worldwide are alerted, however, that NASA's unprecedented close-range surveillance of the planet by the *Cassini* spacecraft for nearly thirteen years, which started back on April 1, 2004, will enter the final year of its epic voyage during the 2016-17 apparition. The spacecraft is expected to conclude its remarkable odyssey on September 15, 2017 when it plunges into the Saturn's atmosphere.

But between now and then, *Cassini* will complete a remarkable two-part endeavor. The first phase involves weekly orbital passages of the spacecraft within 7,800 km of the center of Saturn's narrow braided F-ring that started back in November 2016, with mission scientists hoping to capture high-resolution images of small satellites and study other structures within the ring for the first time since an initial close fly-by back in 2004.

The second phase is being dubbed the "Grand Finale" that involves a gravity assist by a close flyby of Titan to reconfigure of the orbital path of *Cassini* allowing it to make over 20 passages through the gap that is only 2,400 km wide between Saturn and the inner edge of the ring system starting April 27, 2017.

The objective of this phase is to analyze fine dust particles in the rings and sample outer regions of the atmosphere of Saturn, while also imaging the planet's atmosphere closer than in the past, mapping the planetary magnetic and gravitational field, gaining greater knowledge of Saturn's internal structure and rotational dynamics, and acquiring a keener understanding perhaps of the mass of the ring system.

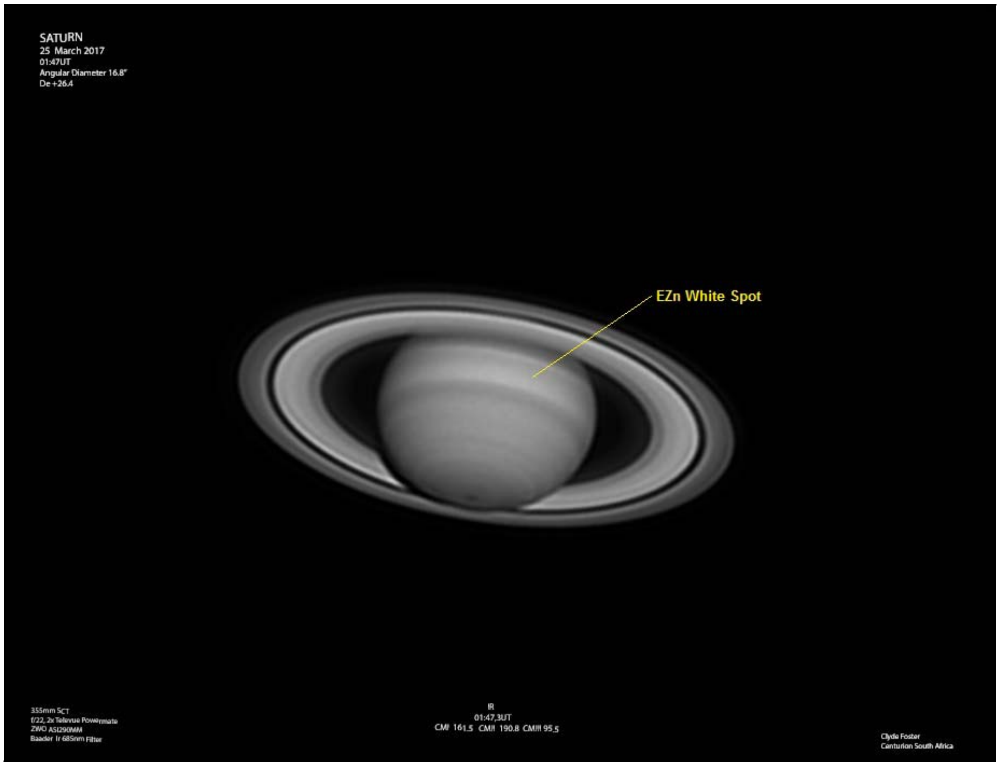
ALPO Saturn observers who have been participating already in our on-going Pro-Am activities, as well as anyone else who wants to join us in our continuing efforts, are highly encouraged to continue to submit systematic observations and digital images of the planet at various wavelengths throughout the 2016-17 apparition. The spacecraft will very likely return some spectacular images of Saturn's northern hemisphere and any discrete phenomena before the two aforementioned plunges into the rings and ultimately into the atmosphere of Saturn in mid-September 2017.

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 (that is, simultaneous observations). Also, while regular imaging of the Saturn is very important, far too many experienced observers neglect making visual numerical relative intensity estimates, which are badly needed for a continuing comparative analysis of belt, zone, and ring component brightness variations over time.

Inside the ALPO

Member, section and activity news



Detailed image of Saturn taken by Clyde Foster of Centurion, South Africa, on March 25, 2017 at 01:47 UT. He was using a 35.6cm (14.0 in.) SCT and a 685nm IR filter. His image depicts a very small and compact EZn white spot closely hugging the N edge of the fuzzy EB as the spot progresses toward the CM as Saturn rotates. Numerous other belts and zones are apparent on the globe, including Cassini's division (A0 or B10) clearly running all the way around the circumference of the rings (except where the globe blocks our view of the rings). Also visible is Encke's "complex" (A5) and other "intensity minima" at the ring ansae. The dark shadow of the globe on the rings is situated toward the East (left) in this image that was taken prior to opposition. Seeing was described as being generally favorable but no numerical rating was given. The apparent diameter of Saturn's globe was 16.7" with a ring tilt of +26.4°. CMI = 161.2°, CMII = 198.5°, CMIII = 95.2°. S is at the top of the image.

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

Both Uranus and Neptune will be visible in the early morning sky during June and July. Pluto will reach opposition on about July 10 and will be located in the constellation Sagittarius.

Both brightness measurements and high resolution images of Uranus and Neptune are needed.

The section has recorded the V-filter brightness of Uranus every year since 1991. I am hoping to see this streak continue into 2017-2018.

Jim Fox and this writer carried out extensive brightness measurements of Uranus and Neptune during 2016. Several others submitted excellent images of Uranus and Neptune during late 2016.

I hope to start working on the 2016-2017 apparition report during the late spring and early summer of 2017.

[Editor's Note: *skyandtelescope.com* is a great source to find specific locations of sky objects.]

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*

Feature Story:

ALPO 2017 With Georgia Regional Astronomers This Fall

By Ken Poshedly, editor & publisher, Journal of the ALPO
ken.poshedly@halpo-astronomy.org

Typical table-top poster.

All ALPO members are hereby invited to submit research posters on the astronomy-related topics of their choice for display at the next ALPO conference to be held jointly with the Georgia Regional Astronomers (GRA) when that group meets on October 27 and 28, 2017.

This change from the usual schedule of holding our conferences in mid-summer was decided after an online discussion and vote by the ALPO board to postpone our meeting so as to feature observing results from the August 21 total solar eclipse.

During the online discussions, ALPO board member Richard Schmude, professor of astronomy & chemistry at Gordon College in Barnesville, Georgia, and board member Julius Benton each suggested approaching the GRA about the possibility of our participation at their October meeting.

After several contacts with Dr. Loris Magnani, professor of astronomy at the University of Georgia (Athens, Georgia), all agreed on the joint meeting.

The event is free, open to all individuals with an interest in astronomy and there is no registration fee.

Participants are encouraged to submit research posters concerning various aspects of Earth-based observational astronomy. Suggested topics include the following:

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

The ALPO portion of the conference will commence with the ALPO board meeting at the UGA Physics Building at 2 p.m., Friday afternoon, October 27.

That evening, an informal social gathering will also be held at the Physics Building where there will be observing through the UGA's 24-inch telescope (weather permitting)

Papers — including four by ALPO members — and table-top presentations will be presented at the Physics Building from 9 a.m. to 5 p.m. the following day, Saturday, October 28, between 9 a.m. and 5 p.m.

Following the close of the paper presentations will be the ALPO awards dinner at the nearby UGA Conference Center & Hotel that evening, featuring Dr. Magnani as the keynote speaker. While there is no registration fee for the meeting, pre-registration and advance payment for the awards dinner will be required so proper arrangements can be made.

Finally, a block of rooms at the UGA Center for reduced rates is being secured for those who prefer to lodge there overnight Friday and/or Saturday.

For information about the GRA meeting, e-mail Dr. Magnani at loris@physast.uga.edu

For information about the ALPO awards dinner and lodging arrangements, e-mail ken.poshedly@alpo-astronomy.org

Feature Story:
The Strolling Astronomer, Journal of the ALPO, Volume 1, No. 1

By Ken Poshedly, editor & publisher,
Journal of the ALPO
ken.poshedly@halpo-astronomy.org

With many thanks to long-longtime members John Westfall and Robert Garfinkle for their assistance in providing the required file to accomplish this, we hereby present in it entirety the very first issue of our own newsletter, dated March 1, 1947.

Oh, how much simpler life was back then . . .

COMPLIMENTARY COPY

Volume I, Number 1 — March 1, 1947

THE STROLLING ASTRONOMER

(Association of Lunar and Planetary Observers)

MAILING ADDRESS:

THE STROLLING ASTRONOMER
Institute of Meteoritics
University of New Mexico
Albuquerque, N. M.

D E D I C A T I O N

Astronomy is one of the sublimest fields of human investigation. The mind that grasps its facts and principles receives something of the enlargement and grandeur belonging to the science itself. -- It is a quickener of devotion. --

H. MANN.

AN APPEAL

There exist amateur astronomers; there exist the telescopes they have built; there exist the moon and the planets. This leaflet is an attempt to persuade the party of the first part to use the party of the second part to increase knowledge of the party of the third part.

We hope to show herein some ways in which John Q. Amateur can profitably study our sister-worlds (perhaps literally neighbor-worlds in an impending age of space travel) and to give him some instructions on how to do so. It is our hope also to call his attention to current happenings of special interest. We urge John Q. Amateur to submit to us the lunar and planetary observations which he makes and shall undertake to study them and to report our findings through published papers in astronomical magazines. And if he wishes to write an article for this leaflet about "The Voracious Mosquito Compared to the Companionable Skunk as a Telescopic Accessory" or even some other subject - we shall be glad to receive his manuscript. We think that we can introduce John Q. to some interesting people and can show him a pleasant and fascinating hobby.

And now, friends, our fate is in your hands. Whether this embryonic leaflet is to be permitted to develop into a lusty infant depends entirely on your response. We propose to send you six future monthly mailings for one dollar. If our plan appears worthy of your support to that degree, we thank you as friends of lunar and planetary science. How about it?

Walter H. Haas

A DARK SOUTH TROPICAL STREAK ON JUPITER

It is risky to tell our readers what to look for on Jupiter; for the changes on this fascinating planet are so unpredictable that one is usually talking of what was, not of what is.

We shall venture, though, to direct attention to a very dark streak just north of the south temperate belt, the second most conspicuous Jovian belt which lies about midway between the center of the disc and the south limb. The center of the streak is now (February 23) near λ_2 340°. The streak should be well-placed for study near these A.M., C.S.T. times: March 6 at 3:00, March 8 at 5:00, March 13 at 4:00, March 18 at 3:00, March 20 at 4:30, March 25 at 4:00, and March 27 at 5:30.

Suitable intermediate times may be approximated by using the rotation-period of 9 hours, 50 minutes.

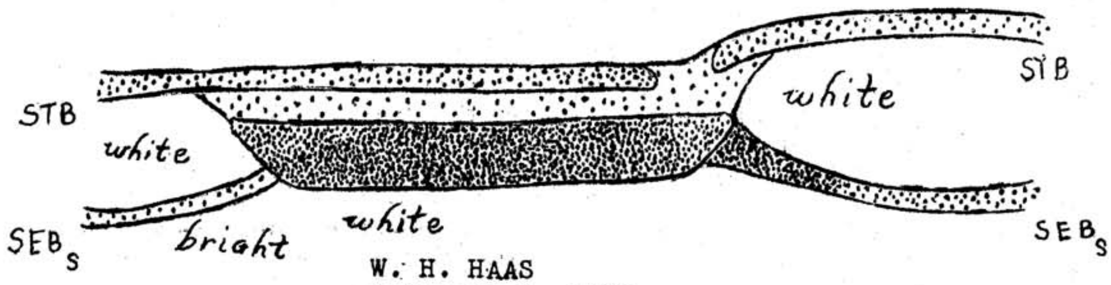
This streak in the planet's south tropical zone bears a striking resemblance to an object seen there in 1941 and 1942. It is probably identical with another object of the same general aspect observed during much of 1946. Jovian phenomena, in fact, show a curious tendency to repeat themselves.

The south component of the south equatorial belt is deflected into the streak at its preceding (left in inverting telescope) end and then bends northward to its usual latitude from the streak's following end. The streak of 1941 and 1942 had an analogous effect on this belt. Again, this same belt for a number of years now has usually been notably dark following (right of, in telescope) the Red Spot. What do these things tell us about the physical nature of the surface of Jupiter?

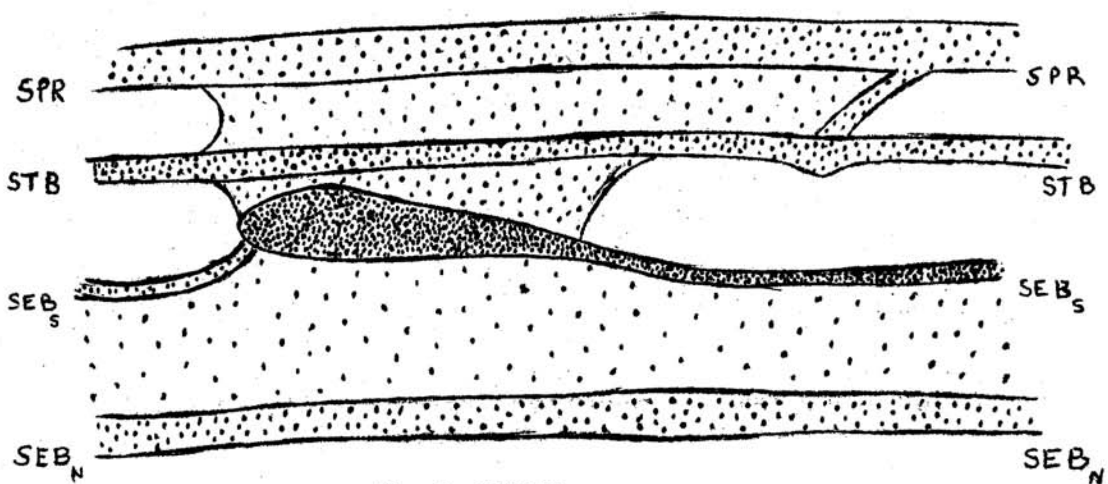
Observers are urged to sketch the streak and its vicinity, to note its color, and to time (to the nearest minute) the passage of its preceding and following ends, or other readily recognized points in it, across the central meridian of Jupiter.

3

SOUTH TROPICAL STREAK ON JUPITER



W. H. HAAS
February 7, 1947
4:50 - 5:05 A.M., M.S.T.
6-inch reflector
141X
Seeing poor
Sky slightly hazy to clear



E. J. REESE
February 12, 1947
5:40 - 6:50 A.M., E.S.T.
6-inch reflector
240X
Seeing poor
Sky slightly hazy

CELESTIAL HASH

We request observations of a possible dark band across the ball of Saturn adjacent to the north edge of the ring-ellipse and parallel to that edge. Is the feature an illusion? Or a Saturnian belt in high northern latitudes? Or perhaps the projection of a sometimes-reported dusky ring outside of Ring A? The band, if there, is not the shadow of the rings.

Try your luck with the spots, streaks, and shadings in the lunar crater Plato; and send us your drawings. We warn you: This detail is delicate; but good work has been done with only 6-inch apertures.

Twinkle, twinkle, little star,
Ever twinkling, there afar.
Awful seeing all the night!
Darn your scintillating light!

R. Barker, "Brendon", Crossbrook Street, Cheshunt, Herts., England, has sent a drawing of a difficult cleft connecting the lunar crater Manners to the famous Ariadaeus cleft. He desires a confirmation.

We suggest to amateurs having telescopes of the usual focal lengths of, say, 50 to 70 inches, that it is worthwhile to obtain an eyepiece of equivalent focal length 1/3". Such an eyepiece will often be more useful than either 1/2" or 1/4" eyepieces. O. E. Monning, 1010 Morningside Drive, Fort Worth, Texas, has supplied us with an eyepiece of e.f.l. 1/3", which has been very helpful in recent lunar and planetary observations.

ACKNOWLEDGMENTS

ELMER J. REESE, 241 South Mount Vernon Avenue, Uniontown, Pennsylvania, for excellent observations of Venus, Jupiter, Saturn, Plato, and Aristarchus, which he has submitted to us. Mr. Reese's telescope is a 6-inch reflector and demonstrates what energetic users can do with good small instruments.

H. PERCY WILKINS, 127 Eversley Avenue, Barnehurst, Kent, England, for what is unquestionably the best map of the Moon yet published. Any serious lunar student must get a copy. Mr. Wilkins is Acting Lunar Director of the British Astronomical Association and will welcome American contributions to lunar studies.

A. F. O'D ALEXANDER, the Saturn Director of the British Astronomical Association, 1 Athelstan Road, Dorchester, Dorset, England, for working out a laudable and extensive program of Saturn observations outlined in several Section Circulars. Dr. Alexander, too, will welcome American observers.

DAVID P. BARCROFT, Madera, California, for the loan of a book on Saturn. Mr. Barcroft's personal lunar and planetary library is perhaps the best private one in the country. He is very generous with his splendid collection.

E. K. WHITE, Chapman Camp, B.C., Canada; F. R. VAUGHN, 1368 East 53rd Street, Chicago, Illinois; H. M. JOHNSON, 1118 West 26th Street, Des Moines, Iowa; C. F. GRAMM, 398 Beresford Road, Rochester, New York; A. W. MOUNT, 4326 Birchman Street, Fort Worth, Texas; and E. J. REESE, all of whom have submitted to us observations of Saturn for the years 1943-6.

There are many others who merit mention for excellent contributions. These will receive space in future publications.

- -

Editor: WALTER H. HAAS, Instructor of Mathematics, University of New Mexico.
Astronomer, Institute of Meteoritics, University of New Mexico, Albuquerque, New Mexico.

Counsellor: Dr. L. LA PAZ, Head of Mathematics Dept., University of New Mexico.
Director, Institute of Meteoritics, University of New Mexico, Albuquerque, New Mexico.

ATTENTION

This publication is for the purpose of coordinating the activities of amateur astronomers. It is a non-profit project; however, to cover the cost of publication and mailing of future issues, the minimum cost of one dollar for six copies is requested.

If you would like to join in the activities of the Association of Lunar and Planetary Observers, please fill in the coupon below, clip, and mail.

- -

Please send six (6) monthly issues of THE STROLLING ASTRONOMER to:______________________________

Name

____

Address

____

City State

I herewith enclose $1.00 to cover the cost of publication and mailing.

Feature Story:

Index to Volume 55 (2013) of The Strolling Astronomer

By Michael Mattei
E-mail: micmattei@hughes.net

PUBLICATION DATA

AUTHOR INDEX

SUBJECT INDEX

Feature Story:

30 Years of Perseids Meteor Observing

By Vincent Giovannone
E-mail: mr3gsr@hotmail.com

Abstract

First recorded in 36 A.D. by the Chinese, then indentified as emanating from the constellation Perseus

in 1835, and finally in 1866, after the perihelion passage of Swift-Tuttle in 1862, was it discovered that

this shower was related to a comet. Its status as a very popular meteor shower to both experienced and novice observers is probably due to the time of year when it occurs, that is, towards the end of summer. The objective of this study is to examine my own 30 years of observing this meteor shower from the Latham, NY, area starting with

non-recorded observations in 1984, then by 1986 taking the next step in recording observations for eventual

submittal to the International Meteor Organization (IMO) and the ALPO in 1991, the techniques learned and the guides used to improve meteor observational techniques.

Starting Observations

In the beginning, observations were just casual — laying on the grass/blanket looking up at the heavens watching meteors whiz by, high above. Being a high school student, recording my observations was not something of importance, so for a few years I just casually observed the Perseids and no other showers. As my study of astronomy began to take off, in reading various books and magazines about the subject did I really start to see the science in meteor observing, obtaining literature from such groups as the IMO, the American Meteor Society (AMS) and later the Association of Lunar & Planetary Observers (ALPO). These groups opened my eyes as to the scientific research done by amateurs in the field of meteor observing/astronomy and the value of such. It's important to note that I would join these groups not only to further astronomical research, but to learn as much as possible about the science of astronomy and how to observe and collect data.

Improvements in Observing

My first observations of the Perseids started in 1984 and as noted above, were just casual. By 1986, and thanks to "Astronomy" magazine's "Plot the Perseids" article, did I begin to plot these meteors. Plotting had its fun, but after joining the IMO and also the American Meteor Society (AMS) and reading their various guides on meteor observing did I learn to record the following:

- Limiting magnitude
- Meteor magnitude
- Estimation of meteor flight
- Time of meteor entry
- Degree of arc
- Any meteor color changes while in flight across the sky and noting any spitting/breaking apart and after glow

So, Why the Perseids?

First, it is the most viewed of all the meteor showers, dating back to 36 A.D. by the Chinese.

Second, ease of viewing, being late summer as the shower runs from approximately July 13 to August 26. It's not too hot or cold, which makes for some comfortable viewing.

Lastly, you can always count on seeing some kind of activity, including some bright meteors, whether it is associated with the Perseids or not. Over the many years of watching this shower, it's never (for me at least) discouraging to watch as long as the weather is good and the sky is clear.

The comet of origin is 109P/Swift-Tuttle and the radiant is near the constellation

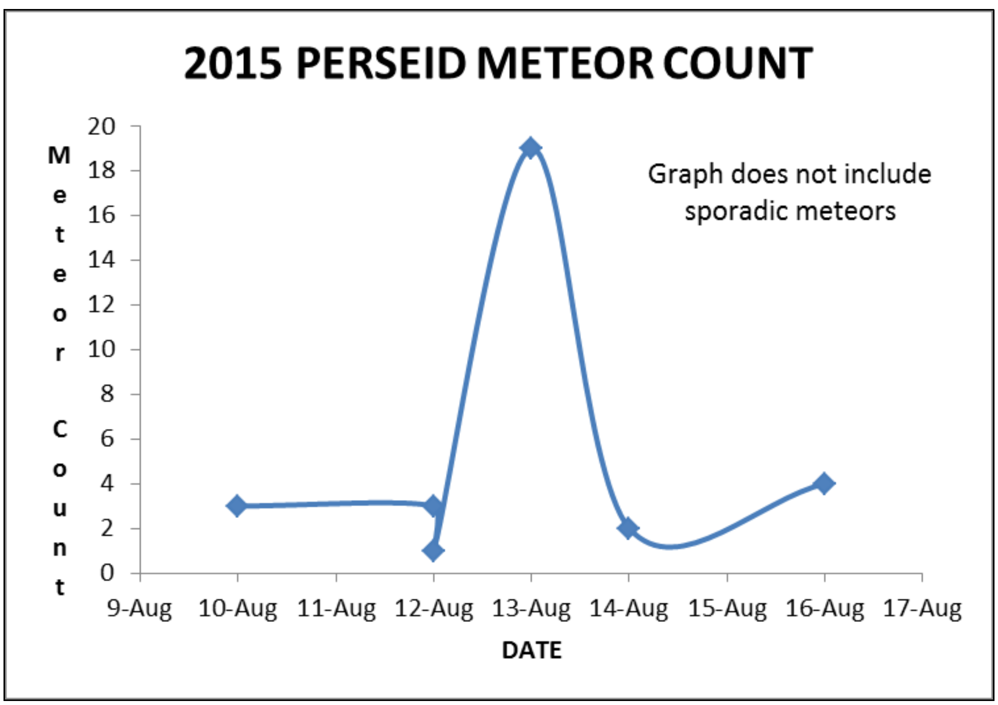


Chart 1. Meteor counts over a 5-night observational period. Notice spike on August 13, 2015, when a total of 19 Perseids were observed that morning over a 70-minute observational time frame (12:50 - 2 a.m.).

Perseus (hence the name the "Perseids" meteor shower). At this time of year, Perseus is located high in the sky during the morning hours and is easily viewed.

Difficulty in Observing

There have been many different theories on this, but the frequency of "Light Pollution" has risen since starting to record the Perseids in the mid 1980's, the city of Latham, NY, being in between some major cities; Albany (south), Troy (east) and Schenectady (west). During the summer months is when I've noticed it to be worst and Latham itself has added its share of lighting a new strip mall to the west, and some new school track lights south of my observing location have added to the complications. My neighbors don't help either, however, they do normally turn their outside lights off late into the night.

The sky glow could just as well be from particle/humidity high above; some summer nights produce a high cirrus cloud level that can cause a limiting magnitude of 6.0 by naked-eye to drop to 4.0, and on some nights even less. Particles in the air high up reflecting light dimly back down or a light water vapor haze is anyone's guess, but it is clearer here in winter months (minus clouds) when compared to summer months.

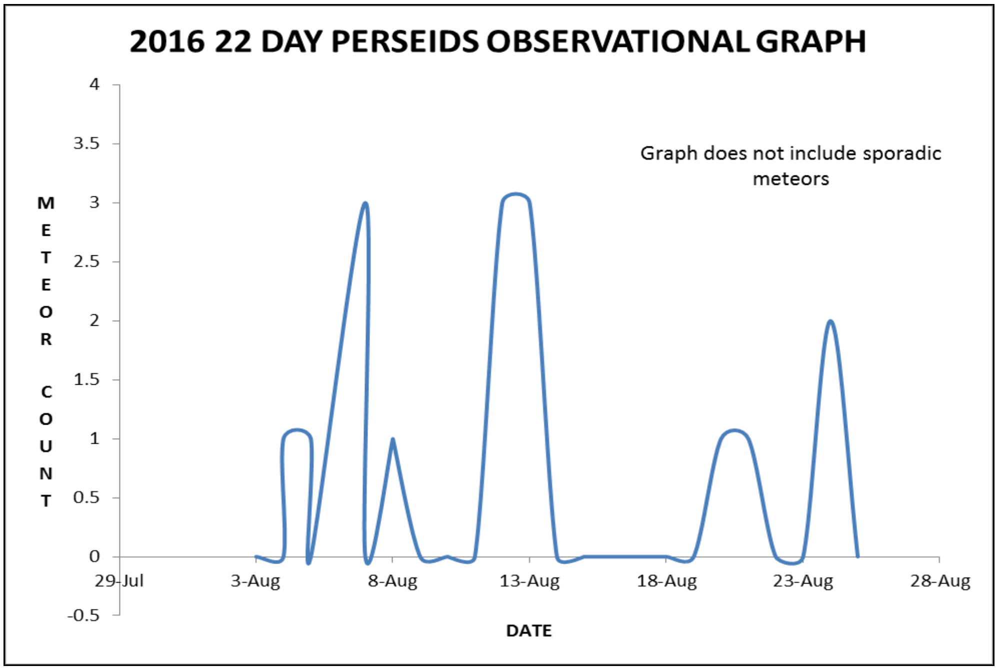


Chart 2. Meteor counts over a 22-night observing period in 2016 (Aug. 3 - 26), including the peak night, from outside the Washington, DC, area. A total of 17 Perseids were observed over the 22 nights (and a total of 10 hours observing time). All observations were after the midnight.

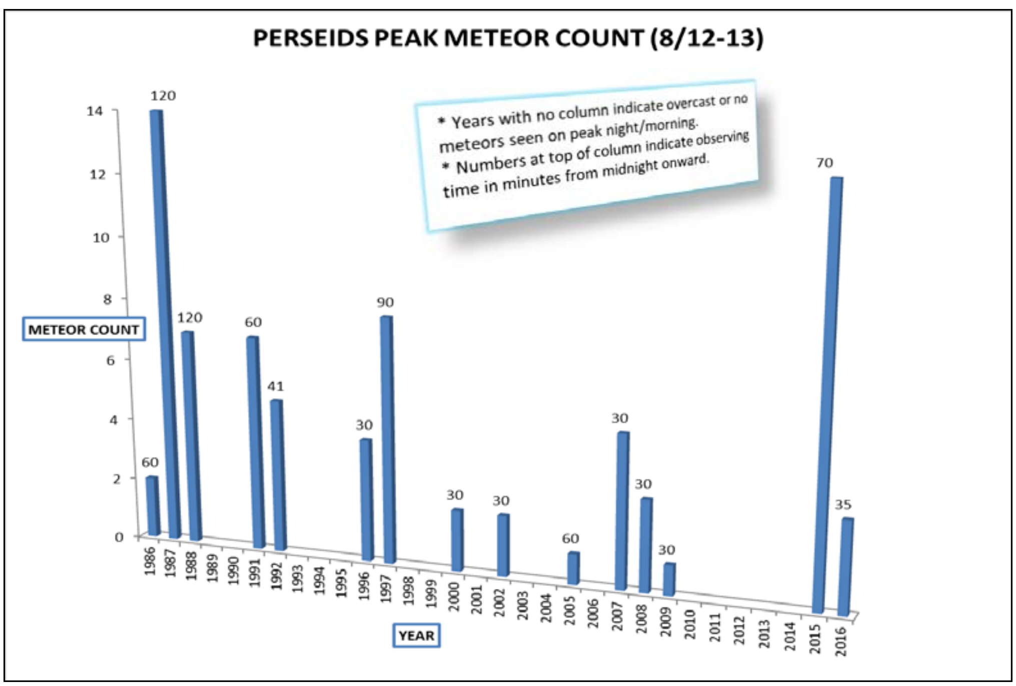


Chart 3. Bar chart tracking the 30 years of Perseids meteor shower observing from the Latham, NY, area on peak nights/mornings. 2016 observing was from the Washington, DC, area.

In Closing

In the 30 years of observing the Perseids meteor showers, two years that really stick out for me are 1987 and 2015. In 1987, I saw 14 Perseids in a two-hour (midnight – 2 a.m.) observing period, with at least four of them being very bright; my observing notes show no plot chart, meteor magnitudes, times of meteor entry, etc., but just a timeframe with a count number and viewing was just that one night. In 2015, we saw a total of 19 Perseids, in which 13 were plotted over a 70-minute (12:50 – 2 a.m.) observing period.

The observations are very different. First, I started to view some nights before peak and my notes include plot charts, meteor entry times, duration, magnitudes, color, arc length and velocity estimates. This was all very different from my observations of 1987.

This article was written after my lecture at the ALCON 2016 in Washington, D.C. Many thanks to my fellow amateur and professional astronomers who attended on the day I had a great joy in speaking at that event.

My hope is that in reading this article, as with my lecture others will follow in observing a meteor shower. Any major meteor shower will do, not just the Perseids. When I started to observe the Perseids, little did I think I would be observing over 30 years or any others for that matter. The joy is what will fly overhead in that "free lab" in the sky. Many clear skies.

VISUAL METEOR OBSERVING FORM

DATE: ____ (year) ____ (month)____ (day) Begin ____ h____ m End _____ h_____ m (____)

LOCATION: Long.=_______________ W. Lat.=________________N. Elevation =__________m

OBSERVER:___________________________PLACE:_____________________________________

LIMITING MAGNITUDE: _____@____:____ _____@____:____ _____@____:____ ______@_____:____

_______@____:____ _______@____:____ _______@____:____ _______@___:___ ______@____:___

PERCENT CLOUDY: ____% @ ____:____ ____% @ ____:___ ____% @ ____:___ ____% @ ____:____

DIRECTION FACING & ALTITUDE : _______@____:____ _______@____:___ _______@____:____

BREAKS:____

COMMENTS:____

TIME (UT)	MAG	TYPE	DURATION	LENGTH	VELOCITY	DCV	R. DIST.	ALTITUDE	PLOT	REMARKS

Feature Story: ALPO Eclipse Section

Part 4: The 21 August 2017 Total Solar Eclipse – The Great American Eclipse

By Michael D. Reynolds,
Coordinator, ALPO Eclipse Section
Executive Director, the ALPO
m.d.reynolds@fscj.edu

Introduction

In this last in a series of four articles on the 2017 total solar eclipse dealing with site selection, weather prospects, observing the eclipse, and specific observing projects, I will provide the reader with an overview of eclipse imaging.

On 21 August 2017 the United States will experience its first total solar eclipse since February 26, 1979. All of the continental United States will experience at least a significant partial solar eclipse; the eclipse is being referred to as The Great American Eclipse.

For those fortunate enough to either live along the narrow track of totality or are able to travel to the path of totality, up to 2 minutes and 40 seconds under the shadow awaits observers. The partial phase of an eclipse never compares to totality; one should plan **now** to get to somewhere within the path of totality!

Eclipse imaging has been a main objective of both amateur and professional astronomers since the photographic medium became available.

The first suitable solar eclipse photograph was taken at the July 28, 1851 total solar eclipse by Julius Berkowski [Figure 1). A 6 cm refractor was used by Berkowski, who was located in his home city of Königsberg, Russia, at the Royal Prussian Observatory [Ref. 1]. His exposure of 84 seconds, which was started right after second contact (the instant when the total phase of an eclipse begins) was far longer than anything required with contemporary digital or even film medium.

Advances in film emulsion led to increasingly better — and significantly shorter — images of totality, as quality and sensitivities of photographic emulsion dramatically improved.

Charles Burckhalter, director of the Chabot Observatory in Oakland, California, ventured with a group of San Francisco Bay Area-based astronomers to Cloverdale, California, on January 1, 1889, to observe and image that eclipse [Figure 2].

At this location, totality lasted approximately two minutes. This eclipse and gathering was also the auspicious start of the Astronomical Society of the Pacific [Ref. 2].

Continued advances in both equipment and recording medium, as well as processing techniques and the switch from analog (film) to digital, has made eclipse imaging that much easier — and in some ways more challenging for today's eclipse photographer.

Equipment: Camera

Most experienced eclipse imagers will first recommend a DSLR, digital single lens reflex camera or a mirrorless ILC, interchangeable lens camera. DSLR's are available with various features and price points, if one does not already own a DSLR. One advantage of the DSLR is one can easily change lenses, from wide-angle to telephoto or direct to a telescope. DSLRs do not all have the same features; some have basic functions, whereas mid- and top-of-the-line DSLRs will support a variety of functions, such as lock-up mirror and

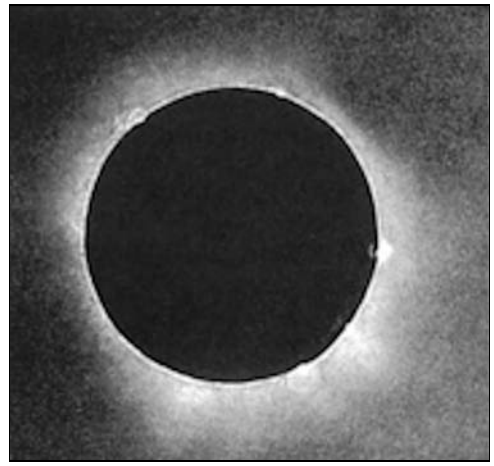


Figure 1. Julius Berkowski's 1851 84 second image of totality. *Image credit: Acta Historica Astronomiae*

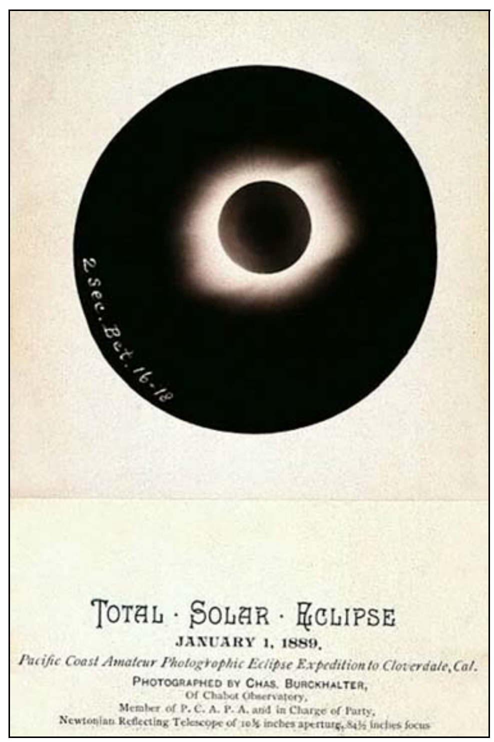


Figure 2. Charles Burckhalter's 1889 2 second image of totality. *Image credit: Chabot Space & Science Center, Eastbay Astronomical Society*

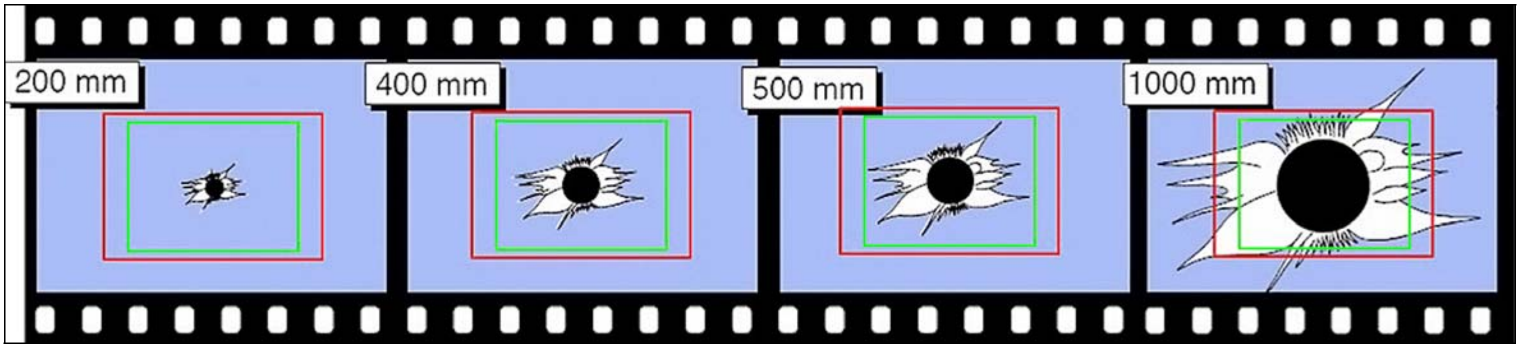


Figure 3. Image size vs. sensor type. Blue Rectangle: Full Frame DSLRs. Red Rectangle: Crop Sensor Canon and Nikon DSLRs. Green Rectangle: 4/3 Sensor Olympus and Kodak DSLRs. *Image credit: American Astronomical Society; adapted from an illustration by Fred Espenak [Ref. 3]*

exposure bracketing. Some of the latest models may also be controlled via the computer and specialized software, as well as direct image download to the computer.

Note that CCDs are not recommended here, especially for those who are imaging an eclipse for the first time. The field of view is limited. And the duration of totality does not allow for one to make adjustments, as with solar system or deep sky imaging.

An important consideration in purchasing a DSLR, or the DSLR you presently own, is the type of digital imaging sensor the camera employs. The sensor detects and sends the image that falls onto the sensor to be processed. The two types of sensors currently found include the full frame and the crop sensor. The full frame sensor is the size of a 35mm film frame; the term "full frame" is somewhat arbitrary. Also called APS-C DSLRs, the crop sensor is a smaller sized sensor. This relates to more noise and poorer low-light performance. Most crop sensor DSLR's do not have all of the available full frame DSLR features. And most importantly for the discussion of eclipse imaging: crop sensor cameras result in magnifying the image. Canon crop sensor cameras magnify by a factor of 1.6 and Nikon by 1.5 [Figure 3].

What To Image – and Equipment Needed

The DSLR's ability to accept a range of lenses and even directly attach to a telescope is an important feature of these cameras. The first decision one will need to make is what one would like to image. If you have multiple cameras, it is possible to image a variety of aspects of the eclipse, both the partial and total.

Table 1: Effective Lens Focal Lengths for Canon and Nikon APS-C Cameras

Lens f/l; Full Frame DSLRs	Canon APS-C 1.6x	Nikon APS-C 1.5x
16 mm	25.6 mm	24 mm
50 mm	80 mm	75 mm
135 mm	216 mm	202.5 mm
200 mm	320 mm	300 mm
400 mm	640 mm	600 mm
500 mm	800 mm	750 mm
1000 mm	1600 mm	1500 mm

The Partial Eclipse

One can image a projection of the partial eclipse, use a telephoto lens or a telescope with a proper solar filter to directly image the Sun, or even use a narrow-band filter (for example, hydrogen-alpha) to take unusual views of the partial phase, both prior to and after totality.

Right Before and After Totality

The Moon's oncoming shadow, colorful sunset-sunrise effect around the horizon, and possibly even shadow bands make

Figure 4. Projected view of the partial phase of the May 20, 2012 annular solar eclipse. *Image credit: Dr. Michael Reynolds.*

Table 2: Imaging Equipment Checklist

Item	Notes
Telescope or Telephoto lens	*Make certain your primary optic choice provides you with an eclipse image which allows you to see details, unless you are planning on high-magnification photography. However if you are not planning on high-magnification, too long a focal length could cut off the outer corona, if imaging the outer corona is one of your goals.*
DSLR Camera	*Full Frame or APS-C Crop Sensor; this also determines the photographic field of view.*
Camera to Telescope Mount	*T-ring for your specific DSLR and a T-adapter. Some companies make a single piece. Make certain you order the correct T-ring for your camera. (Not required if using a camera lens.)*
Mount: Tripod or Equatorial	*A tripod is recommended at a minimum. A mount which tracks should take one additional task away from your imaging procedures.*
Camera Remote	*Many prefer to use a remote, which takes the hand and finger off of the camera, reducing vibration. Some remotes can also be programmed to expose at specific intervals.*
Camera Batteries	*Assure a fully-charged battery; a charged back-up battery is a plus.*
Camera Medium	*Assure the medium is stable, with plenty of space and a fast upload speed.*
Solar Filter	*A white light solar filter for the front of your telescope or telephoto if you wish to image the partial phases*

for interesting photos. These also do not require any type of special lens, and most DSLRs can be automated to take a series of images.

Diamond Ring and Baily's Beads

Leading up to totality is a fairly-quick sequence that involves the last remnants of the Sun's photosphere — and the first light after totality. As the Moon covers the Sun, photosphere sunlight will leak through lunar valleys, producing a brilliant Diamond Ring and Baily's Beads. One must use some caution here while imaging; you are looking at unfiltered sunlight. Diamond Ring and Baily's Beads photos can be spectacular.

Totality!

There are a couple of options for imaging totality. One can photograph the eclipsed Sun as well as the foreground, such as the horizon, people, and/or landscape, by using a short focal length lens. One can also use a telephoto lens or attach the DSLR camera to a telescope to capture details, such as prominences, inner and outer corona, and coronal details.

Images taken through a telephoto lens or telescope will show detail, depending on the telephoto/telescope diameter and focal length. As one images at varying exposure lengths, different features of the totally-eclipsed Sun are readily captured [Figure 9].

There are other, more-advanced types of imaging one might try, such as the flash spectrum or the chromosphere. This usually takes a lot of experience, or just plain luck.

Camera Settings

There are several DSLR camera settings to consider. These include ISO, image quality, exposure length, and focus.

First: Focus, Focus, FOCUS! This is one of the most-essential of all of the camera-lens/telescope settings. I cannot overemphasize this; poor or soft focus cannot be eliminated through post-imaging processing.

If one is using a telephoto lens, do not use the lens' autofocus setting. Since the Sun is at infinity, for all practical purposes, the lens will search for the proper focus and will take few, if any, images. You need to accurately focus in advance. Many will use a piece of tape to temporarily hold the focus ring in place; an accidental twist right before totality could ruin one's images. Check the focus

Figure 5. October 23, 2014 partial solar eclipse; Solar View 50mm f/8 refractor with integrated Hydrogen-alpha filter with <0.7 nm bandpass, Celestron NexImage 5 camera; 177 stacked frames. *Image credit: Dr. Ron Brecher.*

as the day warms, and then cools due to the moon's shadow [Ref. 4].

One will also need to set the recorded image size. It is best to image at the camera's highest quality, usually RAW or at least large JPEG files. The higher quality will take more memory space, but will result in higher-quality images when enlarged. Make certain well in advance the memory card will hold all of the planned images.

ISO is a measure of the sensitivity of the DSLR's digital imaging sensor. The higher the number, the more-sensitive the imaging sensor, thus less light is needed to capture an image. One might think "the higher the sensitivity, the better." Yet as the ISO is increased, so is the noise also captured in the image. With film this is referred to as grain; high ISO film results were said to be grainy.

There are instances one might use a higher ISO, but total eclipse imaging is not one of those instances. I recommend 400 ISO maximum; I will set my DSLR's ISO to 100. Above 400 ISO begins to introduce noise in most cameras. One might need to image at a higher ISO if using poor mount or hand-holding the camera. A number of the newer DSLR cameras also employ a noise reduction feature; a valuable setting.

Other Considerations

First, there are other things and accessories to consider. For example I find a remote or remote timer useful. These attach to the DSLR or are connected through Blue Tooth. A remote allows for the taking of photographs without touching the camera – and introducing vibrations in the system.

Computer-control software, specifically designed for solar eclipses, is utilized by some during the eclipse. Such software allows one to input equipment details, such as telescope and DSLR. The software will control imaging during totality, taking the speculation out of exposure length or manual operation of the camera.

Additional camera batteries and memory media are both essential, as previously noted. As totality begins, one does not want to be staring at a dead camera or no capability to take a photo due to a full memory card. Nor does one want to be trying to put in a charged battery at second contact, or replacing a full memory card. Change out the battery and memory well-before second contact, if required. One might also want to consider using a battery pack or external power source, as well as a direct download to a computer or other memory device.

I always keep a red flashlight handy during the eclipse. As second contact approaches, it will get dark enough one will need some additional light. I might want to check something, say a cable connection, and the red flashlight gives me that opportunity. Consider how you observe at night.

Some like to use a digital tape recorder to record comments, observations, photo notes, or capture the excitement around totality. Others use it to record a checklist of what to do when, and then play it back during totality, such as look for Venus or check the camera's available memory.

Figure 6. Part of a 200 image series showing the Sun, sky, ocean, and cruise ship leading up to the November 13, 2012 total solar eclipse. Canon 6D and a Canon 16m-35mm zoom; 1/800 second at ISO 100. The camera was tilted to get the entire combination in the frame of view, due to the ship's orientation. *Image credit: Dr. Michael Reynolds.*

No matter where I go for an eclipse, I carry a small tool bag. I include items such as a slotted and Phillips screwdrivers, jeweler's screwdriver set, hex set, pliers, and a small adjustable wrench. I also carry a roll of duct tape. I usually never need any of these tools or supplies, but someone else always needs something.

I also bring something to cover my equipment, just in case of inclement weather. One can go as fancy as a tarp; a heavy duty garbage bag will work just as well. Be certain you can attach the cover so it doesn't blow away; bungee cords work well. Hopefully, we will not hear of any use for these items on August 21.

Other Imaging Options

- It seems that smartphones and tablets are everywhere. Some of these devices feature decent lenses. If one does not attempt to push the capabilities of these devices too far, some reasonable photos of the totally-eclipsed Sun, colors around the horizon, and people can indeed be captured. Electronic zooms usually produces poor results. Be certain to turn off the device's strobe. People will say that it bothers them during totality; usually the strobe flashes into their backs, not their faces. The smartphone would make for an easy-to-use video and audio device, too.

- Smartphone external auxiliary lenses can add telephoto or wide angle features, often with only fair results. Also available are mounts that allow attachment of a smartphone to the telescope's eyepiece. I have seen good success in using this method for imaging the moon.

- Point-and-shoot cameras gives one the flexibility of a reasonably-good optical system and more imaging options. The ISO and other camera features can easily be adjusted. By adjusting the point-and-shoot camera's sensitivity, aperture (f-stop), and exposure length, one can take a variety of exposures showing the Sun's inner and outer corona. The point-and-shoot camera employs a viewfinder, separate from the camera's imaging system. This camera type does not feature interchangeable lenses.

- Video camcorders offer another option for capturing the eclipse. From time-lapse during the partial phase, changes in the environment, people, and even totality, many will shoot video, allowing one to capture audio that occurs around totality. The audio is often a keepsake unto its own.

- Some note a film medium camera gives over digital imaging, especially with large format film cameras. The main drawback to the film camera is the limited number of images one can take. I would not want to discourage anyone with a film photographic resolved to pursue this type of eclipse imaging.

Figure 7. Second (left) and third contacts at the July 11, 2010 total solar eclipse on Easter Island. Explore Scientific 80mm APO and a Canon 5D Mark II DSLR; 2nd Contact: 1/2,000 second and 3rd Contact 1/800 second at ISO 100. *Image credit: Dr. Michael Reynolds*.

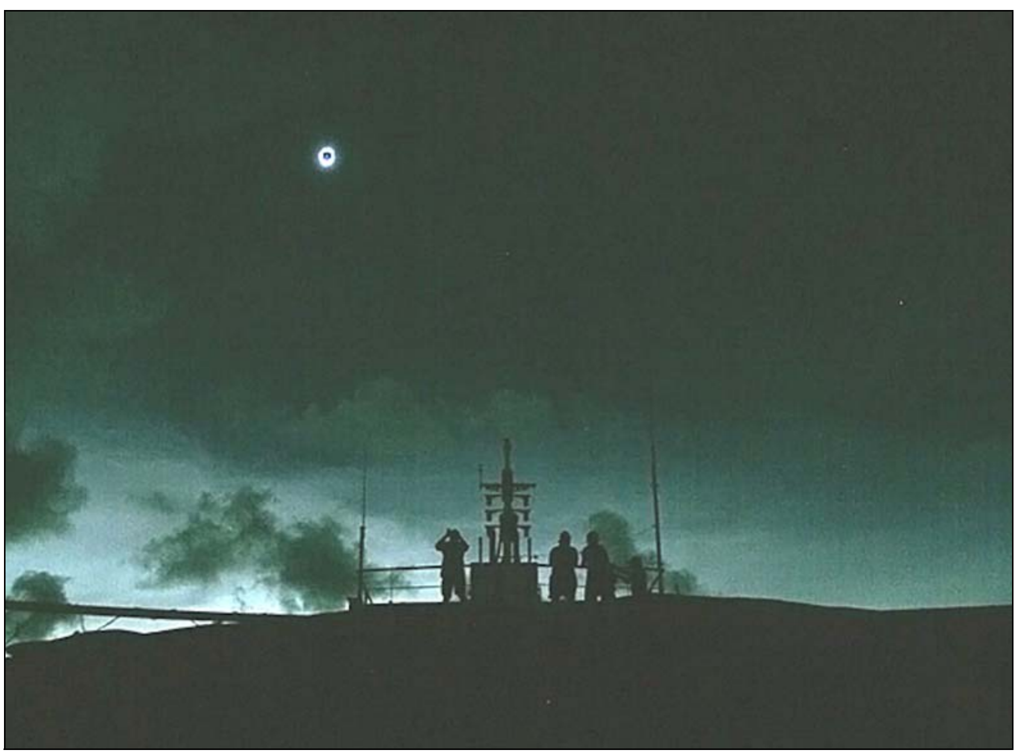


Figure 8. Totality at the July 22, 2009 total solar eclipse off of Kiribati. Canon 6D Mark DSLR and a 24-105 Zoom set at about 30mm; 1/100 second at ISO 100. *Image credit: Dr. Michael Reynolds*.

After the Eclipse

For some, this is where the work begins. From adjusting contrast to stacking images, post- processing takes a good image and makes it great. This is especially true for total solar eclipse photographs. As you look at images with different exposures, one will realize that none of the images truly capture what the eye sees. To produce such an image requires stacking of varying exposure lengths. This is also referred to as HDR, high dynamic range, and is a technique some of us have been using for a number of years. HDR has now become a mainstay in lunar photography as well as all types of photography.

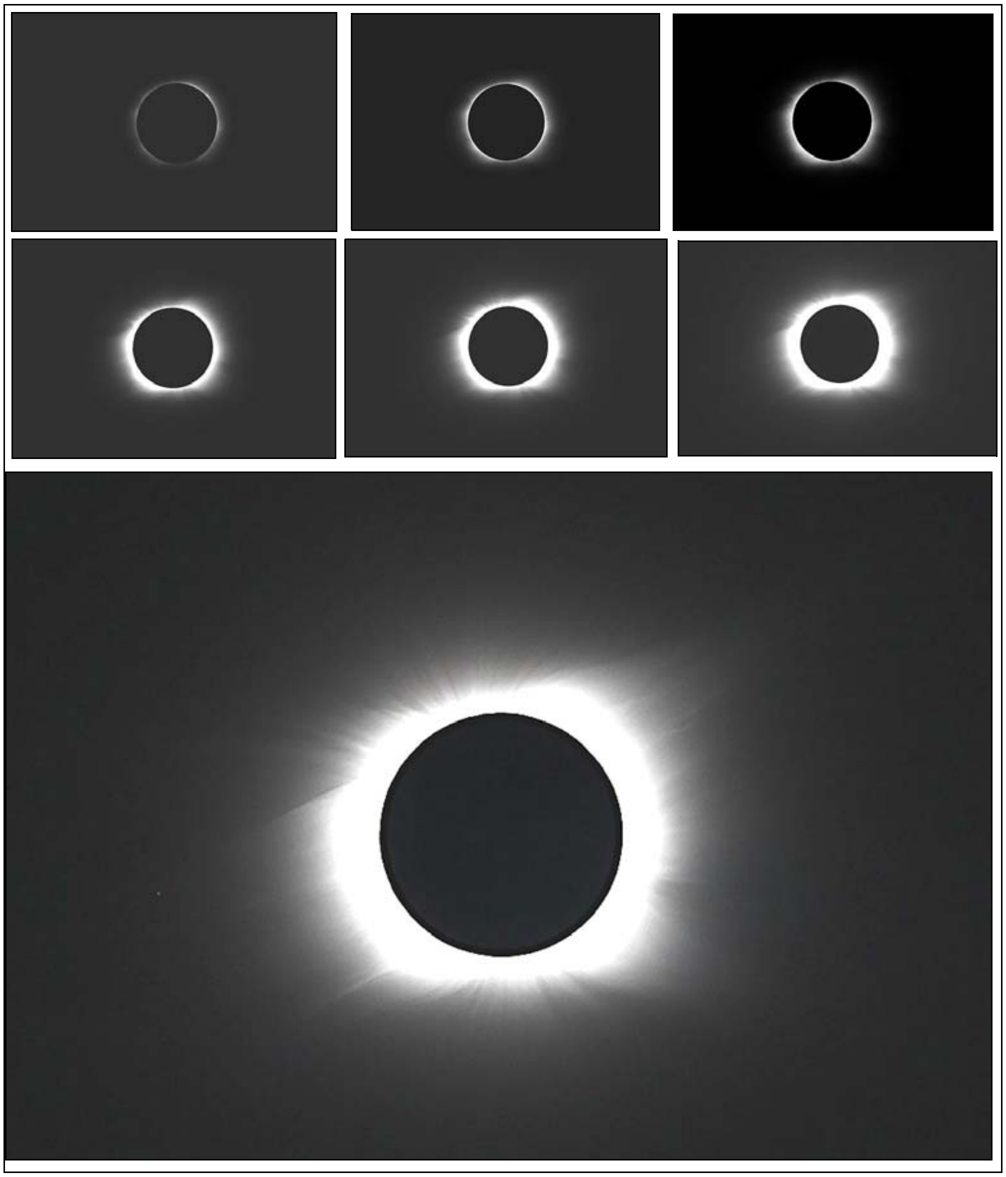


Figure 9. A series of totality images taken at the July 11, 2010 total solar eclipse, Easter Island. Explore Scientific 80mm APO with a Canon 5D Mark II DSLR at ISO 100.

Exposures, starting at the upper left Row 1: 1/8,000 second, 1/1,600 second, 1/800 second. Row 2: 1/500 second, 1/250 second, 1/125 second

Bottom image is 1/80 second. Note how one can see prominence details and inner corona in shorter exposures, outer corona detail in longer exposures. *Image credit: Dr. Michael Reynolds*.

Finally: Practice Makes Perfect!

Those who have successfully imaged eclipses already know how important checking out all of one's equipment and planned techniques are prior to eclipse day. I check my entire set-up and procedures several times. I like to practice on the Moon, specifically on the Full Moon. It is somewhat dark outside and will help one appreciate those nighttime imaging challenges. The Full Moon also provides one with a similar imaging scenario; both in size (minus the corona) and average exposure length. I also do several practice solar imaging sessions.

Regardless of how or even if you decide to image the eclipse, make certain you take some time to look at and experience the eclipse. Totality is something to be experienced, not just photographed!

Clear skies in the shadow,

Dr. Mike Reynolds
18 total solar eclipses … and counting

References

[1] Axel D. Wittmann and Reinhard E. Schielicke, On the Berkowski daguerreotype (Königsberg, 1851 July 28): the first correctly-exposed photograph of the solar corona, Acta Historica Astronomiae, vol. 25, p. 128-147.

[2] Chabot Space & Science Center, Eastbay Astronomical Society records.

[3] American Astronomical Society, https://eclipse.aas.org/imaging-video/images-videos

[4] Reynolds, Mike and Richard Sweetsir. Observe Eclipses, Astronomical League, 1994

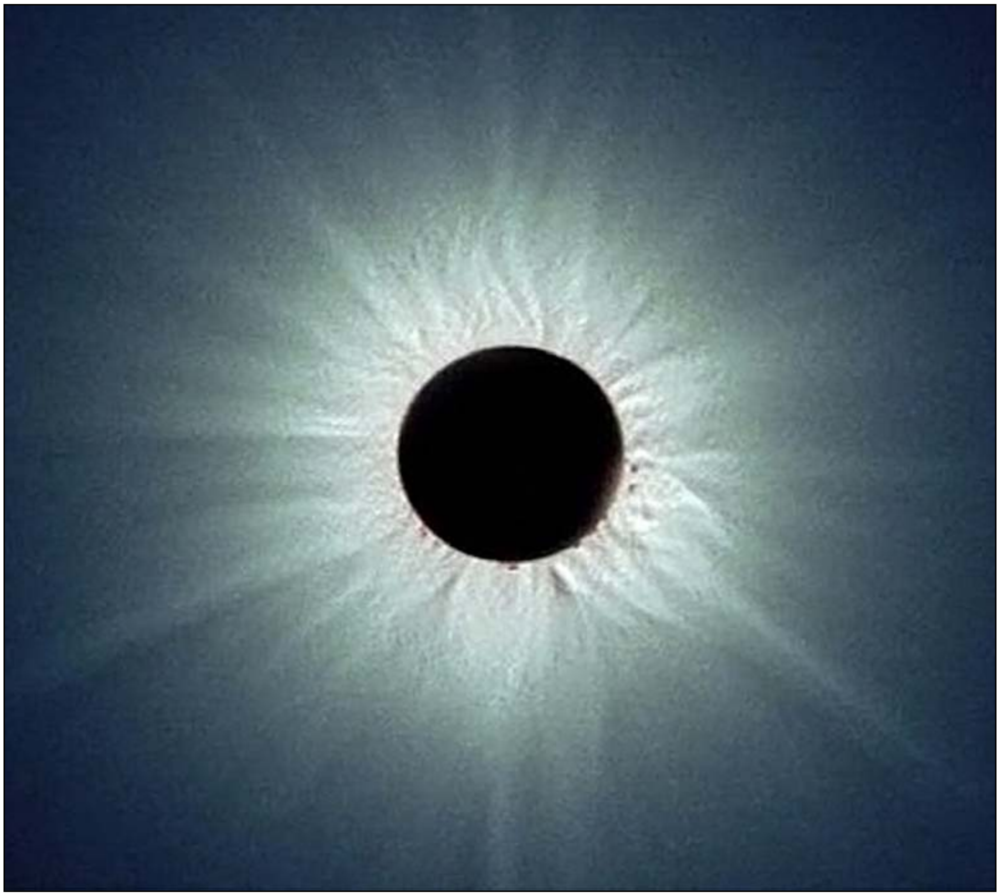


Figure 10. A stacked 10-image photograph of the June 21, 2001 total solar eclipse in Chisamba, Zambia. Canon AE1 and 400mm f/4 telephoto;
1/30 second to 1/1,000 second on Ektachrome film. *Image credit: Dr. Michael Reynolds*.

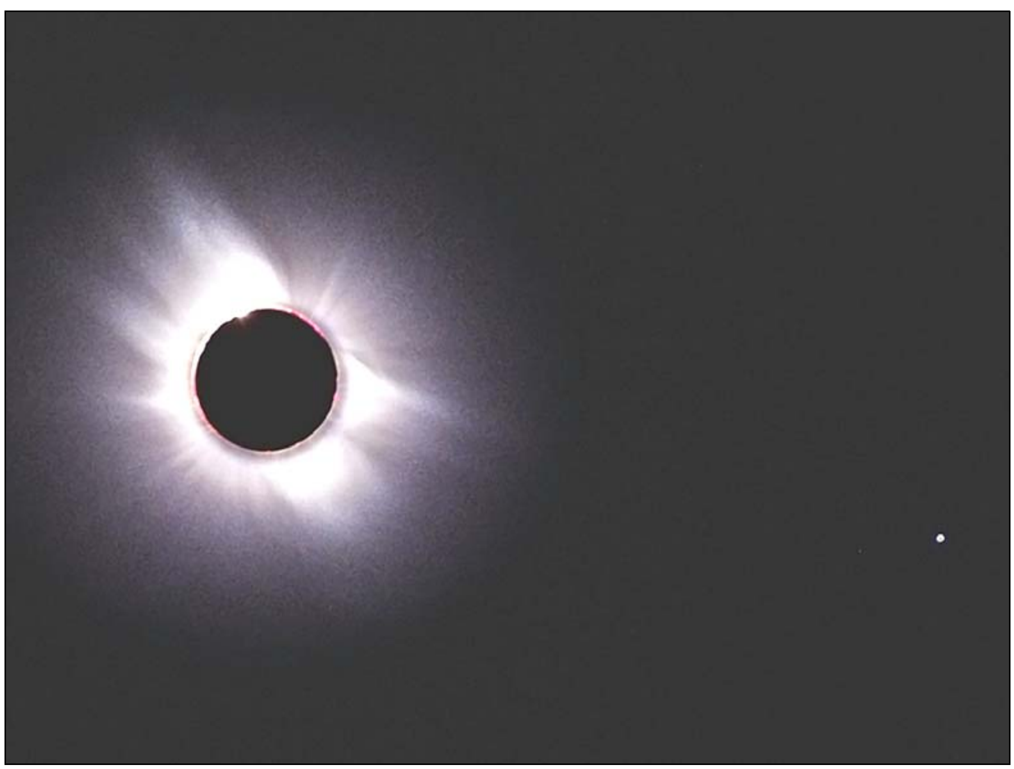
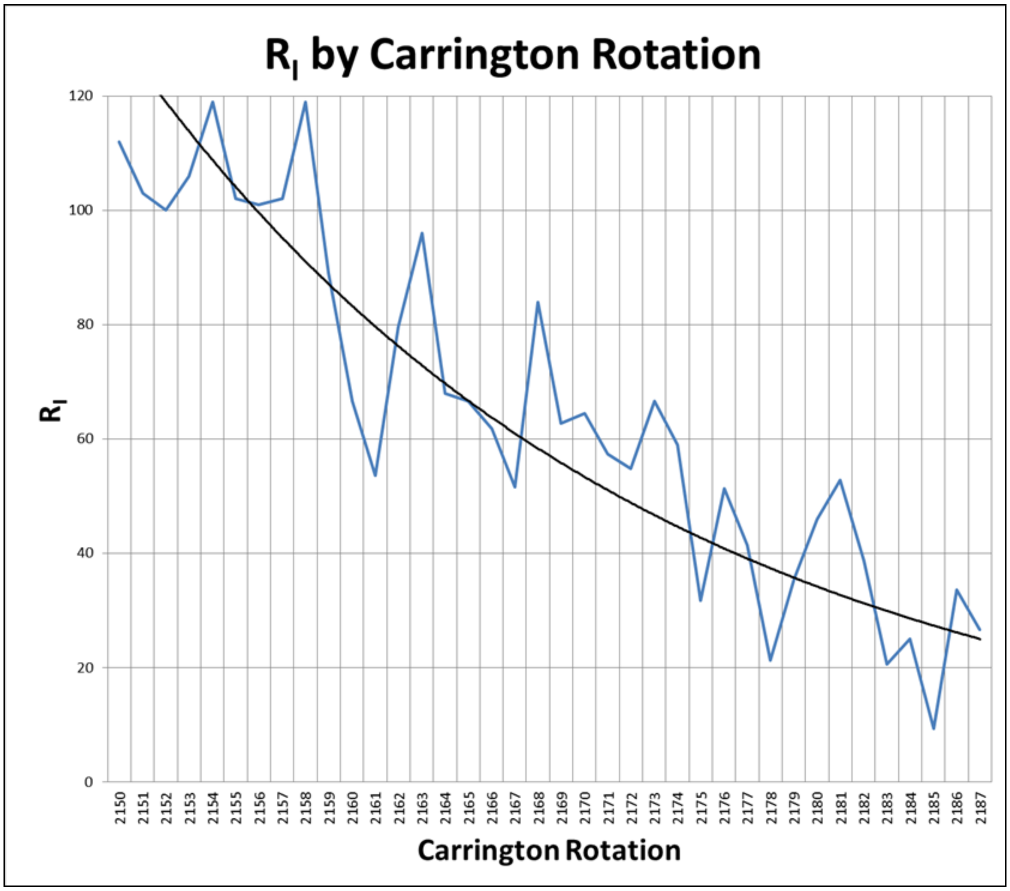


Figure 11. A stacked four-image photograph of the April 8, 2005 total solar eclipse. Four different telescope-cameras were used to capture the eclipsed Sun and Venus (to the right). The stacked image also shows the Sun's chromosphere. *Image credit: Fred Bruenjes, Dr. Michael Reynolds, Jen Winter, and Vic Winter.*

Feature Story: ALPO Solar Section

A Report on Carrington Rotations 2184 through 2187 (2016 11 16.7354 to 2017 03 06.0597)

By Richard (Rik) Hill,
Coordinator &
Scientific Advisor,
ALPO Solar Section
rhill@lpl.arizona.edu



Overview

This reporting period was characterized by the lowest activity since the last solar minimum. The largest region of the period was AR 2612 which attained an area of 230 millionths on 11/25 in CR 2184, the first rotation of the report. For the other three rotations, no region attained an area of 200 millionths. Most regions popped up, attained maximum development in one or two days and rapidly dwindled away. Some popped up and were designated and gone 24 hours after that! This does not mean that strong activity will not happen until we pass minimum (2019-2020), as AR 2645 proved in April with a maximum area of 700 millionths and plenty of flare activity.

Terms and Abbreviations Used In This Report

This short section is similar to the same in earlier reports but should be at least briefly scanned. 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 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 in this report 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 under the link "Solar Ephemerides and Rotations".

The terms “leader” and “follower” are used here instead of “east” or “west” on the Sun to avoid confusion. The abbreviation to indicate white-light observations is “w-l”, while hydrogen-alpha is “H-a” and calcium K-line is “CaK”. Though there were no reports of naked-eye sunspots during this period, it is nevertheless important to point out that this term means the ability to see a feature on the Sun through proper and safe solar filtration, with no other optical aid. You should never look at the Sun, however briefly, without such filtration. 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) will often be abbreviated as N, S, E, W.

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-

Table 1. Contributors to This Report

Observer	Location	Telescope (aperture, type)	Camera	Mode	Format
Michael Borman	Evansville IN	102mm, RFR	Point Grey GS3	w-l	digital images
		90mm	"	H-a	digital images
		102mm, RFR	"	CaK	digital images
Richard Bosman	Enschede, Netherlands	110mm, RFR	Basler Ace 1280	H-a	digital images
		355mm, SCT	"	w-l	digital images
Raffaello Braga	Milano, Italy	112mm,RFR	PGR Chameleon mono 2.0	H-a	digital images
Tony Broxton	Cornwall, UK	127mm, SCT	N/A	w-l	drawings
Jean-Francois (Jeff) Coliac	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	digital images
Brennerad Damacenco	Sao Palo, Brazil	90mm, MCT	ASI224MC	w-l	digital images
Franky Dubois	West-Vlaanderen, Belgium	125mm, RFR	N/A	visual sunspot reports	
Howard Eskildsen	Ocala, FL	80mm, RFR	DMK41AF02	w-l wedge	digital images
		80mm, RFR	DMK41AF02	CaK	digital images
Joe Gianninoto	Tucson, AZ	115mm, RFR	N/A	w-l	drawings
		80mm, RFR	N/A	H-a	drawings
		90mm, MCT	N/A	w-l, H-a	drawings
Guilherme Grassmann	Curitiba, Brazil	60mm, RFR	Lumenera Skynyx 2.0	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	ASI174MM	H-a	digital images
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	digital images
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
		250mm, SCT	Canon-Rebel	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 reports	
Theo Ramakers	Oxford, GA	80mm, RFR	ZWO ASI174MM	H-a	digital images
		11 in. SCT	DMK41AU02AS	w-l	digital images
		40mm, H-a PST	DMK21AU03AS	H-a	digital images
		40mm, CaK PST	DMK21AU03AS	CaK	digital images
Ryc Rienks	Baker City OR	203mm, SCT	N/A	w-l	drawings
		40mm, H-a PST	N/A	H-a	drawings
Chris Schur	Payson, AZ	152mm, RFR	DMK51	CaK	digital images
		152mm, RFR	DMK51	w-l (CaK-offband continuum)	digital images
		100mm, RFR	DMK51	H-a	digital images
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-pentaprism	digital images
David Teske	Starkville MS	60mm, RFR	N/A	W-L/H-a	drawings
		"	Malincam	W-L	digital images
James Kevin Ty	Manila, Philippines	TV101, RFR	ZWO-ASI 120MM	H-a	digital images
David Tyler	Buckinghamshire, UK	178mm, RFR	ZWO	W-L	digital images
	"	90mm, RFR	ZWO	H-a	digital images

NOTE: Telescope types: Refractor (RFR), Newtonian Reflector (RFL-N), Schmidt Cassegrain (SCT) Maksutov-Cassegrain (MCT), Meade Personal Solar Telescope (PST).

1,000 millionths for the average observer. The modified Zurich classifications used here are the ones defined by Patrick McIntosh of National Oceanic and Atmospheric Administration (referred to in this report as "NOAA") (McIntosh 1981, 1989) and detailed in an article in the JALPO Volume 33 (Hill 1989). This classification system is also detailed by the author on the Section website at: *http://www.alpo-astronomy.org/solarblog/?page_id=200* in an article on white light flare observation. Lastly, the magnetic class of regions is assigned by NOAA and will be abbreviated as "mag. class".

Included here is a table of Section observers, most of whom contributed to this report. The table summarizes their modes of observing as well as their locations. It will be used as a reference throughout this report rather than repeating this information on every image or mention.

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.

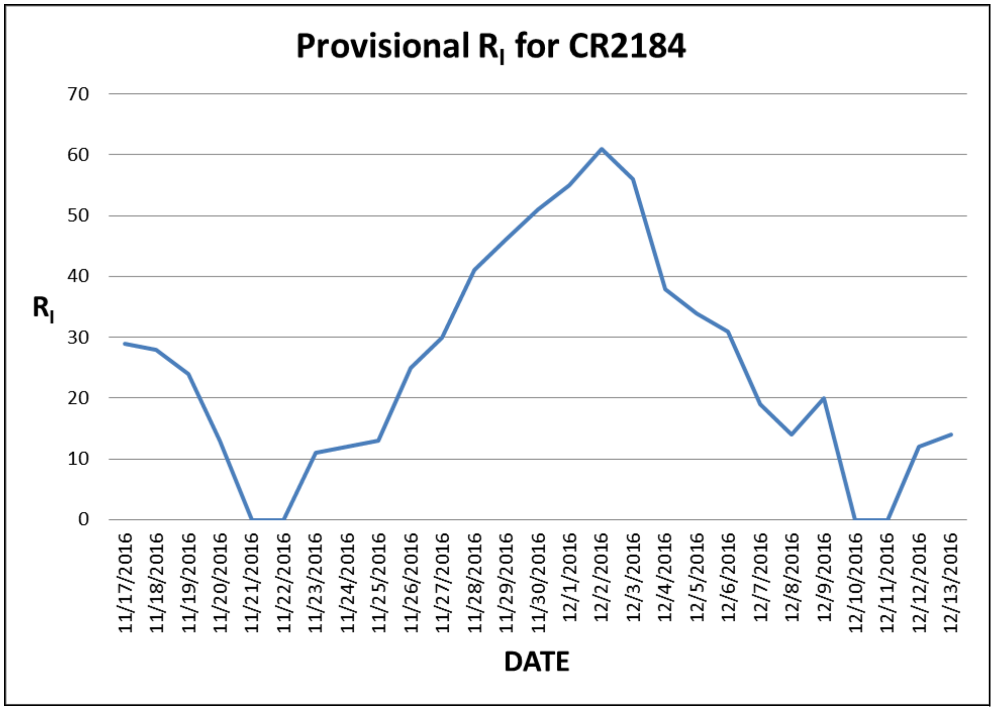
Additional references used in the preparation of this report:

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 2184

Dates: 2016 11 16.7354 to 2016 12 14.0521

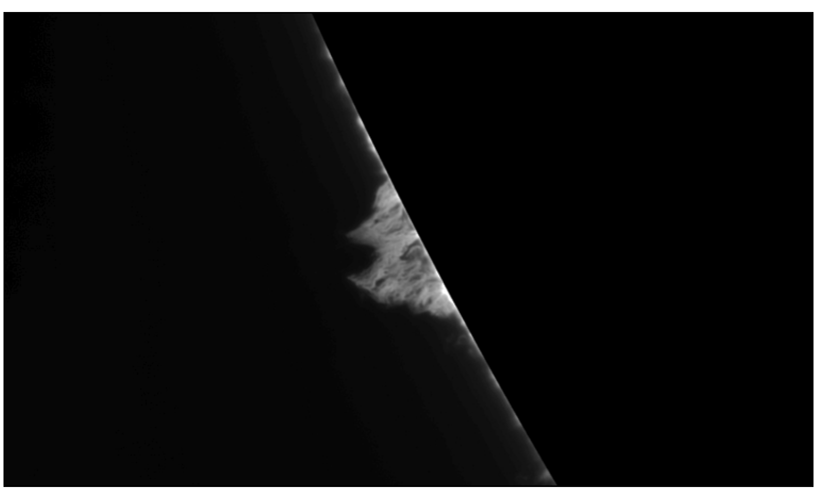
Avg. R_I= 25.1
High R_I = 61 (12/2)
Low R_I = 0 (4 days)

Activity or the average R_I for this rotation was higher than average R_I for the previous rotation (20.7) but still very low. This low activity has not been seen since early 2010. During this rotation, nine Active Regions were designated by NOAA, AR2609 to AR2617. This rotation had two active regions that contributed most to the activity, AR2612 and AR2615. They were both on the disk along with AR2614 on 12/02 when the finalized sunspot number was 61.

AR 2612 came onto the disk with a class of Hsx and an area of 120 millionths (mag. class "alpha") on 11/23. Levinthal, Teske and Gianninoto all observed it the first day and noted the same class. Thanks to the Gianninoto drawing, it was possible to make a positive identification of a Shivak image of a prominence over this region (Fig. 1). It is not unusual for a sunspot group to be given an H-class when on the limb and before all the spots can be seen and the true nature is known. But in this case, it retained that classification for four days. By the second day, the three aforementioned observers had given it a C-class designation, as it could be seen that it was two collections of umbrae in one broken penumbra.

In H-a and Cak images, Grassmann showed the region to be followed by a bright vertical plage. His image on the 25th showed this even better (Fig. 2). By then, the area had grown to 230 millionths (mag class unchanged) which

See Table 1 for equipment details for the following images.



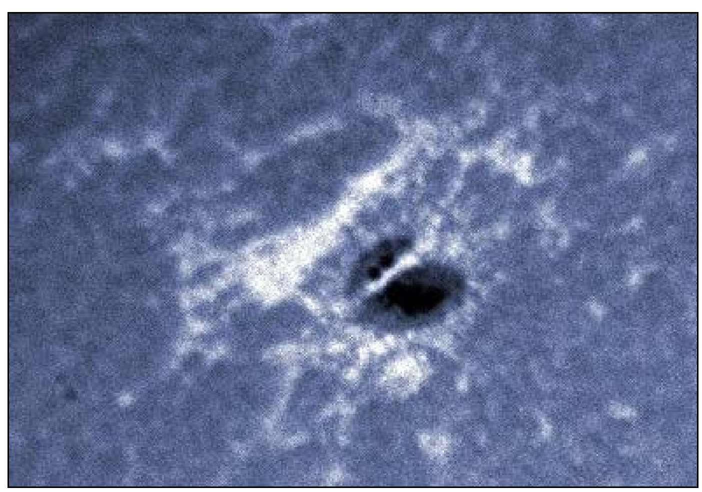


Figure 1 (left) - A limb prominence captured by Shivak over AR 2612 as it came into view on 2016-11-23 at 18:05 UT.
Figure 2 (right) - CaK of AR 2612 pm 2016-11-25 at 11:12 UT by Grassmann.

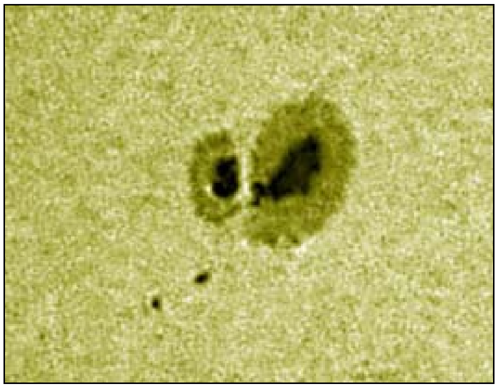
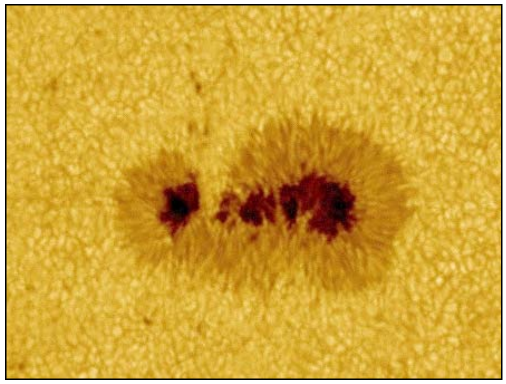
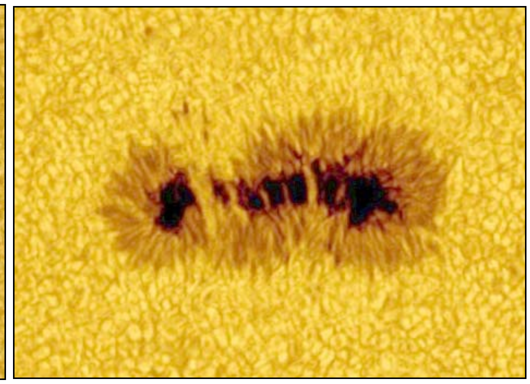




Figure 3 (left) - AR 2612 in white light by Ramakers on 2016-11-26 at 14:33 UT.
Figure 4 (center) - A white-light image of AR 2612 taken by Tyler on 2016-11-28 at 11:34 UT using a Baader solar filter, continuum filter, and IR blocker. Further instrumental information can be found on Table 1.
Figure 5 (right) - AR 2612 in white light on 2016-11-29 at 10:15 UT by Tyler.

would be the maximum development for this region. It was only producing about one flare every six hours, which is pretty low activity. A Ramakers w-l image the next day showed that the two spots had separated and the light bridge between them in his image is quite bright (possibly a white-light flare?) (Fig. 3). The following bright vertical plage remained.

On 11/28, the day of meridian passage, we have a good detailed w-l image by Tyler of this region. The two collections of umbrae, each in their own penumbra with a quiescent light bridge in between, overlapped on the southern edges (Fig. 4). The area had dropped to 170 millionths, but NOAA was now classifying the group as Cao, which our own observers had been doing for two days.

Flare production was even lower, as the region was beginning to break down. On the 29th, another light bridge cut the larger leading spot in half again and we had three collections of umbrae — each with separate penumbra. It looked like a caterpillar working its way across the Sun! (Fig. 5). From here it continued to decrease in area until on 12/02, the day of maximum sunspot number for this rotation, it was Dao class of 120 millionths area (beta mag class), producing only one flare in every eight hours on average.

As AR 2612 was crossing the meridian, AR 2615 popped into view on 12/29. It was first seen on that date by Broxton at 10:17 UT as a Bxo group. NOAA designated it as Dsi a few hours later, indicating rapid growth and development. The area on this day was listed as 30 millionths (mag class beta) with 45 flares in the first day! A w-l image on that first day at 11:11 UT showed three main spots with rudimentary penumbra (Fig. 6). The leader was slightly closer to the equator while the other two were at a latitude of S08. All had rudimentary or fragmentary penumbra and there were a couple outlier spots to the north as well.

The whole region was wreathed in faculae, and H-a and Cak images by Grassmann showed an active plage following the main leader with numerous bright points in that plage. The region doubled in size each of the next two days, with the leader growing while a strong neutral line snaked from the southern edge of the middle spots to the north edge of the follower spots. This was the site for many flares as seen by our observers. On 12/01, in w-l, the leader spot was a larger umbra with a symmetrical penumbra followed by naked umbrae and penumbral bits and pores well-shown in an image by Ramakers at 14:29 UT (Fig. 7).

AR 2615 crossed the meridian on 12/03 as a Dao (mag class still beta) group

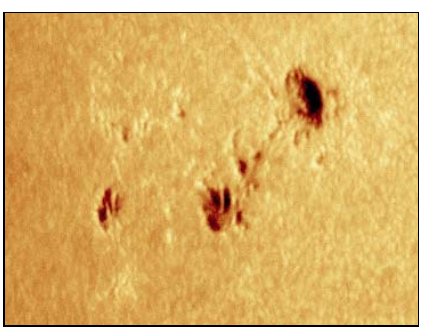
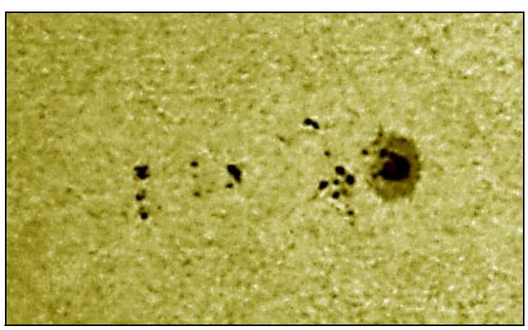
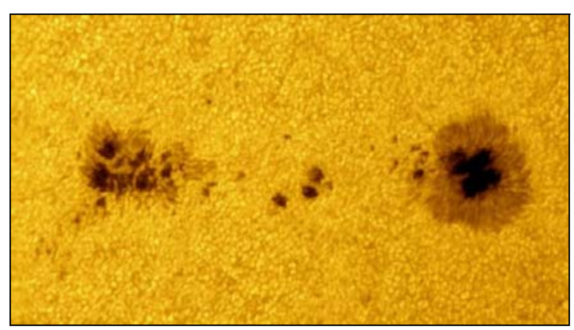




Figure 6 (left) - A Tyler white light image of AR 2615 on 2016-11-29 at 11:11 UT.
Figure 7 (center) - AR 2615 as imaged in white light by Ramakers on 2016-12-01 at 14:29 UT.
Figure 8 (right) - A remarkable white-light image of AR 2615 taken on 216-12-05 at 1056 UT in excellent seeing.

with an area of 110 millionths. Flare production had decreased to half of what it was three days earlier, now being only one every two hours or so. Teske was the only observer to note meridian passage in a w-l drawing. Maximum development for this region was on 12/05 when the class was Dai (mag class still beta) with and area of 200 millionths. The leader spot was a large, four-lobed umbra in a radially symmetrical penumbra followed by a middle collection of three naked umbrae and a follower spot that was a group of at least 10 umbrae in scattered rudimentary and fragmentary penumbra seen in another Tyler image at 10:56 UT (Fig. 8).

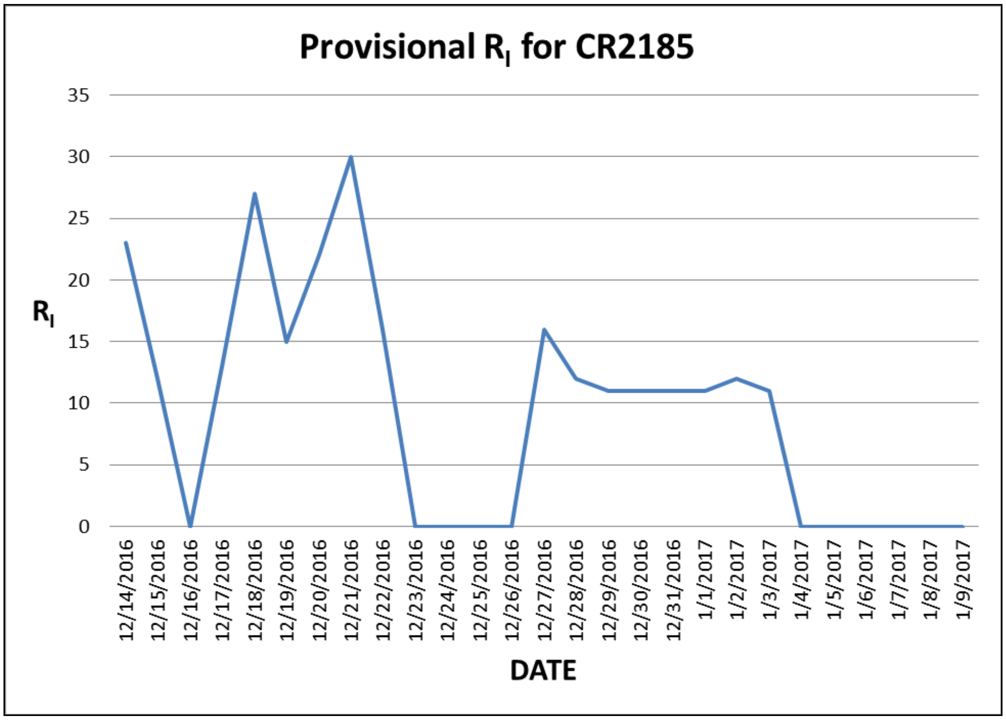
The middle and follower spots were all in a plage but flare production was still about the same shown in a Grassmann CaK image the next day at 12:26 UT (Fig. 9). From this point on, the activity decreased further as the region approached the limb and left the disk on 12/09, then a Cao group of 60 millionths area in a web work of faculae. We had some nice limb prominence images about that time but no effort was made to identify the limb or to associate them with any particular AR, so it's not clear at all that they were due to AR 2615!

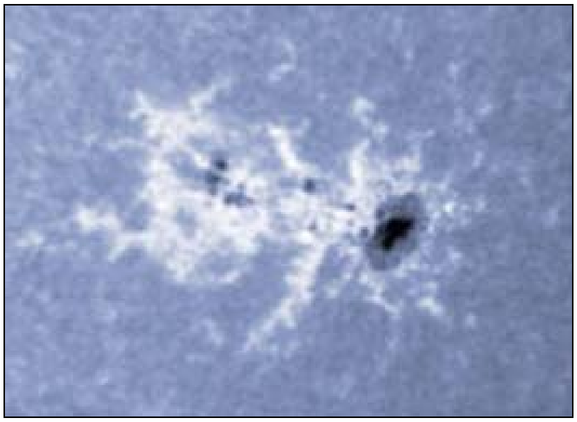
Carrington Rotation 2185

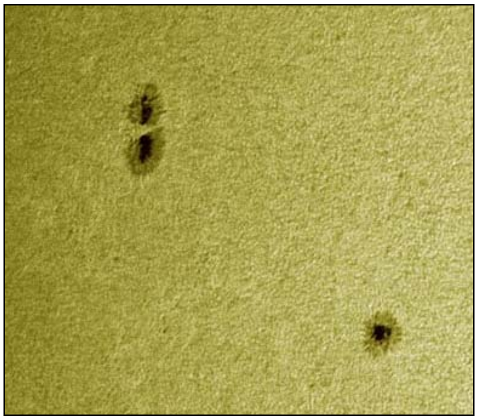
Dates: 2016 12 14.0521 to 2017 01 10.3840

Avg. R_I= 9.4
High R_I = 30 (12/21)
Low R_I = 0 (11 days)

Activity for this rotation dropped to exceptionally low levels. The highest final daily R_I was only 30, and as can be seen in the plot below, it dropped quickly from that. No regions exceeded 70 millionths and the one that attained that was AR 2617 on the first day of the rotation as it was leaving the disk. It demonstrated only three flares in its last 48 hours on the disk. We had no good images of this group or region beyond whole disk images. This level of activity could be a peek at what is coming in the next few years.







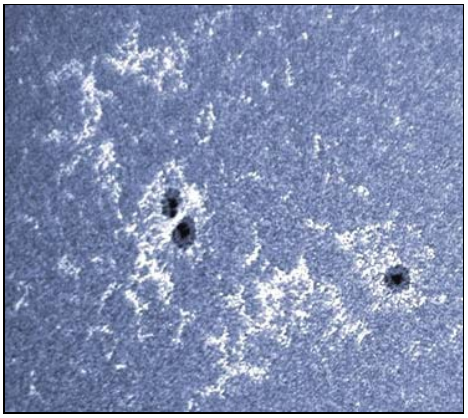
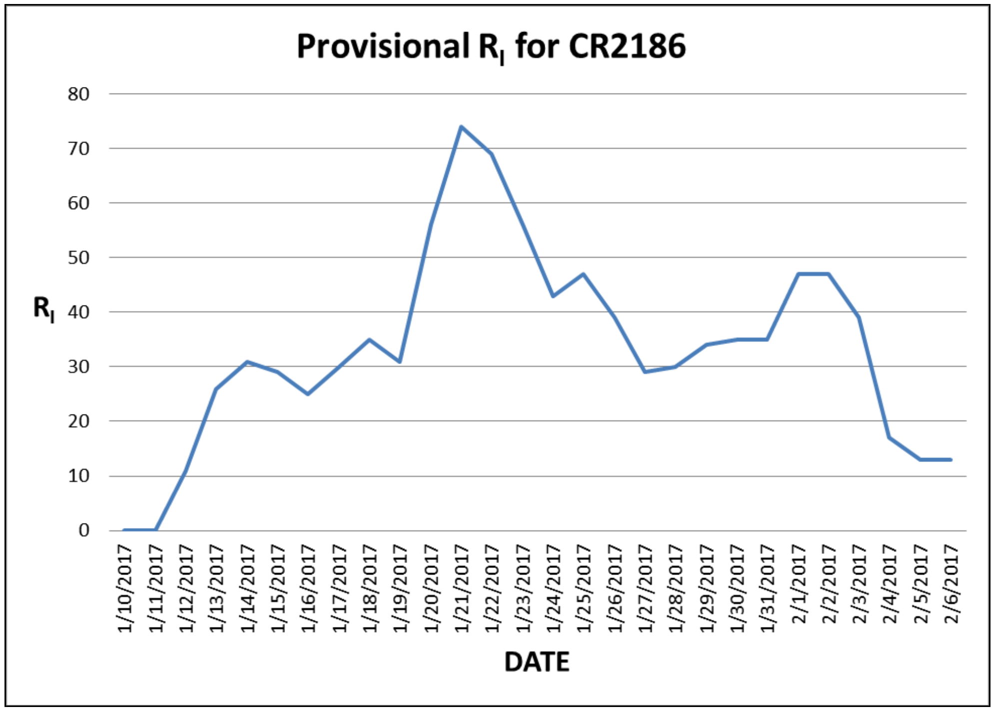


Figure 9 (left) - A Grassmann CaK image of AR 2615 on 2016-12-06 at 12:26 UT.
Figure 10 (center) - ARs 2625 and 2626 on 2017-01-15 at 15:13 UT by Ramakers.
Figure 11 (right) - A CaK view of ARs 2625 and 2626 by Grassmann on 2017-01-16 at 12:00 UT.

Carrington Rotation 2186

Dates: 2017 01 10.3840 to 2017 02 06.7250

Avg. R_I= 33.6
High R_I = 74 (1/21)
Low RI = 0 (1/10, 1/11)



Though the rotation opened with two days of zero sunspots, there was nevertheless an increase in activity with the number of groups being about the same, but larger in areas and numbers of spots. The day of highest R_I was 1/21 when the count was 74. Still only one region attained an area in excess of 200 millionths of the disk.

AR 2626 entered the disk as Hsx with an area of 20 millionths on 1/13 and in three days jumped to 140 millionths (mag class alpha) with only one flare in 48 hours. This situation remained unchanged through the 15th after which it began declining and left the disk as Aax with an area of 10 millionths. We have a good w-l image of this region and AR 2625 south of it from Ramakers on 1/15 at 15:12 UT (Fig. 10) and a nice CaK image from Grassmann the next day showing both regions in a plage filigree at 12:00 UT (Fig. 11).

AR 2628 became the largest region of this rotation. It formed on the disk on 1/20 as a Bxo group of 20 millionths (mag class beta), but produced 20 flares in its first two days! It was first observed by Broxton in a w-l drawing at 10:32 UT on that day. By 1/21, it had rapidly grown to Dai (mag class beta-gamma) with an area of 120 millionths.

It consisted of a leader that was a N-S oriented umbrae in a well-organized penumbra followed by a scattering of fragmentary umbrae and penumbral bits and a final follower of a single medium-sized naked umbra and pore as seen in a Tyler image on that date (Fig. 12). By 1/23, the classes were unchanged but the area had grown by 100 millionths as it crossed the central meridian (Fig. 13).

Then on 1/24, it began to show signs of weakening when flare production dropped to only one in 48 hours and a class was Dso (mag class only beta) with an unchanged area.

This continued the next day, 1/25, when the class went up to Eao (mag class still beta) while the area decreased slightly to 210 millionths. A curious umbral tail followed the leader spot as shown in a Ramakers w-l image (Fig. 14). Flare production was now zero, which was odd considering the McIntosh class. AR 2629 was now the big flare producer on the disk.

On 1/26, the class for AR 2628 dropped to Cao with an area of 180 millionths and still no flares. The class stayed the same on the 27th with a further decrease in area to 120 millionths and then to 110 millionths a day later. As it neared the limb on 1/29, the area

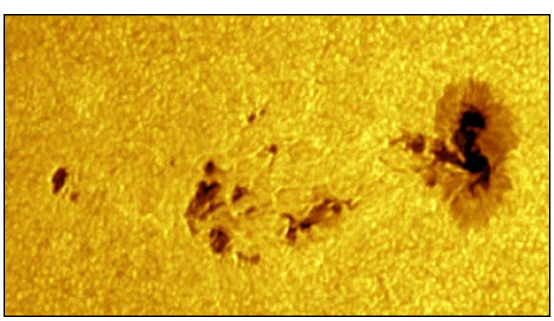
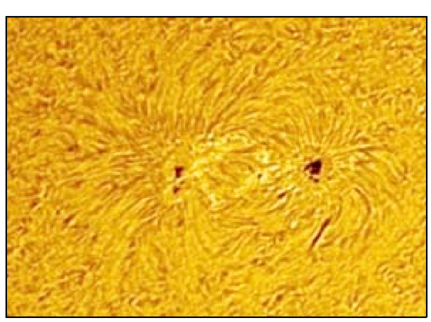
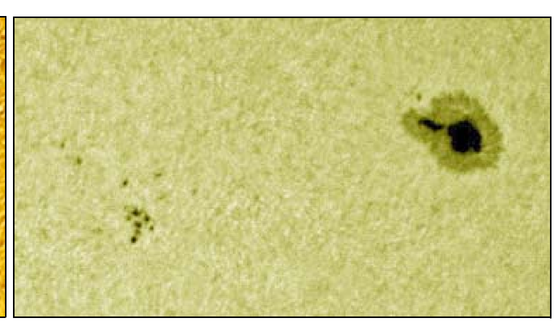




Figure 12 (left) - A Tyler white light image of AR 2628 on 2017-01-21 at 11:27 UT.
Figure 13 (center) - A Grassmann H-alpha image of AR 2628 on 2017-01-22 at 19:49 UT.
Figure 14 (right) - A white-light view of AR2628 on 2017-01-25 at 1507 UT as imaged by Ramakers.

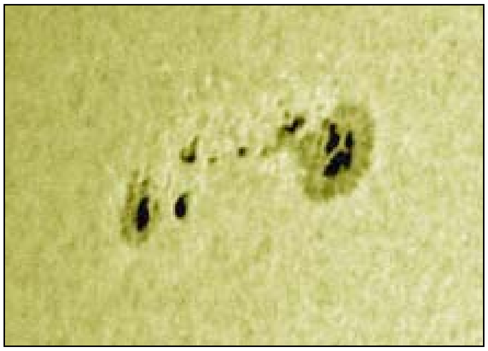


Figure 15 - Another Ramakers white-light image, this time of AR 2629 on 2017-01-25 at 15:08 UT.

stayed the same but the class was now Hsx. This is how it left the disk on 1/30.

The last region of note during CR 2186 was AR 2629. It rapidly formed on the disk on 1/24, growing to Cao with an area of 70 millionths in the first day. Ramakers showed the leading spot on the leading edge of a circular ring of faculae. In Eskildsen and Ramakers H-a and CaK images, the facular region is seen as a very intensely bright plage, possibly low-level flaring. This was particularly true in the CaK images. It was at this time producing one flare every two hours on average.

The next day, 1/25, was maximum development for this region. The class was Dao with an area of 180 millionths as seen in a Ramakers w-l image taken at 15:08 UT (Fig. 15). The leader consisted of a collection of four umbrae within a well-organized penumbra followed by one spot with four small umbrae and rudimentary penumbra and then another four umbrae in the mid-region. The follower spot was a half-dozen small umbrae in poorly organized penumbra. The entire region was covered with faculae and in H-a, the hot region appeared to be on the leading edge of the follower spot.

Flare production was about the same and this region was the leading flare producer on the Sun at this time. Over the next few days, flare production dropped off while the area slowly decreased in area. At meridian passage on 1/29, the class was Dao with an area of 130 millionths and it only produced one flare in 48 hours. The next day it dropped to Cso with an area of 120 millionths and then on 1/31, it lost the follower spots and became class Hsx with an area of only 60 millionths. It stayed more or less the same until it left the disk on 2/3.

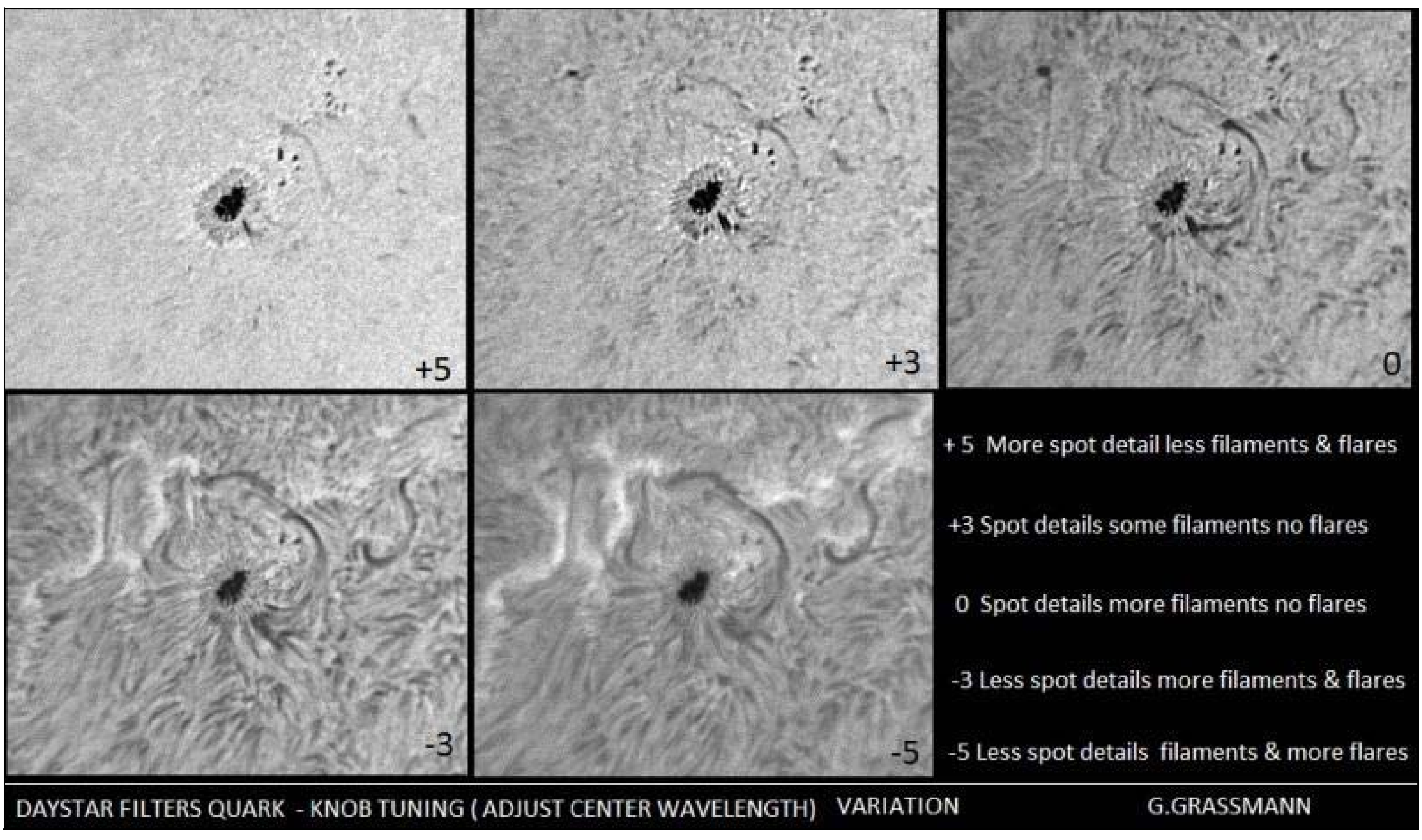


Figure 16 - A multi-panel H-alpha montage of images of AR 2638 by Grassmann as he went from off-line on the red side to off-line on the blue side by the same amount. The red-shift image shows features that are moving away, while the blue shows to the opposite.

Carrington Rotation 2187

Dates: 2017 02 06.7250 to 2017 03 06.0597

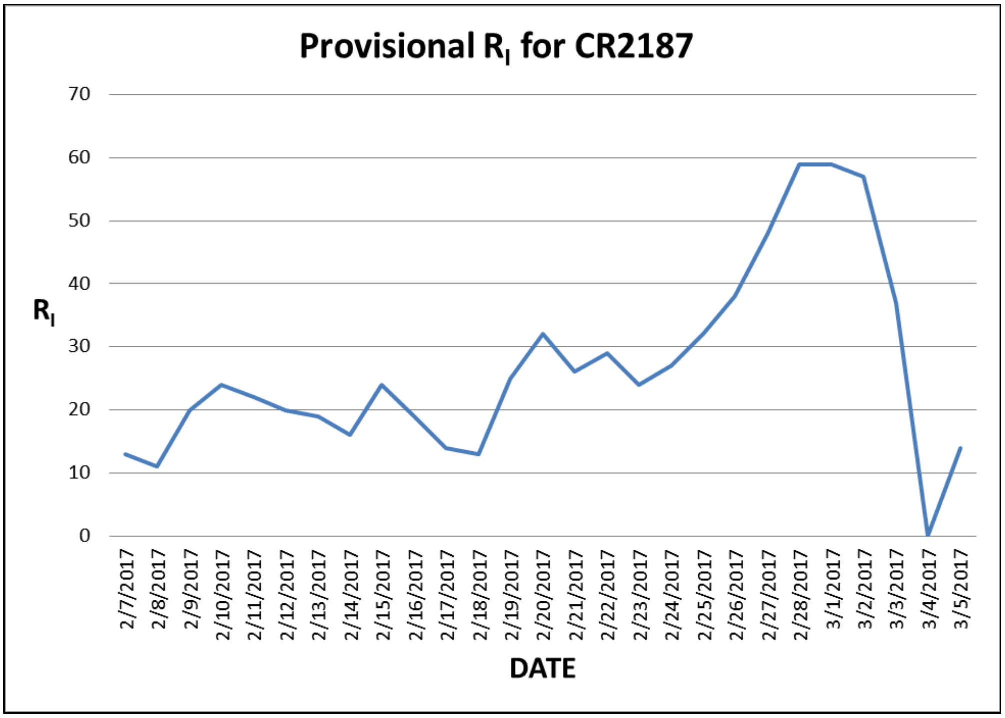
Avg. R_I = 26.7
High R_I = 59 (2/28, 3/1)
Low R_I = 0 (3/4)

As with the last rotation, no single region was dominant during CR 2187. In fact, no region exceeded 150 millionths!

The largest region for this rotation, AR 2638, formed on the disk on 2/20 and within 24 hours was Dao with an area of 80 millionths. By 2/22 it had nearly doubled in area and was now Dso, generating one flare every four hours on average. Grassman has an interesting grouping of H-a images showing the changing appearance as he adjusted his filter from off-band (continuum) through the center of the H-alpha line (Fig. 16).

Maximum development was on 2/24, a day before meridian passage with an officially listed class of Cso and an area of 150 millionths, but it only produced about one flare every six hours on average.

However, I have to agree with Gianninoto's designation of Hsx on this date. There were a few pores near the main spot, a large umbra in a radially symmetrical penumbra which is pretty much the definition of Hsx. It is shown in a w-l image by Tyler on this date (Fig. 17). This is the classic form many spot groups take on as they are decaying. They retain the H-class form while shrinking in area until they are gone.



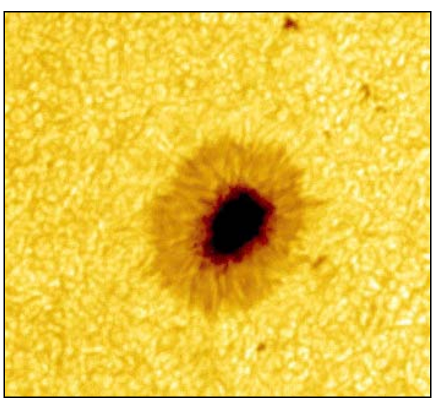
Two days later, NOAA changed the class to Hsx and over the next 12 days it did just what I described until it left the disk on 3/9 as only a plage. Braga showed an interesting filament that had formed to the north of the spot on 2/26 (Fig. 18). It was so straight it caught the eye. But by the next day, Ty showed it to be breaking down and becoming more sinuous (Fig. 19).

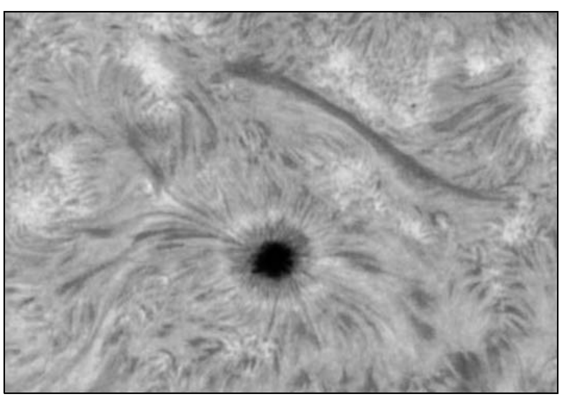
This was the last notable activity from this region.

Conclusion

While activity was lackluster during this reporting period, as mentioned earlier, we can still get occasional regions that will provide a good show.

Observers need to remain vigilant during solar minimum. The solar community is split right now on how deep this upcoming minimum will be and for how long. There seems to be some agreement on a protracted minimum with some researchers predicting another Maunder-type minimum! The solar minimum is also a good time for honing techniques and equipment in preparation for the inevitable rise to the next solar max.





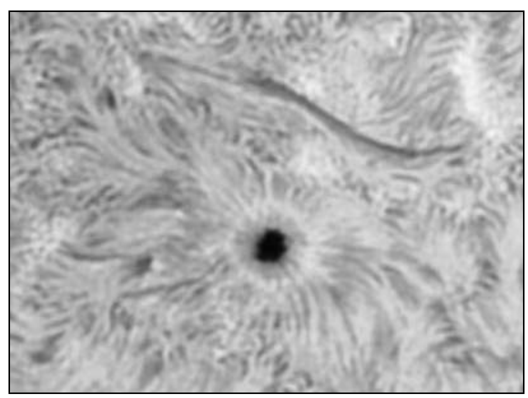


Figure 17 (right) - AR 2638 as imaged by Tyler showing a classic H-class form. The image was taken on 2017-02-24 at 11:36 UT
Figure 18 (center) - A large filament that formed to the north of AR 2638 as imaged by Braga on 2017-02-26 at 10:50 UT.
Figure 19 (right) - The filament to the north of AR 2638 on 2017-02-27 at 10:53 UT as imaged by Ty.

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)

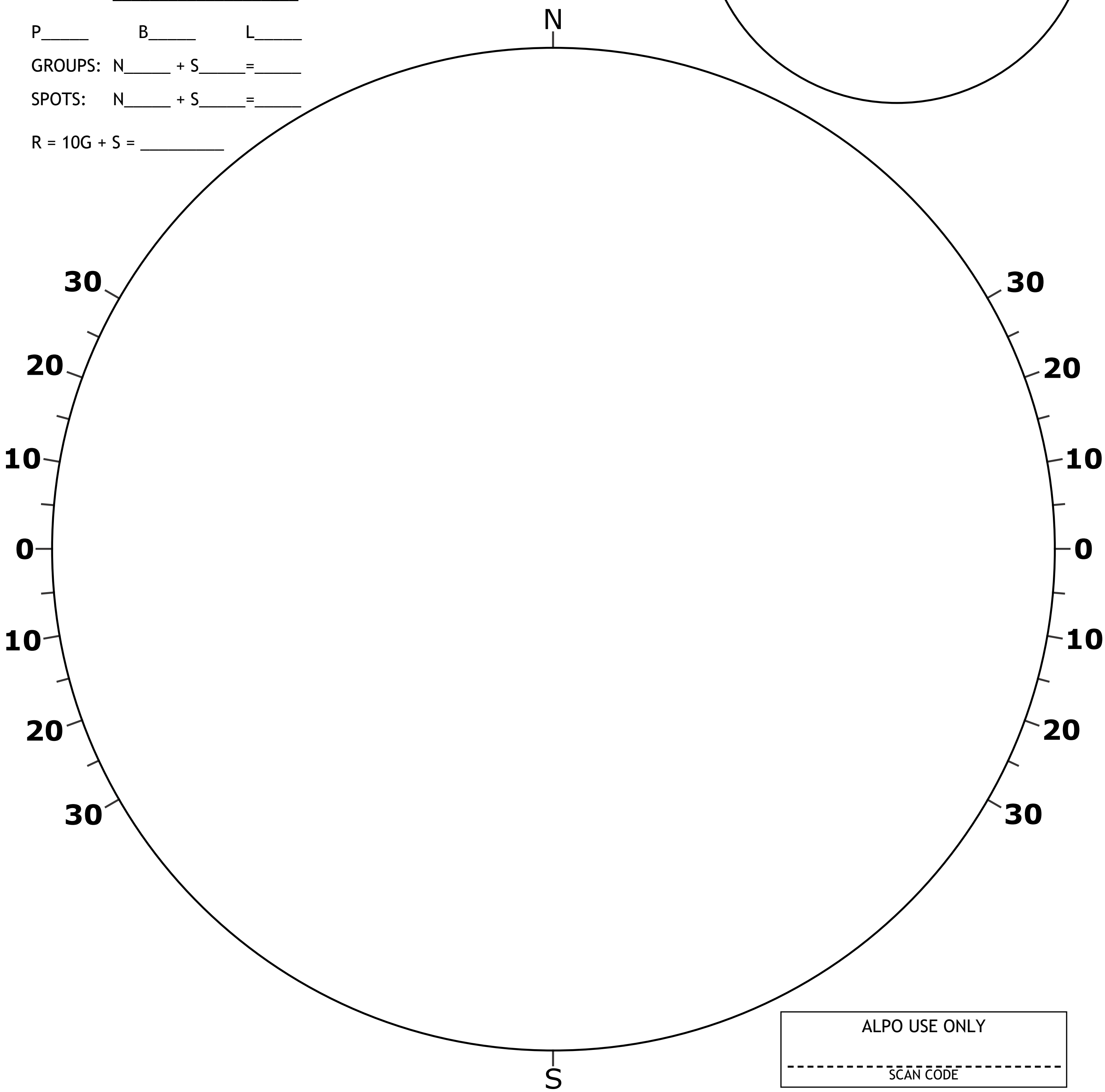
ROTATION_____________

P_____ B_____ L_____

GROUPS: N_____ + S_____=_____

SPOTS: N_____ + S_____=_____

R = 10G + S = _________



ALPO USE ONLY

SCAN CODE

Feature Story: Venus

ALPO Observations of Venus During the 2013-2014 Eastern (Evening) Apparition

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

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

Abstract

Twelve observers from Australia, France, Germany, Italy, Netherlands, New Zealand, Sweden, United Kingdom, and the United States submitted images and visual observations (drawings and descriptive reports) to the ALPO Venus Section during the 2013-14 Eastern (Evening) Apparition. This report summarizes the results of the 145 total observations. Types of telescopes and accessories used in making the observations, as well as sources of data, are noted. Comparative studies take into account observers, instruments, visual and photographic results. The report includes illustrations and a statistical analysis of the long-established categories of atmospheric features on Venus, including cusps, cusp-caps, and cusp-bands, all seen or suspected at visual wavelengths in integrated light and with color filters, as well as images captured at visual, ultraviolet (UV), and infrared (IR) wavelengths. Terminator irregularities and the apparent phase phenomena, plus results from continued monitoring of the dark hemisphere of Venus for the enigmatic Ashen Light and imaging of dark side thermal emission in the infrared (IR) are discussed. As noted in the report, the 2013-14 Eastern (Evening) Apparition ended on December 29, 2013.

Introduction

The ALPO Venus Section received 145 observations for the 2013-14 Eastern (Evening) Apparition, consisting of visual drawings, descriptive reports, and digital images from twelve observers residing in Australia, France, Germany, Italy, Netherlands, New Zealand, Sweden, United Kingdom, and the United States. Geocentric phenomena in Universal Time (UT) for this observing season are given in Table 1, while Figure 1 presents the distribution of observations by month during the apparition. Table 2 gives the location where observations were made, the number of observations submitted, and the telescopes utilized.

Observational coverage of Venus during this apparition was fair, with several individuals beginning their studies of the planet about one month following Superior Conjunction on March 28, 2013. Contributions by observers upon which this report is based spanned the period beginning April 15, 2013, through December 29, 2013, with 68.3% of the total contributions for June through September 2013. For the 2013-14 Eastern (Evening) Apparition of Venus, the planet passed through its waning phases (a progression from fully illuminated through crescentic phases) when observers witnessed the leading hemisphere of Venus at the time of sunset on Earth. The ALPO Venus Section always encourages observers to plan ahead and try to carry out systematic observations of Venus starting

All Readers

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

Online Features

Left-click your mouse on:

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

Observing Scales

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

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

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

IAU directions are used in all instances.

Terminology: Western vs Eastern

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

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

early in any given apparition right after conjunction for as long as possible until the next conjunction occurs. We have been fortunate to have a dedicated and growing team of observers who have been trying very hard to do that in recent years.

Figure 2 shows the distribution of observers and contributed observations by nation of origin for this apparition, where it can be seen that 25.0% of the participants in our programs were located in the United States, and they accounted for 24.8% of the total observations. Continued international cooperation was good this observing season, whereby 75.0% of the observers resided outside the United States and contributed 75.2% of the overall observations. The ALPO Venus Section highly encourages this valuable global teamwork by observers in the future.

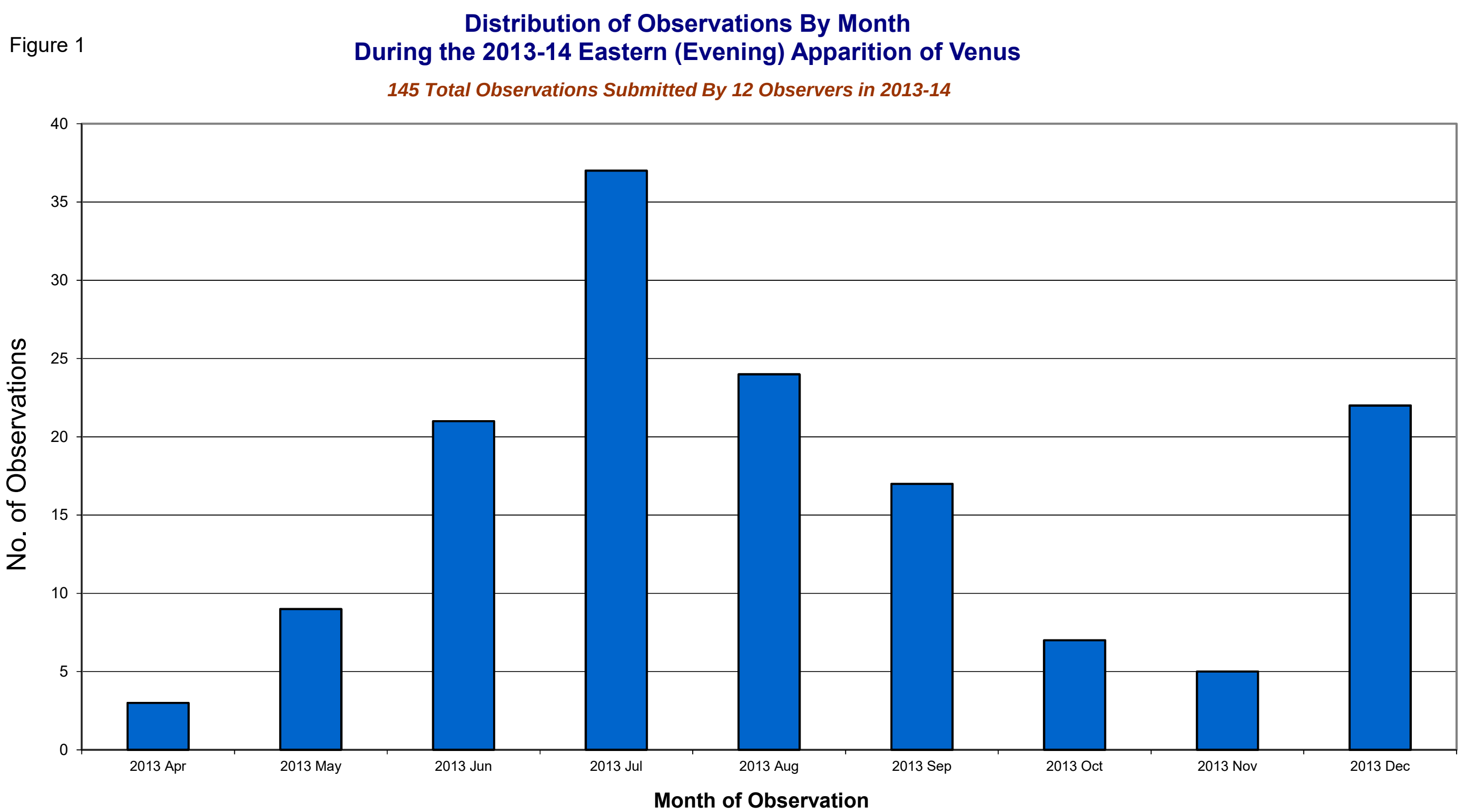
The types of telescopes used to observe and image Venus are shown in Figure 3.

Table 1: Geocentric Phenomena in Universal Time (UT)
Table for the 2013-2014 Eastern (Evening) Apparition of Venus

Superior Conjunction	2013 Mar 28^d 17^h UT
Initial Observation	Apr 15 09:40
Dichotomy (predicted)	Oct 31 03:21:36 (31.14^d)
Greatest Elongation East	Nov 01 08:00 (47.0˚)
Greatest Illuminated Extent	Dec 06 19:00 (m_v = –4.4)
Final Observation	Dec 29 13:20
Inferior Conjunction	2014 Jan 11 12
Apparent Diameter (observed range):	9.8″ (2013 Apr 15) ↔ 58.5″ (2013 Dec 29)
Phase Coefficient, ***k*** (observed range):	0.992 (2013 Apr 15) ↔ 0.057 (2013 Dec 29)

All observations were made with telescopes ranging from 9.0 cm (3.5 in.) up to 62.0 cm (24.4 in.) in aperture, and 84.8% were made with telescopes 15.2 cm (6.0 in.). During the 2013-14 Eastern (Evening) Apparition of Venus, the frequency of use of classical designs (refractors, Cassegrains, and Newtonians) was 19.3%, while utilization of catadioptrics (Schmidt Cassegrain, Dall-Kirkham, Schmidt-Newtonian, and Maksutov Cassegrain) was 80.7%. All observations this apparition were performed under daylight or twilight conditions, generally because more experienced Venus observers recognize that viewing the planet during twilight or in full daylight substantially reduces the excessive glare associated with the planet. Also, viewing or imaging Venus when it is higher in the sky substantially cuts down on the detrimental effects of atmospheric dispersion and image distortion prevalent near the horizon.

Figure 1



The ALPO Venus Section sincerely appreciates the efforts of the twelve observers who made this report possible by regularly sending in drawings, descriptive reports, and digital images of Venus in 2013-14. Readers who wish to observe Venus in coming apparitions are urged to join the ALPO and start participating in our programs. With its dazzling brightness Venus is easy to find in the twilight or night sky, and can sometimes be spotted in broad daylight if one knows where to look under clear skies. When near greatest elongation from the Sun, it can be almost 15 times brighter than the star Sirius, and from a dark, moonless observing site, the planet can even cast shadows.

Observations of Atmospheric Details on Venus

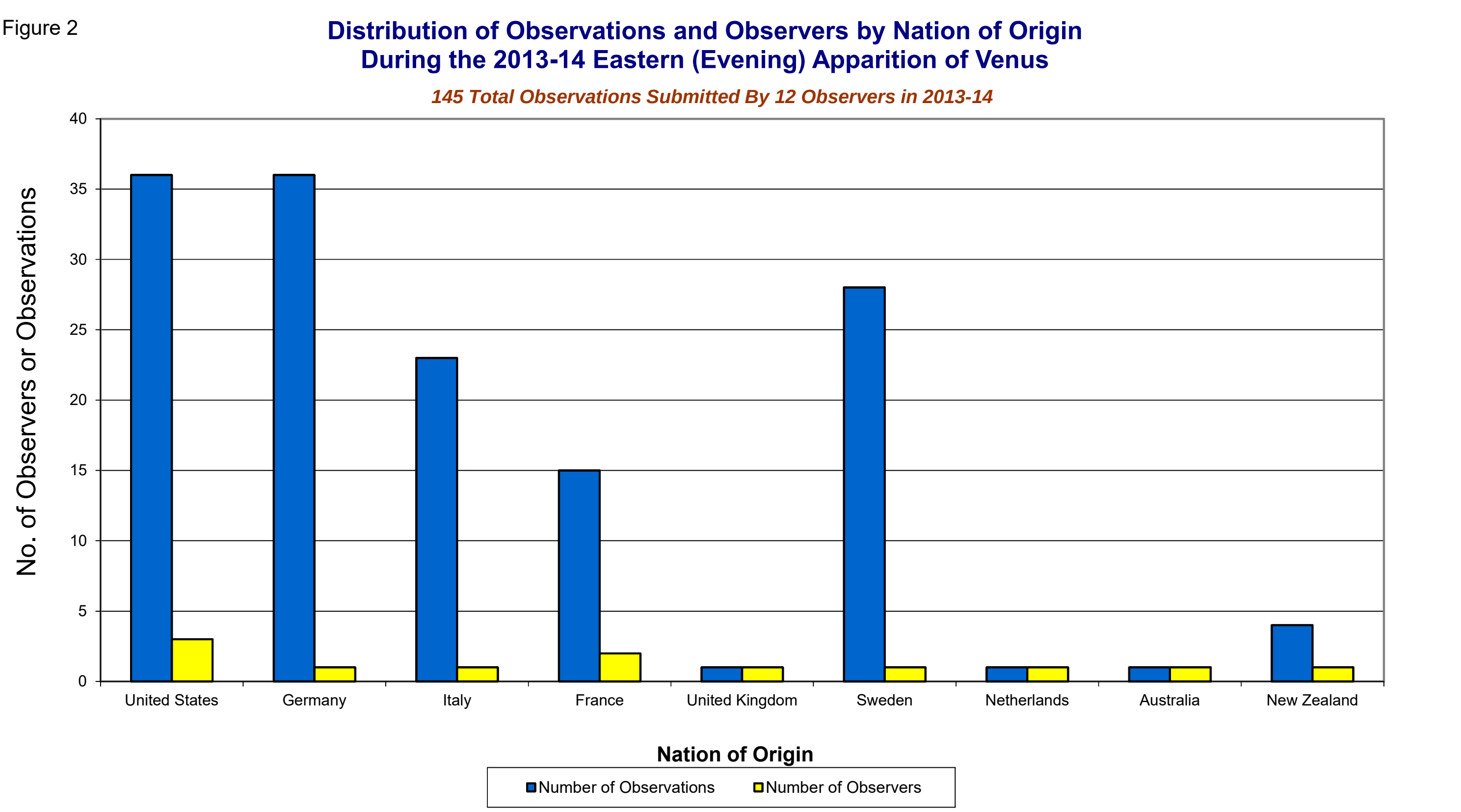
The methods and techniques for visual studies of the especially faint, elusive "markings" in the atmosphere of Venus

Table 2: ALPO Observing Participants in the 2013-14 Eastern (Evening) Apparition of Venus

Observer and Observing Site	No. Obs.	Telescope(s) Used*
Abel, Paul G. - Leichester, UK	1	20.3 cm (8.0 in.) NEW
Benton, Julius L. - Wilmington Island, GA	18	9.0 cm (3.5 in.) MAK
Braga, Raffaello - Milan, Italy	3 5 12 3	9.0 cm (3.5 in.) REF 12.0 cm (4.7 in.) REF 12.7 cm (5.0 in.) MAK 21.0 cm (8.3 in.) DALL
Collins, Maurice - Palmerston North, NZ	1 3	9.0 cm (3.5 in.) MAK 11.0 cm (4.3 in.) REF
Hill, Rik - Tucson, AZ	8	20.3 cm (8.0 in.) MAK
Legrande, Michel -Le Baule, France	14	21.0 cm (8.3 in.) NEW
Lindberg, H.G. - Skultuna, Sweden	28	25.4 cm (10.0 in.) SCH-NEW
Melillo, Frank J. - Holtsville, NY	10	25.4 cm (10.0 in.) SCT
Niechoy, Detlev - Göttingen, Germany	36	20.3 cm (8.0 in.) SCT
Pellier, Christophe - Bruz, France	1	62.0 cm (24.4 in.) CAS
Sussenbach, John - Houten, The Netherlands	1	28.0 cm (11.0 in.) SCT
Wesley, Anthony - Paris, France	1	36.8 cm (14.5 in.) NEW
Total No. of Observers	**12**	
Total No. of Observations	**145**	

*REF = Refractor, SCT = Schmidt-Cassegrain, MAK = Maksutov, NEW = Newtonian, CAS = Cassegrain, DALL = Dall-Kirkham, SCH-NEW = Schmidt-Newtonian

Figure 2



are described in detail in The Venus Handbook, available from the ALPO Venus Section in both hard copy and as a pdf (portable document format) file. Readers who maintain archives of earlier issues of this Journal may also find it useful to consult previous apparition reports for a historical account of ALPO studies of Venus.

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

Represented in the photo-visual data for this apparition were all of the long-established categories of dusky and bright markings in the atmosphere of Venus, including a small fraction of radial dusky features, described in the literature cited as references at the end of this report. Figure 4 shows the frequency of readily identifiable forms of markings seen or suspected on Venus. Most observations referenced more than one category of marking or feature, so totals exceeding 100% are not unusual. At least some level of subjectivity is inevitable when visual observers attempt to describe, or accurately represent on drawings, the variety of highly elusive atmospheric features on Venus, and this natural bias had some effect on the data represented in Figure 4. It is assumed, however, that conclusions discussed in this report are worthwhile interpretations.

The dusky markings of Venus' atmosphere are always a challenge to detect when using normal visual observing methods, and this familiar characteristic of the planet is mostly independent of the experience of the observer. When color filters and variable-density polarizers are systematically employed, views of cloud phenomena on Venus at visual wavelengths can be considerably improved. Without neglecting routine visual work, comprised of making drawings at the eyepiece and filling out vital information on standardized observing forms, the ALPO Venus Section urges observers to try digital imaging of Venus at UV and IR wavelengths. The morphology of features captured at UV and IR wavelengths can appear quite different from visual impressions, particularly atmospheric radial dusky patterns (in the UV) and the appearance of the dark hemisphere (in IR). Similarities do occasionally occur, however, between images taken at UV wavelengths and drawings made with blue and violet filters. The more of these that the ALPO Venus Section receives during an observing season, the more interesting are the comparisons of what can or cannot be detected visually versus what is captured with digital imagers at different wavelengths.

Figure 3

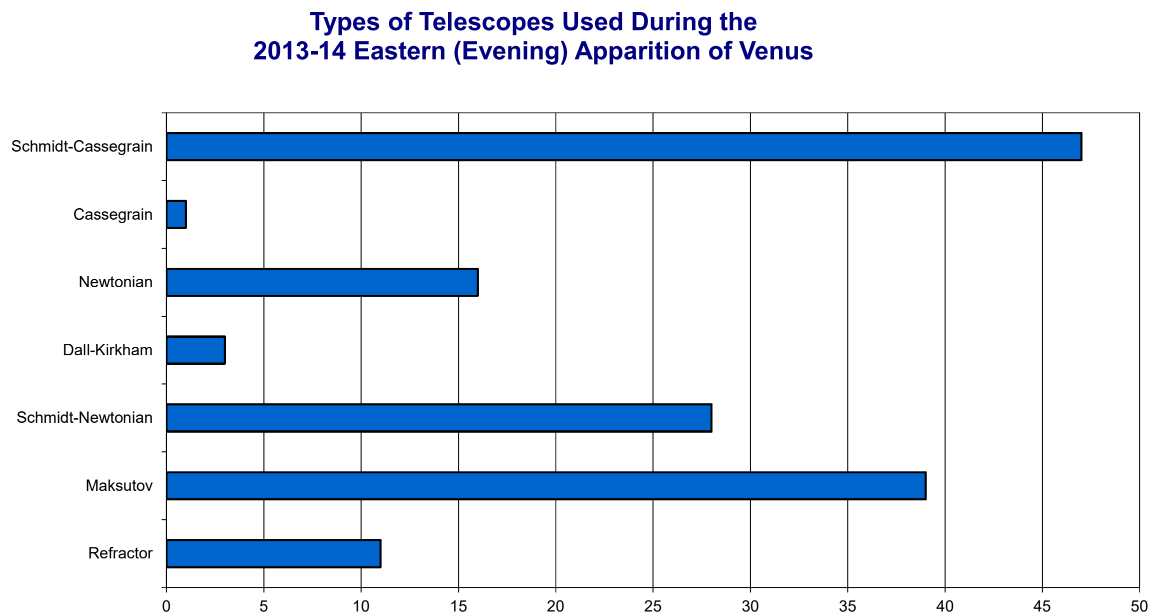


Figure 4

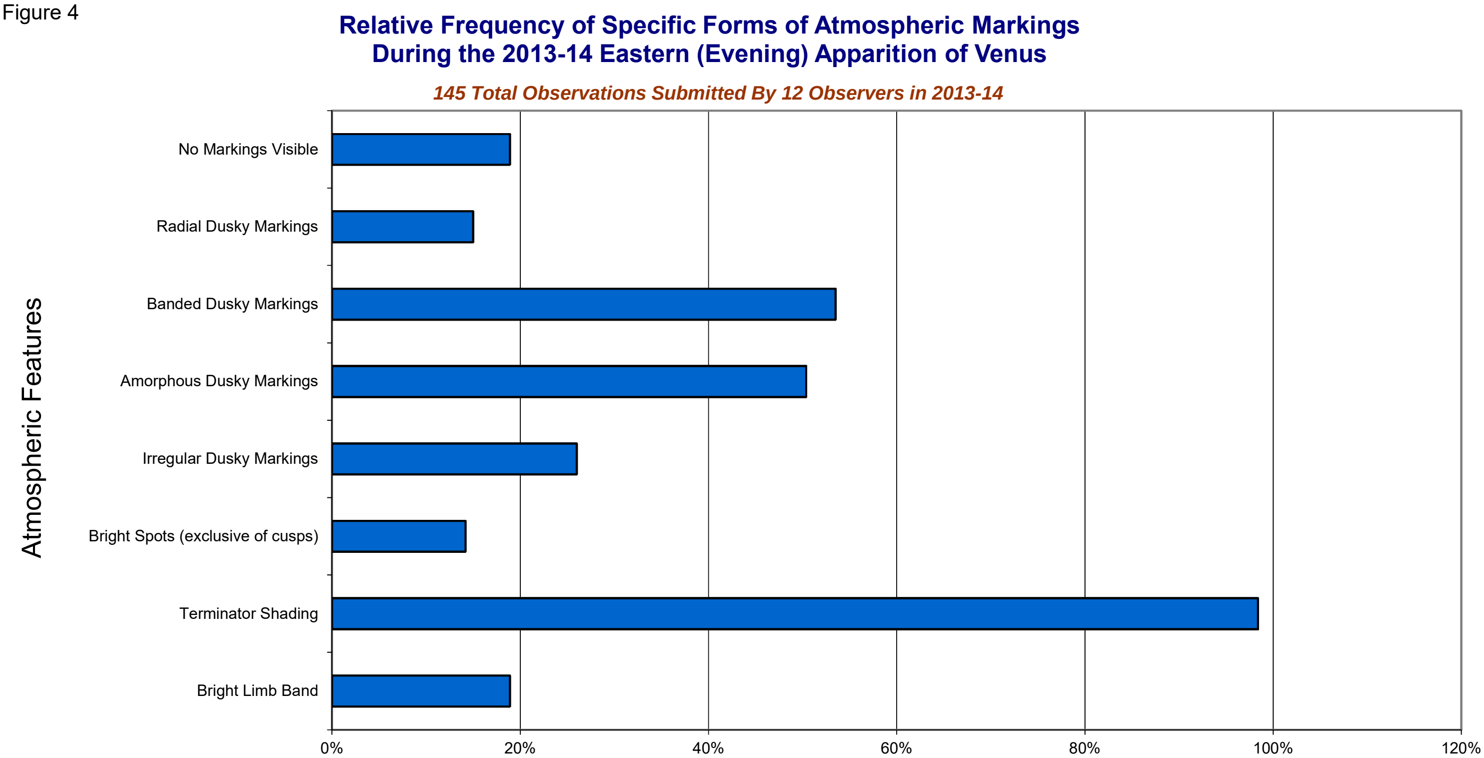


Figure 5

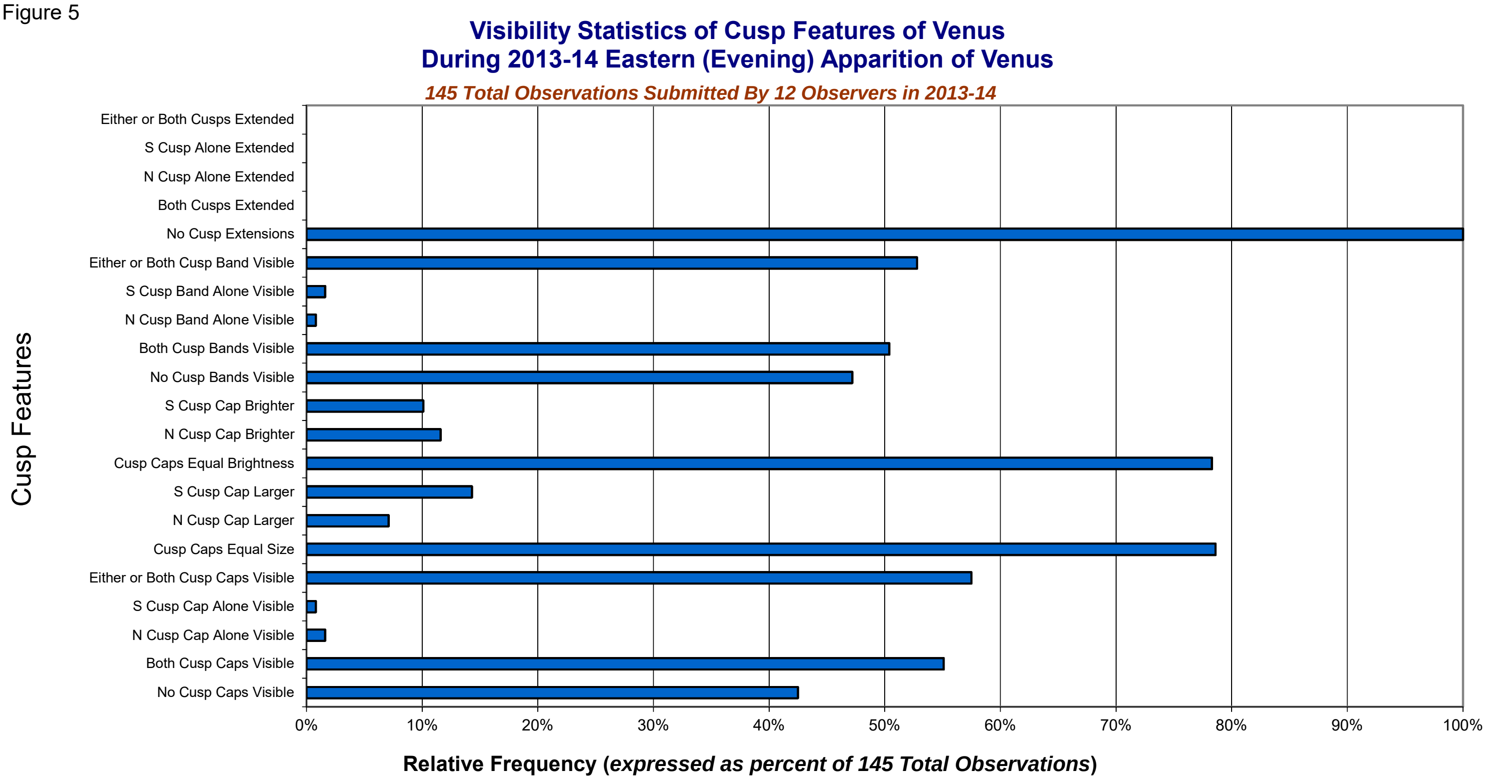


Figure 4 illustrates that in 18.9% of the observations submitted this apparition the bright disc of Venus was considered as being completely devoid of atmospheric features. When dusky features were seen or suspected, or imaged, the Banded Dusky Markings" were reported 53.5% of the time, "Amorphous Dusky Markings" in 50.4% of the reports, and "Irregular Dusky Markings" (26.0%) [Refer to Illustrations No. 001, 002, 003, 004, 005, 006, 007, and 012].The "Radial Dusky Markings" comprised 15.0% of the reports, to include horizontal V, Y, or ψ (psi) shaped dusky clouds that are frequently aligned along the planet's equator [Refer to Illustrations No. 008, 009, and 010]. The latter are typically only revealed in UV images.

Terminator shading was reported in 98.4% of the observations, as shown in Figure 4. Terminator shading usually extended from one cusp of Venus to the other, and the dusky shading was progressively lighter in tone (higher intensity) from the region of the terminator toward the bright planetary limb. Many visual observers described this upward gradation in brightness as ending in the Bright Limb Band [Refer to Illustrations No. 011], while a considerable number of images at visual and UV wavelengths showed terminator shading [Refer to Illustrations No. 012, 013, and 014].

The mean numerical relative intensity for all of the dusky features on Venus this apparition averaged about 8.9. The ALPO Scale of Conspicuousness (a numerical sequence from 0.0 for "definitely not seen" up to 10.0 for "definitely seen") was used regularly, and the dusky markings in Figure 4 had a mean conspicuousness of ~3.0 throughout the apparition, suggesting that the atmospheric features on Venus were within the range from very indistinct impressions to fairly strong indications of their actual presence.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusps, were seen or suspected in 14.2% of the submitted visual observations and images [Refer to Illustrations No. 004, 005, 011, 013, 015, and 016]. As a usual practice, when visual observers detect such bright areas, it is an ordinary practice to denote them on drawings by using dotted lines to surround them.

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

The Bright Limb Band

Figure 4 illustrates that 18.9% of the submitted observations this apparition referred to a conspicuous "Bright Limb Band" on the illuminated hemisphere of Venus. When the Bright Limb Band was visible or imaged, it appeared as a continuous, brilliant arc running from cusp to cusp 50.0% of the time, and interrupted or only marginally visible along the limb of Venus in 50.0% of the positive reports. The bright limb band was more likely to be incomplete in UV images than those captured at visual wavelengths or as depicted on submitted drawings. The mean numerical intensity of the Bright Limb Band was 9.8, seemingly a bit more obvious when color filters or variable-density polarizers were used. This very bright feature, described by visual observers and imaged as well this apparition [Refer to Illustrations No. 006, 008, 011, 017, and 018].

Terminator Irregularities

The terminator is the geometric curve that separates the brilliant sunlit and dark hemispheres of Venus. A deformed or asymmetric terminator was reported in 37.8% of the observations. Amorphous, banded, and irregular dusky atmospheric markings frequently seemed to merge with the terminator shading, possibly contributing to some of the reported incidences of irregularities. Filter techniques usually improved the visibility of terminator asymmetries and associated dusky atmospheric features. Bright features adjacent to the terminator can occasionally take the form of bulges, while darker markings may appear as wispy hollows [Refer to Illustrations No. 019 and 020].

Cusps, Cusp-Caps, and Cusp-Bands

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

Table 3: Ashen Light Observations During the 2013-14 Eastern (Evening) Apparition of Venus

UT Date and Time		X	*k*	Observational Notes
2013 Sep 05	13:11 UT	225	0.722	Ashen Light suspected in IL (Integrated Light)
2013 Nov 25	16:58 UT	210	0.347	Ashen Light suspected in IL (Integrated Light)
2013 Dec 10	16:13 UT	82	0.227	Ashen Light definitely present in IL (Integrated Light)
2013 Dec 13	15:41 UT	163	0.200	Ashen Light suspected in IL (Integrated Light)
2013 Dec 16	15:51 UT	82	0.172	Ashen Light definitely present in IL (Integrated Light)

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

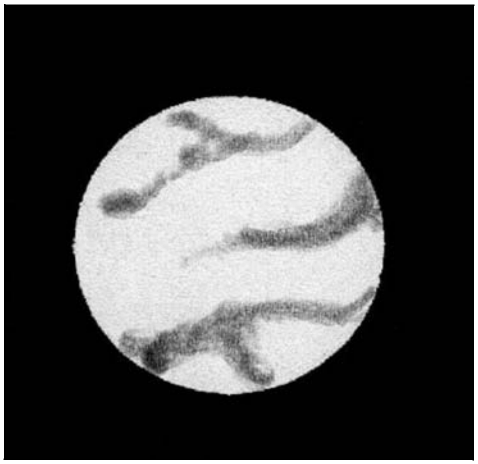


Illustration 001 2013 April 15 09:40 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 82X and UG3 filter. Seeing 3.0 (interpolated). Transparency (not specified). Phase (k) = 0.997, Apparent Diameter = 9.8". Drawing shows nearly full disk of Venus with banded and irregular dusky markings approximately 3 weeks after superior conjunction. S is at the top of the image.

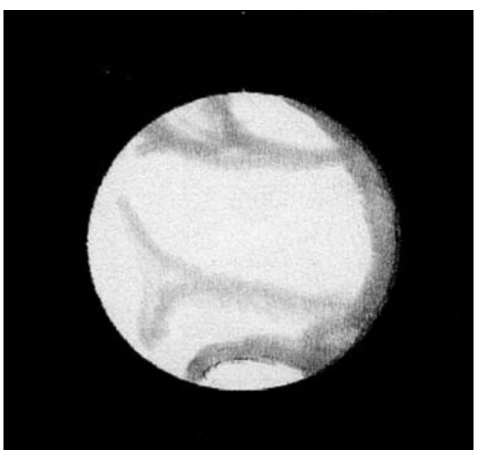


Illustration 002 2013 May 04 11:35 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 163X and UG3 filter. Seeing 3.0 (interpolated). Transparency (not specified). Phase (k) = 0.986, Apparent Diameter = 9.9". Drawing depicts the gibbous disk of Venus with banded and irregular dusky markings, N and S cusp caps and cusp bands, and terminator shading. S is at the top of the image.

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

When the northern and southern cusp-caps of Venus were reported this observing season, Figure 5 graphically shows that these features were equal in size 78.6% of the time and in brightness in 78.3% of the observations. Also, there were several instances when the southern and northern cusp-caps were larger and brighter than each other. Both cusp-caps were visible in 55.1% of the observational reports, and their mean relative intensity averaged 9.6 during the observing season. Dusky cusp-bands were detected flanking the bright cusp-caps in 50.4% of the observations when cusp-caps were visible. When seen, the cusp-bands displayed a mean relative intensity of about 7.6 (see Figure 5) [Refer to Illustrations No. 003, 004, 005, 008, 013, and 021].

Cusp Extensions

None of the submitted visual observations during the apparition called attention to cusp extensions beyond the 180° expected from simple geometry in integrated light or with color filters (see Figure 5). The same impression occurred with digital images of Venus this observing season. Experience has shown that cusp extensions are notoriously hard to image because the sunlit regions of Venus are overwhelmingly brighter than faint cusp extensions, but observers are still encouraged to try to record these features using digital imagers in upcoming apparitions.

Estimates of Dichotomy

A discrepancy between predicted and observed dates of dichotomy (half-phase)

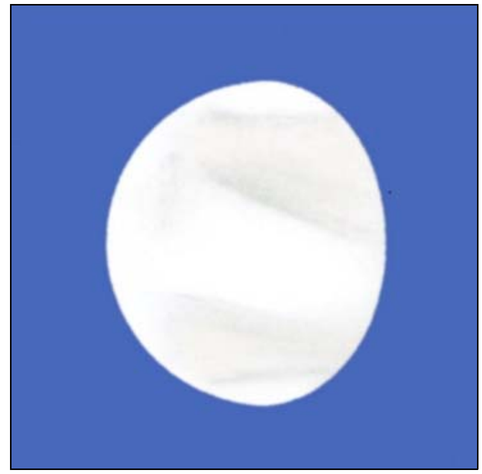


Illustration 003 2013 June 04 16:47 UT. Drawing in daylight by Paul G. Abel. 20.3 cm (8.0 in.) NEW at 200X and 222X using W21 (orange) filter. Seeing 5.0 (interpolated). Transparency described as good but not numerically rated. Phase (k) = 0.951, Apparent Diameter = 10.4". Amorphous and banded dusky markings are represented in this drawing along with the slightly larger and brighter S cusp cap; both cusp bands are seen. S is at the top of the image.

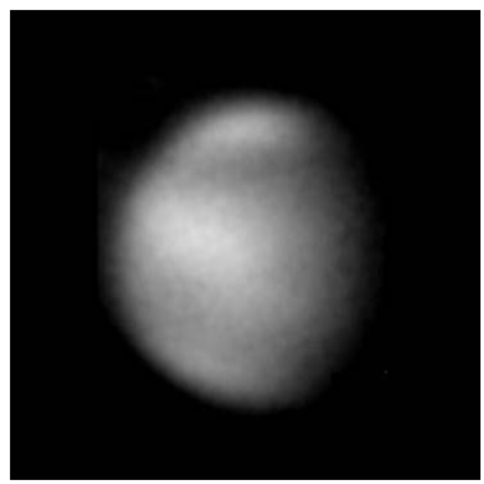


Illustration 004 2013 July 16 16:29 UT. Digital image by H.G. Lindberg. 25.4 cm (10.0 in.) SCH-NEW at 365nm UV. Seeing (not specified). Transparency (not specified). Phase (k) = 0.868, Apparent Diameter = 11.8". Banded dusky markings are apparent along with N and S cusp caps and cusp bands, as well as a bright area toward the E limb. S is at the top of the image.

is often referred to as the "Schröter Effect" on Venus. The predicted half-phase occurs when k = 0.500, and the

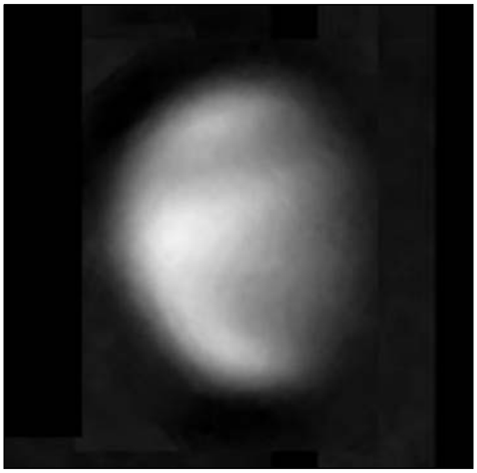


Illustration 005 2013 July 26 16:30 UT. Digital image by H.G. Lindberg. 25.4 cm (10.0 in.) SCH-NEW at 365nm UV. Seeing (not specified). Transparency (not specified). Phase (k) = 0.842, Apparent Diameter = 12.3". Amorphous and banded dusky markings are apparent along with N and S cusp caps and cusp bands, as well as a bright area toward the E limb. S is at the top of the image.

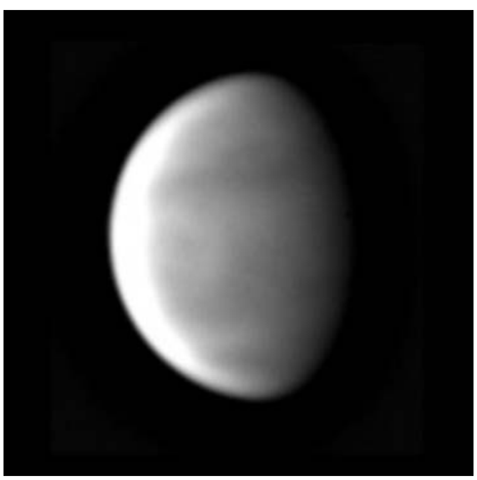


Illustration 006 2013 August 10 15:20 UT. Digital Image by Christophe Pellier. 62.0 cm (24.4 in.) CAS at 800nm IR. Seeing (not specified). Transparency (not specified). Phase (k) = 0.801, Apparent Diameter = 13.3". Banded and amorphous dusky markings, as well as the bright limb band from cusp to cusp, including a bright area midway between the cusps, in this superb image taken in the IR. S is at the top of the image.

phase angle, i, between the Sun and the Earth as seen from Venus equals 90°. Although theoretical dichotomy occurred on October 31, 2014 at 03:21:36 UT (31.14d), systematic visual dichotomy estimates were not submitted during this apparition.

Ashen Light Observations

The Ashen Light, reported the first time by G. Riccioli in 1643, is an extremely elusive, faint illumination of Venus' dark hemisphere. Some observers describe the Ashen Light as resembling Earthshine on the dark portion of the Moon, but the origin of the latter is clearly not the same. It is natural to presuppose that Venus should ideally be viewed against a totally dark sky for the Ashen Light to be detectable, but such circumstances occur only when the planet is very low in the sky where poor seeing adversely affects viewing. The substantial glare from Venus in contrast with the surrounding dark sky is a further complication. Nevertheless, the ALPO Venus Section continues to receive reports from experienced observers viewing the planet in twilight who are absolutely convinced they have seen the Ashen Light, and so the controversy continues. There were no digital images that were submitted suggesting the presence of the Ashen Light during 2013-14 Eastern (Evening) Apparition, but as shown in Table 3, five visual observations by Detlev Niechoy, observing from Göttingen, Germany, called attention to its occurrence in Integrated Light (no filter) in September, November, and especially in December with a 25.4 cm (10.0 in.) SCT [Refer to Illustrations No. 022, 023, and 024].

Venus observers are encouraged to monitor the dark side of Venus using digital imagers to try to capture any illumination that may be present on the planet, ideally as part of a cooperative simultaneous observing endeavor with visual observers.

There were no instances when the dark hemisphere of Venus allegedly appeared

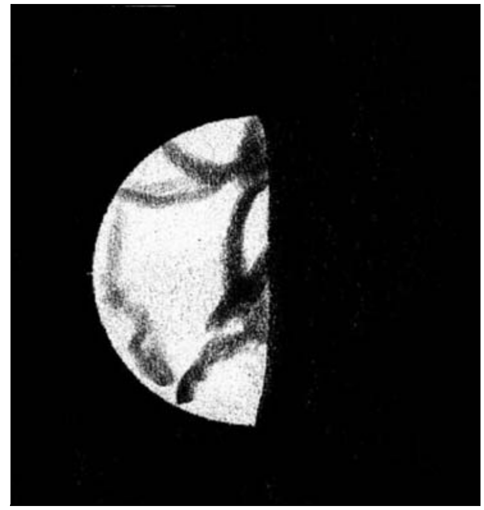


Illustration 007 2013 September 27 12:58 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 163X in Integrated Light (no filter). Seeing 3.0 (interpolated), Transparency (not specified). Phase (k) = 0.695, Apparent Diameter = 16.3". Irregular and banded dusky markings appear in this sketch as well as the bright limb band and both cusp caps and cusp bands. S is at the top of the image.

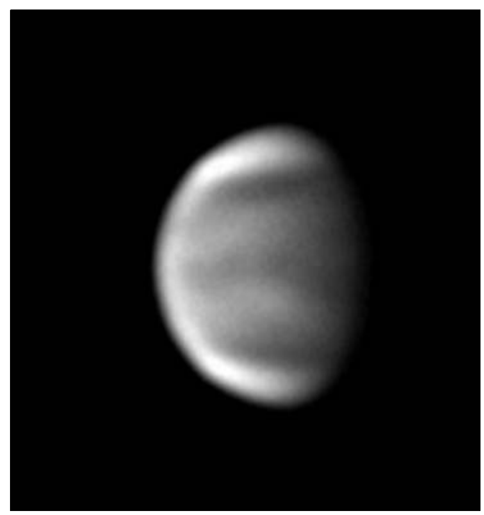


Illustration 008 2013 August 10 15:42 UT. Digital Image by Christophe Pellier. 62.0 cm (24.4 in.) CAS at 370nm UV. Seeing (not specified). Transparency (not specified). Phase (k) = 0.801, Apparent Diameter = 13.3". Banded dusky markings and Y shaped dusky clouds common on UV images are depicted in this image, as well as the bright limb band from cusp to cusp, plus cusp caps and cusp bands. S is at the top of the image.

darker than the background sky during the 2013-14 Eastern (Evening)

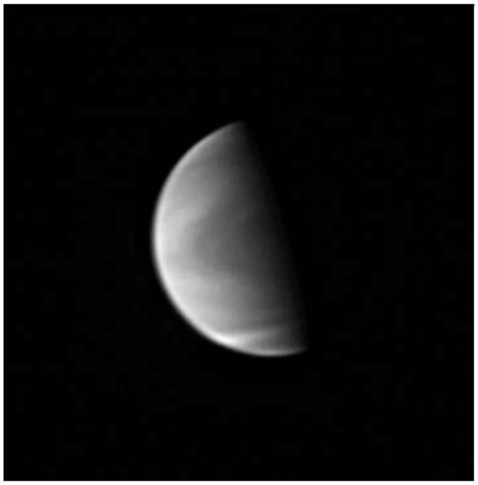


Illustration 009 2013 October 12 07:18 UT. Digital image by Anthony Wesley. 36.8 cm (14.5 in.) NEW at 350nm UV. Seeing (not specified). Transparency (not specified). Phase (k) = 0.587, Apparent Diameter = 20.5". Y and ψ (psi) shaped dusky clouds are aligned along the planet's equator along with banded dusky markings, the bright limb band from cusp to cusp, and a curious bright streak appears near the N cusp in the marvelously detailed image. S is at the top of the image.

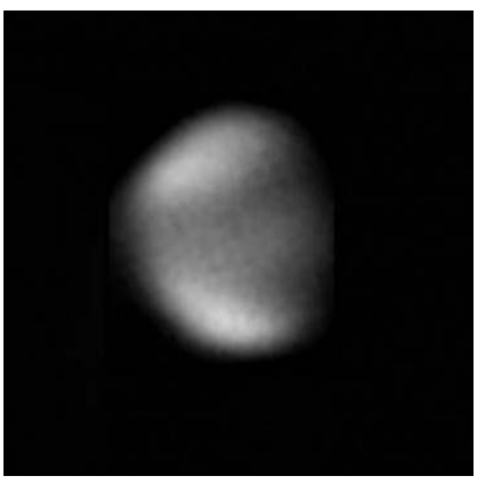


Illustration 010 2013 July 24 16:09 UT. Digital image by H.G. Lindberg. 25.4 cm (10.0 in.) SCH-NEW at 365nm UV. Seeing (not specified). Transparency (not specified). Phase (k) = 0.848, Apparent Diameter = 12.2". Both cusp caps are seen in this image that includes V shaped dusky features near the planet's equatorial region. S is at the top of the image.

Apparition, a phenomenon that is likely nothing more than a spurious contrast effect.

Dark Hemisphere Thermal Emission at IR Wavelengths

Since the instrumentation and methodology are not really complicated, the ALPO Venus Section encourages observers to pursue systematic imaging of the planet in the near-IR at about 1000nm. At these wavelengths, the hot surface of the planet becomes quite apparent and occasionally mottling shows up in such images, attributable to the presence of cooler, dark, higher-elevation terrain and warmer, bright, lower surface areas in the IR.

At least one observer during the 2013-14 Eastern (Evening) Apparition (namely Frank Melillo of Holtsville, NY) attempted imaging the crescent of Venus at 1000nm near-IR wavelength images from December 18th through 28th. In particular, the image he submitted for December 27th at 22:10 UT in average seeing conditions showed the most detail within the planet's dark hemisphere [refer to Illustration No. 025].

Simultaneous Observations

The atmospheric features and phenomena of Venus are elusive, and it not unusual for two observers looking at Venus at the same time to derive somewhat different impressions of what is seen. Our challenge is to establish which features are real on any given date of observation, and the only way to build confidence in any database is to increase observational coverage on the same date and at the same time. Therefore, the ideal scenario would be to have simultaneous observational coverage throughout any apparition. Simultaneous observations are defined as independent, systematic, and standardized studies of Venus carried out by a large group of observers using the same techniques, similar equipment, and identical observing forms to record what is seen. While this standardized approach emphasizes a thorough visual coverage

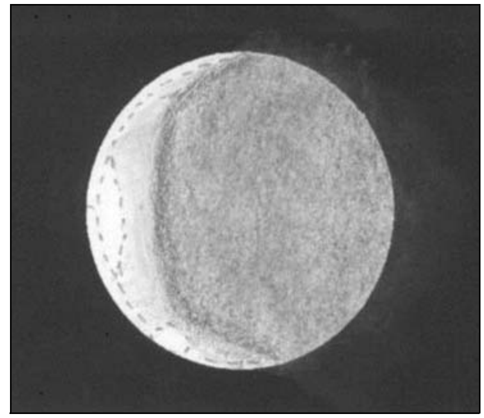


Illustration 011 2013 December 16 15:01 UT. Drawing by Michel Legrand. 21.0 cm (8.3 in.) NEW at 157X to 210X using W80A (blue), W38 (deep blue), W47 (violet), W58 (green), W21 (orange), and W25 (red) filters to make the sketch. Seeing = 4.0, Transparency = 4.0. Phase (k) = 0.173, Apparent Diameter = 48.4". Terminator shading and banded dusky markings are seen in the drawing, along with the bright limb band from cusp to cusp and bright regions adjacent to the bright limb band. S is at the top of the image.

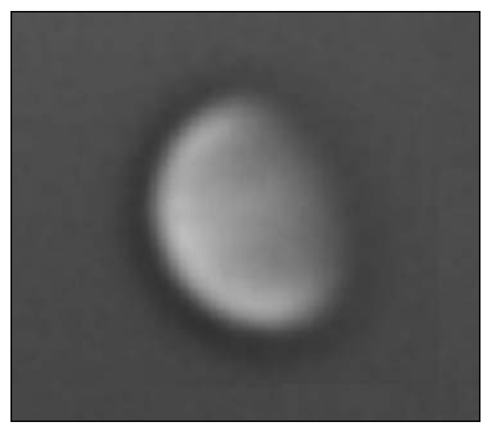


Illustration 012 2013 August 08 16:30 UT. Digital image by Raffaello Braga. 21.0 cm (8.3 in.) DALL with W47 (violet) filter. Seeing = 5.0 (interpolated), Transparency (not specified). Phase (k) = 0.807, Apparent Diameter = 13.1". Along with terminator shading, banded dusky markings are visible in this image plus both cusp caps and cusp bands and the bright limb band. S is at the top of the image.

of Venus, it is also intended to stimulate routine digital imaging of the planet at visual and various other wavelengths, such as infrared and ultraviolet. By these exhaustive efforts, we would hope to be able to at least partially answer some of the questions that persist about the existence and patterns of atmospheric phenomena on Venus.

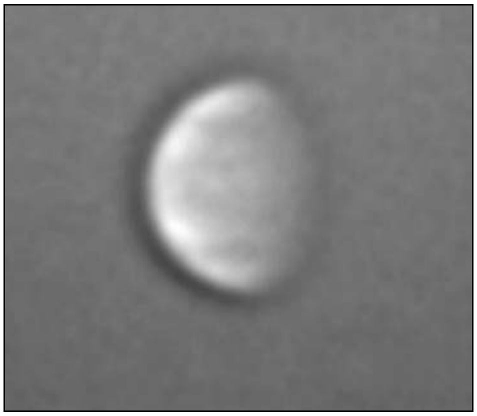


Illustration 013 2013 August 16 16:19 UT. Digital image by Raffaello Braga. 12.7 cm (5.0 in.) MAK with W47 (violet) filter. Seeing described as poor b UT not numerically rated, Transparency (not specified). Phase (k) = 0.784, Apparent Diameter = 13.7”. Banded dusky markings are visible in this image along with both cusp caps and cusp bands, terminator shading, the bright limb band, and a pair of bright regions along the E limb of Venus. S is at the top of the image.

Illustration 014 2013 September 28 22:00 UT. Digital image by Frank Melillo. 25.4 cm (10.0 in.) SCT using Schott UG-1 UV filter. Seeing = 5.0, Transparency (not specified). Phase (k) = 0.640, Apparent Diameter = 18.3”. Terminator shading and amorphous dusky features are apparent in this UV image, including a possible bright spot along the limb toward the S. S is at the top of the image.

Amateur-Professional Cooperative Programs

The ALPO Venus Section continues to routinely share visual observations and digital images at various wavelengths with the professional community. As readers will recall, the European Space Agency’s Venus Express (VEX) mission that started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in May 2006, ended its highly successful campaign early in 2015 as it made its final descent into the atmosphere of the planet. It was a tremendously successful Pro-Am collaborative effort involving ALPO Venus observers around the globe, and those who actively participated are commended for their perseverance and dedication. It should be emphasized that it is still not too late for those who want to send their digital images to the ALPO Venus Section and the VEX website (see below) to do so. Sought after also are drawings of Venus in Integrated Light and with color filters of known transmission while the VEX mission was in progress. These collective data are important for further study and will continue to be analyzed for several years to come as a result of this endeavor. The VEX website is *http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38833&fbodylongid=1856*.

As of this writing, the ALPO Venus Section is formulating plans for an ALPO Pro-Am cooperative with Japan’s (JAXA) Akatsuki mission that was to start full-scale observations in April 2016. There will be more news forthcoming on this potential endeavor in later updates in this Journal.

Conclusions

Analysis of ALPO observations of Venus during the 2013-14 Eastern (Evening) Apparition revealed that vague shadings on the disc of the planet were routinely

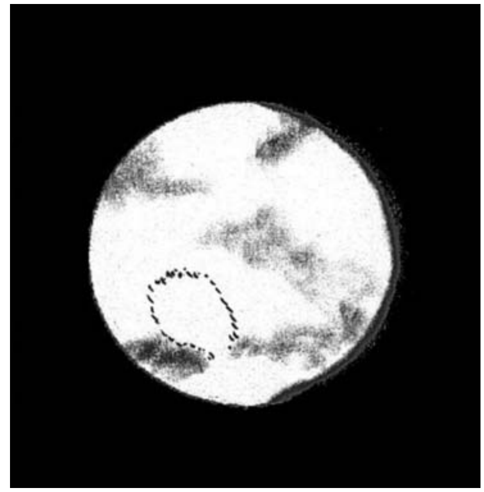


Illustration 015 2013 June 18 14:46 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 82X in Integrated Light (no filter). Seeing 2.0 (interpolated), Transparency (not specified). Phase (k) = 0.928, Apparent Diameter = 10.8”. Amorphous and irregular dusky markings are visible including a bright spot toward the S on the disk of Venus. S is at the top of the image.

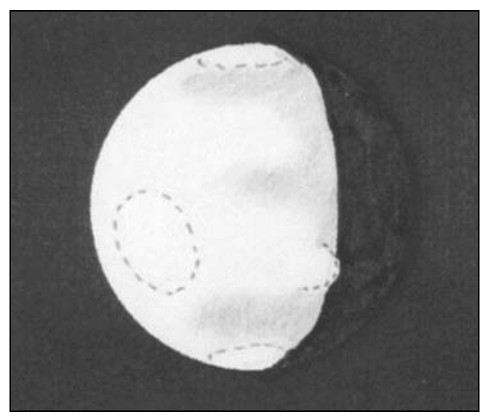


Illustration 016 2013 August 22 13:53 UT. Drawing by Michel Legrand. 21.0 cm (8.3 in.) NEW at 157X to 210X using W38 (deep blue) and W25 (red) filters. Seeing = 4.0, Transparency = 4.0. Phase (k) = 0.766, Apparent Diameter = 14.1”. Banded dusky markings and bright spots are illustrated in this sketch along with both cusp caps and cusp bands. One of the bright spots appears to extend across the terminator in the N. S is at the top of the image.



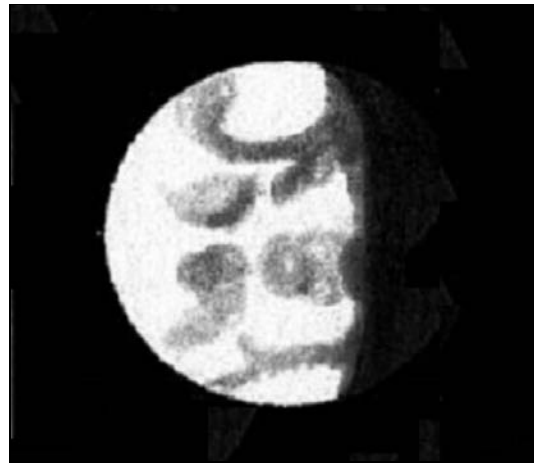


Illustration 017 (left) 2013 September 27 13:25 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 225X with a W25 (red). Seeing 2.5 (interpolated), Transparency (not specified). Phase (k) = 0.645, Apparent Diameter = 18.1". Along with irregular dusky markings the bright limb band is indicated in this sketch. S is at the top of the image.
Illustration 018 (center) 2013 July 30 02:39 UT. Digital image by Rik Hill. 20.3 cm (8.0 in.) MAK using UV filter. Seeing = 7.0, Transparency (not specified). Phase (k) = 0.833, Apparent Diameter = 12.5". The bright limb is visible b UT discontinuous toward the S along the limb. Both cusp caps and cusp bands are seen as well as amorphous dusky shadings. S is at the top of the image.
Illustration 019 (right) 2013 August 16 12:16 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 82X in Integrated Light (no filter). Seeing 2.0 (interpolated), Transparency (not specified). Phase (k) = 0.784, Apparent Diameter = 13.7". The shaded terminator appears deformed along its extent from N to S with irregular and amorphous dusky markings across the disk. S is at the top of the image.

apparent to visual observers who employed standardized filter techniques to help see the notoriously elusive atmospheric features. It usually very difficult to be certain visually what is real and what is merely illusory at visual wavelengths in the atmosphere of Venus, but improved confidence in visual results continues to occur with a higher incidence of simultaneous observations in recent apparitions. Readers and potential observers should realize that well-executed drawings of Venus remain a vital part of our overall program as we seek to enhance the opportunity for confirmation of highly elusive atmospheric phenomena, to introduce more objectivity, and to standardize observational techniques and methodology. It is also especially nice to see that more Venus observers are contributing digital images of the planet at visual, near-UV, and near-IR wavelengths, plus it is encouraging to see observers using visual methods concurrently with others employing digital imaging to provide comparable results. For example, atmospheric banded features and radial ("spoke") patterns depicted on drawings often look strikingly similar to those captured with digital imagers at the same date and time.

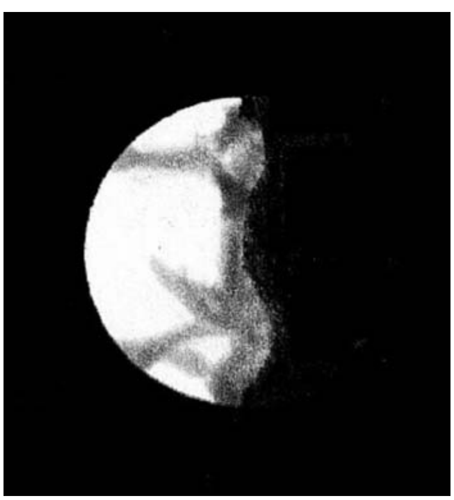
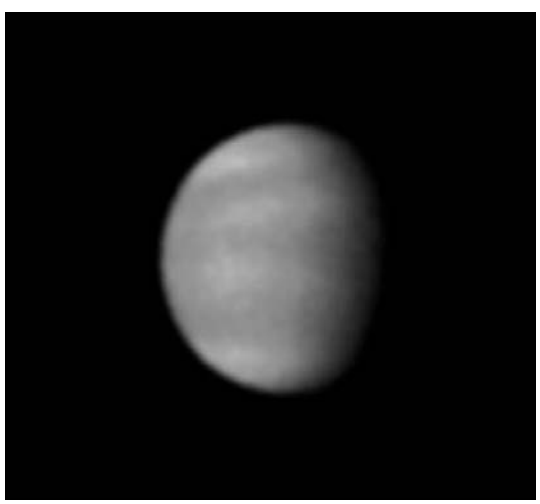



Illustration 020 (left) 2013 September 29 13:24 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 225X with W25 (red). Seeing 3.0 (interpolated), Transparency (not specified). Phase (k) = 0.637, Apparent Diameter = 18.4". The shaded terminator appears markedly irregular along its extent from N to S. Amorphous and irregular dusky markings are seen along with both cusp caps and cusp bands. S is at the top of the image.
Illustration 021 (right) 2013 August 01 17:35 UT. Digital image by John Sussenbach. 28.0 cm (11.0 in.) SCT with UV filter. Seeing (not specified). Transparency (not specified). Phase (k) = 0.826, Apparent Diameter = 12.7". Both cusp caps and cusp bands are quite distinct in this excellent UV image along with terminator shading and banded dusky markings. S is at the top of the image.

Active international cooperation by individuals making regular systematic, simultaneous observations of Venus remain our main objective, including visual work and digital imaging, and our efforts as part of the aforementioned Pro-Am cooperatives continue. The ALPO Venus Section encourages interested readers to join us in our many projects and challenges in the coming years.

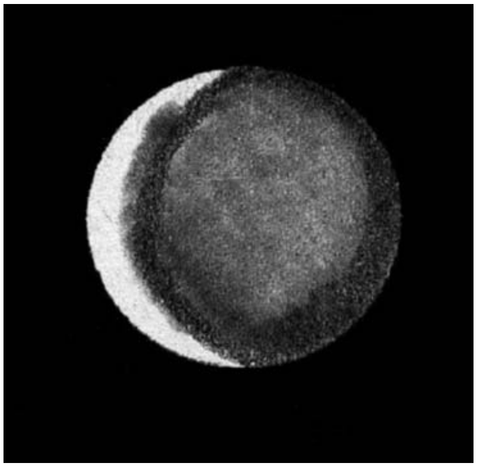


Illustration 022 2013 December 10 16:13 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 82X in Integrated Light (no filter). Seeing 3.0 (interpolated), Transparency (not specified). Phase (k) = 0.227, Apparent Diameter = 43.9”. Ashen Light was reported as definitely visible roughly centered within the otherwise dark hemisphere of Venus. S is at the top of the image.

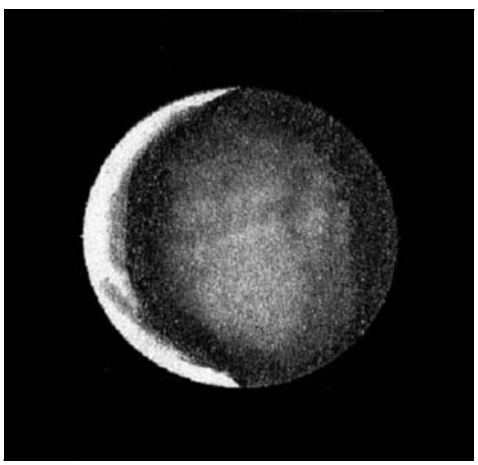


Illustration 023 2013 December 13 15:41 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 163X in Integrated Light (no filter). Seeing 3.0 (interpolated), Transparency (not specified). Phase (k) = 0.200, Apparent Diameter = 46.1”. The shaded terminator appears markedly irregular along its extent from N to S. Ashen Light was again strongly suspected centrally within the dark hemisphere of Venus. S is at the top of the image.

References

Benton, Julius L., Jr., (2002). *An Introduction to Observing Venus*. Savannah, GA: Review Publishing Co. Available from the author at jlbaina@msn.com

———, (2015), “ALPO Observations of Venus During the 2010 Eastern (Evening) Apparition of Venus.” Journal of the Assn of Lunar and Planetary Observers, 57, No. 2 (Summer), 22-33. *http://www.alpo-astronomy.org/djalpo/57-2/DJALPO57-2-Spring2015.pdf*

-———, (2016), “ALPO Observations of Venus During the 2011-12 Eastern (Evening) Apparition of Venus.” Journal of the Assn of Lunar and Planetary Observers, 58, No. 3 (Summer 2016).

de Pater, Imke and Lissauer, Jack J., (2013). Fundamental Planetary Science. New York: Cambridge University Press. *http://www.amazon.com/Fundamental-Planetary-Science-Chemistry-Habitability/dp/052161855X*

Hunten, D.M., et al, eds. (1983). “*Venus.”* Tucson: University of Arizona Press. *http://www.uapress.arizona.edu/BOOKS/bid222.htm*

United States Naval Observatory. The Astronomical Almanac. Washington: U.S. Government Printing Office. (Annual Publication; the 2013 and 2014 editions, which were published in 2012 and 2013, respectively, were used for this report.

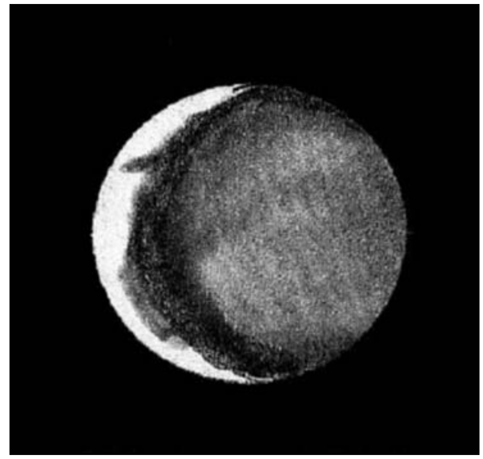


Illustration 024 2013 December 16 15:57 UT. Drawing by Detlev Niechoy. 20.3 cm (8.0 in.) SCT at 163X in Integrated Light (no filter). Seeing 3.0 (interpolated), Transparency (not specified). Phase (k) = 0.172, Apparent Diameter = 48.5”. Yet another suspicion of the Ashen Light being present within the dark hemisphere of Venus. S is at the top of the image.

Illustration 025 2013 December 27 22:10 UT. Digital image by Frank Melillo. 25.4 cm (10.0 in.) SCT using 1000nm IR filter. Seeing = 5.0, Transparency (not specified). Phase (k) = 0.070, Apparent Diameter = 57.3”. At 1000nm IR wavelength the hot surface of Venus shows obvious mottling in this image of the dark hemisphere. The crescent of Venus is intentionally overexposed in order to catch the faint thermal glow of the dark side. S is at the top of the image.

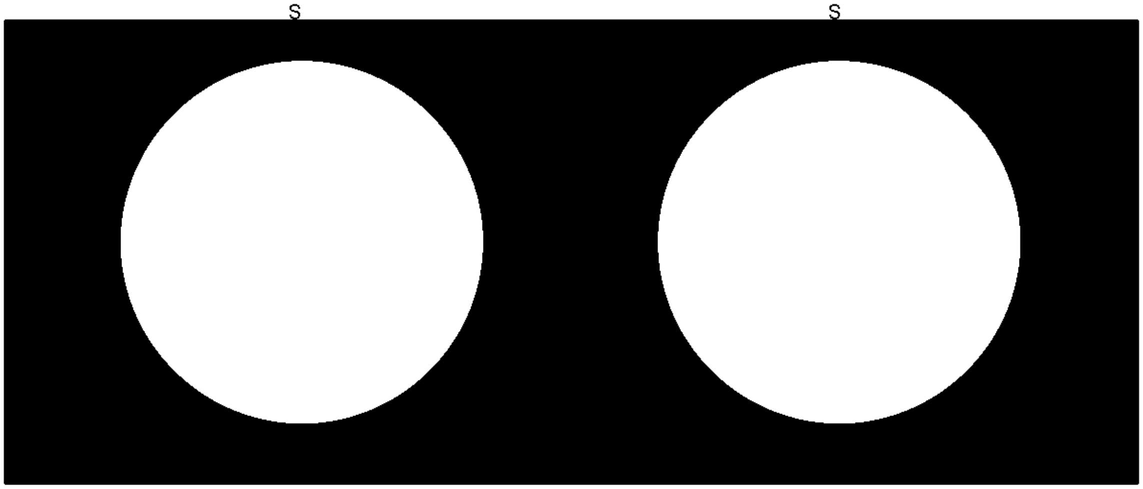
Association of Lunar and Planetary Observers (A.L.P.O.): Venus Section

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

Drawing Blank *Intensity Estimates Blank*

S S

p *f*



N (*all coordinates are IAU*) N

Observer______________________________Location____
UT Date _____________ UT Start _______________ UT End _______________ D = __________″ k_m = __________ k_c = ___________
m_v = ___________ Instrument ____ Magnification(s) _____________ x_{min} _____________ x_{max}
Filter(s) IL(none) __________ f_1 __________ f_2 __________ f_3 ___________ Seeing ______________ Transparency _______________

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

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

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

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

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

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

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

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

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

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

ALPO Resources

People, publications, etc., to help our members

Board of Directors

http://www.alpo-astronomy.org/main/board.html

- Member of the Board; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410; *jlbaina@msn.com* (preferred) and *jbenton55@comcast.net*
- Member of the Board; Sanjay Limaye, University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bldg. 1017, 1225 W. Dayton St., Madison, WI 53706; *sanjayl@ssec.wisc.edu*
- Member of the Board; Ken Poshedly, 1741 Bruckner Ct., Snellville, GA 30078-2784; *ken.poshedly@alpo-astronomy.org*
- Executive Director; Mike D. Reynolds, Dean of Liberal Arts & Sciences, Florida State College at Jacksonville, 3939 Roosevelt Blvd, F-112b, Jacksonville, FL 32205; *m.d.reynolds@fscj.edu*
- Associate Executive Director; Richard W. Schmude, Jr., Gordon State College, 419 College Dr., Barnesville, GA 30204; *schmude@gordonstate.edu*
- Member of the Board; John E. Westfall, 5061 Carbondale Way, Antioch, CA 94531; *johnwestfall@comcast.net*
- Member of the Board, Secretary/Treasurer; Matthew Will, P.O. Box 13456, Springfield, IL 62791-3456; *matt.will@alpo-astronomy.org*
- Founder/Director Emeritus; the late Walter H. Haas

Publications Staff

Publisher & Editor-in-Chief

- Ken Poshedly (all papers, submissions, etc, ALPO-Member-Discussion e-mail group moderator); 1741 Bruckner Ct, Snellville, GA 30078-2784; *ken.poshedly@alpo-astronomy.org*

Book Review Editor

- Robert A. Garfinkle, F.R.A.S., 32924 Monrovia St., Union City, CA 94587-5433; *ragarf@earthlink.net*

Interest Sections

Computing Section

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

- Coordinator; Larry Owens, 4225 Park Brooke Trace, Alpharetta, GA 30022; *larry.owens@alpo-astronomy.org*
- Acting Assistant Coordinator; Theo Ramakers, 130 Bluegrass Ct, Oxford, GA 30054; *theo@ceastronomy.org*

Lunar & Planetary Training Program

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

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

Online Section

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

- Coordinator (ALPO website); Larry Owens, 4225 Park Brooke Trace, Alpharetta, GA 30022; *larry@ceastronomy.org*
- Assistant Coordinator (ALPO social media); Steven Siedentop, 59 Mission Oak Dr., Grayson, GA 30017; *sdsiedentop@gmail.com*
- Acting Assistant Coordinator; Theo Ramakers, 130 Bluegrass Ct, Oxford, GA 30054; *theo@ceastronomy.org*

Youth Section

http://www.cometman.net/youth

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

Observing Sections

Eclipse Section

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

- Coordinator; Mike D. Reynolds, Dean of Liberal Arts & Sciences, Florida State College at Jacksonville, 3939 Roosevelt Blvd, F-112b, Jacksonville, FL 32205; *m.d.reynolds@fscj.edu*

Solar Section

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

- Coordinator & Scientific Advisor; Richard Hill, 10130 E. King Manor Dr., Tucson, AZ 85730; *rhill@lpl.arizona.edu*
- Acting Assistant Coordinator (new observers and ALPO Solar Section Online Image Archive contact); Theo Ramakers, 130 Bluegrass Ct, Oxford, GA 30054; *theo@ceastronomy.org*
- Acting Assistant Coordinator (primary moderator, ALPO Solar Section Yahoo email list); Rick Gossett, 20251 Lakeworth St., Roseville, MI. 48066; *rick2d2@sbcglobal.net*
- Acting Assistant Coordinator; Pam Shivak, P.O. Box 26288, Prescott Valley, AZ 86312; *pamelashivak@yahoo.com*

Mercury Section

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

- Coordinator; Frank J. Melillo, 14 Glen-Hollow Dr., E-#16, Holtsville, NY 11742; *frankj12@aol.com*

Venus Section

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

- Coordinator; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410; *jlbaina@msn.com* (preferred) and *jbenton55@comcast.net*

Mercury/Venus Transit Section

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

- Coordinator; John E. Westfall, 5061 Carbondale Way, Antioch, CA 94531; *johnwestfall@comcast.net*

Lunar Section

- Coordinator; Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080; *wayne.bailey@alpo-astronomy.org*
- Assistant Coordinator; William Dembowski, 219 Old Bedford Pike, Windber, PA 15963; *dembowski@zone-vx.com*
- Assistant Coordinator; Jerry Hubbell, 406 Yorktown Blvd, Locust Grove, VA 22508; *jerry.hubbell@comcast.net*

Lunar Topographical Studies Program

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

Lunar Selected Areas Program

http://moon.scopesandscapes.com/alpo-sap.html

ALPO Resources

People, publications, etc., to help our members

Banded Craters Program

http://moon.scopesandscapes.com/alpo-bcp.htm

Lunar Meteoritic Impacts Search Program

http://www.alpo-astronomy.org/lunar/lunimpacts.htm

- Coordinator; Brian Cudnik, 11851 Leaf Oak Drive, Houston, TX 77065; cudnik@sbcglobal.net

Lunar Transient Phenomena

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

- Coordinator; Dr. Anthony Charles Cook, Institute of Mathematical and Physical Sciences, University of Aberystwyth, Penglais, Aberystwyth, Ceredigion. SY23 3BZ, United Kingdom; tony.cook@alpo-astronomy.org
- Assistant Coordinator; David O. Darling, 416 West Wilson St., Sun Prairie, WI 53590-2114; DOD121252@aol.com

Mars Section

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

- Coordinator; Roger J. Venable, MD, P.O. Box 117, Chester, GA 31012; rjvmd@hughes.net
- Assistant Coordinator (CCD/Video imaging and specific correspondence with CCD/Video imaging); Open
- Assistant Coordinator (photometry and polarimetry); Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204; schmude@gordonstate.edu
- Assistant Coordinator; Jim Melka, 14176 Trailtop Dr., Chesterfield, MO 63017; jtmelka@yahoo.com

Minor Planets Section

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

- Coordinator; Frederick Pilcher, 4438 Organ Mesa Loop, Las Cruces, NM 88011; fpilcher35@gmail.com
- Scientific Advisor: Alan W. Harris, 4750 Walnut St, Suite 205, Boulder, CO 80301; awharris@spacescience.org
- Scientific Advisor; Dr. Petr Pravec, Ondrejov Observatory, Astronomical Institute, Academy of Sciences, Cz-25 165 Ondrejov, Czech Republic; ppravec@asu.cas.cz
- Asteroid Photometry Coordinator; Brian D. Warner, Center For Solar System Studies, 446 Sycamore Ave, Eaton, CO 80615; brian@MinorPlanetObserver.com

Jupiter Section

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

- Coordinator; Ed Grafton, 15411 Greenleaf Lane, Houston, TX 77062; ed@egrafton.com
- Assistant Coordinator (Apparition Reports); Richard W. Schmude Jr., 109 Tyus St., Barnesville, GA 30204; schmude@gordonstate.edu
- Assistant Coordinator/Program Coordinator, Galilean Satellite Eclipses; John E. Westfall, 5061 Carbondale Way, Antioch, CA 94531; johnwestfall@comcast.net
- Assistant Coordinator, Transit Timings; John McAnally, 2124 Wooded Acres, Waco, TX 76710; CPAJohnM@aol.com
- Assistant Coordinator, Newsletter; Craig MacDougal, 821 Settlers Road, Tampa, FL 33613; macdouc@verizon.net

Saturn Section

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

- Coordinator; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410; ; jlbaina@msn.com (preferred) and jbenton55@comcast.net

Remote Planets Section

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

- Coordinator; Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204; schmude@gordonstate.edu

Comets Section

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

- Coordinator; Carl Hergenrother, 4101 North Sunnywood Place, Tuscon, AZ 85749; chergen@lpl.arizona.edu
- Assistant Coordinator; Gary Kronk, 153 Samarra Estates Dr, Fenton, MO 63026; gkronk@gmail.com

Meteors Section

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

- Coordinator; Robert D. Lunsford, 1828 Cobblecreek St., Chula Vista, CA 91913-3917; lunro.imo.usa@cox.net
- Assistant Coordinator; Robin Gray, P.O. Box 547, Winnemuca, NV 89446; sevenvalleysent@yahoo.com

Meteorites Section

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

- Coordinator; Dolores Hill, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721; dhill@lpl.arizona.edu

****

ALPO Publications

The Monograph Series

http://www.alpo-astronomy.org/publications/Monographs page.html

ALPO monographs are publications that we believe will appeal to our members, but which are too lengthy for publication in *The Strolling Astronomer*. 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. 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.

ALPO Resources

People, publications, etc., to help our members

- **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;
  Schmidt1113.pdf, approx. 22.7 mb;
  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:** *(1) ALPO Mars Observers Handbook,* from the Astronomical League Sales, temporarily out of stock. *(2) Observing Forms;* send SASE to obtain one form for you to copy; otherwise send $3.60 to obtain 25 copies (send and make checks payable to “Deborah Hines”, see address under “Mars Section”).

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

- **Jupiter:** *(1) Jupiter Observer’s Handbook*, from the Astronomical League Sales, temporarily out of stock. (2) *Jupiter*, the ALPO section newsletter, available from Craig MacDougal at *macdouc@verizon.net;* (3) *ALPO_Jupiter*, the ALPO Jupiter Section e-mail network; to join, send a blank e-mail to *ALPO_Jupiter-subscribe@yahoogroups.com* (4) *Timing the Eclipses of Jupiter’s Galilean Satellites* free at *http://www.alpo-astronomy.org/jupiter/GaliInstr.pdf*, report form online at *http://www.alpo-astronomy.org/jupiter/GaliForm.pdf*; send SASE to John Westfall for observing kit and report form via regular

ALPO Resources

People, publications, etc., to help our members

mail. (5) *Jupiter Observer's Startup Kit*, $3 from Richard Schmude, Jupiter Section Coordinator.

- **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.

Back Issues of The Strolling Astronomer

Download JALPO43-1 thru the latest available issue as a pdf file from the ALPO Publications Section Gallery via the ALPO website at http://www.alpo-astronomy.org Note that the newest four issues are available for downloading only by ALPO members.

Some hard-copy back issues listed below may be out of stock with no guarantee of availability. Issues are sold on a first-come, first-served basis. Back issues are $4 each, and $5 for the current issue. Discounts available on orders over $30. Contact Secretary/ Treasurer Matthew Will for downloading instructions or to ordr hard copies (see address under "Board of Directors,"):

$4 each:
Vol. 16 (1962) Nos. 3-4
Vol. 17 (1963) Nos. 1-2
Vol. 19 (1965) Nos. 3-4
Vol. 29 (1981-83) Nos. 1-2 and 11-12
Vol. 30 (1983-84) Nos. 1-2, 7-8, 9-10
Vol. 32 (1987-88) Nos. 3-4, 10-12
Vol. 33 (1989) Nos. 10-12
Vol. 34 (1990) Nos. 1 and 3
Vol. 35 (1991) Nos. 1, 2, and 4
Vol. 36 (1992-93) Nos. 1, 2, 3, and 4
Vol. 37 (1993-94) Nos. 1, 2, 3, and 4
Vol. 38 (1994-96) Nos. 1, 2, 3, and 4
Vol. 39 (1996-97) Nos. 1, 2, 3, and 4
Vol. 40 (1998) Nos. 2 and 3
Vol. 41 (1999) Nos. 1, 2, and 3
Vol. 42 (2000) Nos. 1 and 4
Vol. 43 (2001) Nos. 1, 2, 3, and 4
Vol. 44 (2002) Nos. 1, 2, 3, and 4
Vol. 45 (2003) Nos. 1, 2, and 3 (no issue 4)
Vol. 46 (2004) Nos. 1, 2, 3, and 4
Vol. 47 (2005) Nos. 1, 2, 3, and 4
Vol. 48 (2006) Nos. 1, 2, 3, and 4
Vol. 49 (2007) Nos. 1, 2, 3, and 4
Vol. 50 (2008) Nos. 1, 2, 3, and 4
Vol. 51 (2009) Nos. 1, 2, 3, and 4
Vol. 52 (2010) Nos. 1, 2, 3, and 4
Vol. 53 (2011) Nos. 1, 2, 3, and 4
Vol. 54 (2012) Nos. 1, 2, 3, and 4
Vol. 55 (2013) Nos. 1, 2, 3 and 4
Vol. 56 (2014) Nos. 1, 2, 3 and 4
Vol. 57 (2015) Nos. 1, 2, 3 and 4
Vol. 58 (2016) Nos. 1, 2, 3 and 4
Vol. 59 (2017) Nos. 1 and 2

$5: Vol. 59 (2017) No. 3 (current issue)

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*, also called *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.

Subscription rates and terms are listed below (effective March 1, 2015).

We heartily invite you to join the ALPO and look forward to hearing from you.

- ..$US14 – 4 issues of the digital Journal only, all countries, e-mail address required
- ..$US24 – 8 issues of the digital Journal only, all countries, e-mail address required
- ..$US39 – 4 issues of the paper Journal only, US, Mexico and Canada
- ..$US72 – 8 issues of the paper Journal only, US, Mexico and Canada
- ..$US46 – 4 issues of the paper Journal only, all other countries
- ..$US86 – 8 issues of the paper Journal only, all other countries
- ..$US75 – Sustaining Member level, 4 issues of the digital and paper Journal, all countries
- ..$US150 – Sponsoring Member level, 4 issues of the digital and paper Journal, all countries

For your convenience, you may join online via the via the Internet or by completing the form at the bottom of this page.

To join or renew online, simply left-click on this Astronomical League web page:
http://www.astroleague.org/store/index.php?main_page=product_info&cPath=10&products_id=39

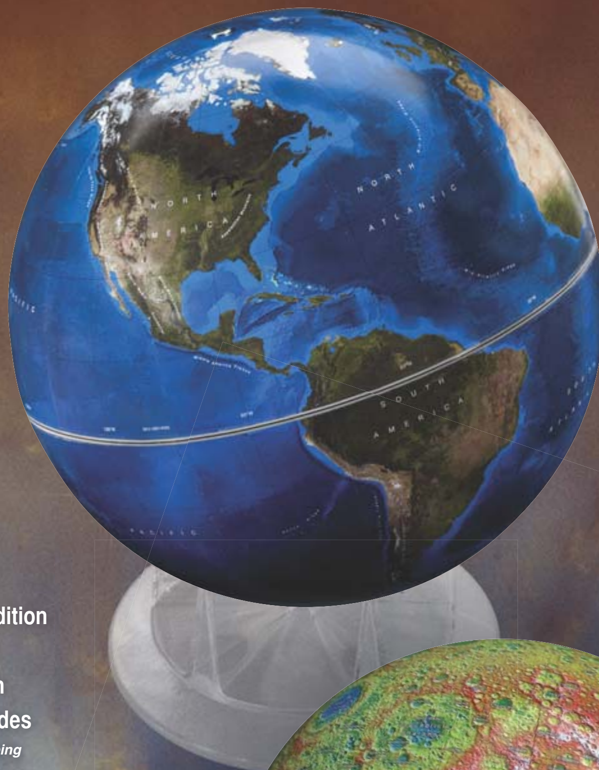
Afterwards, e-mail the ALPO membership secretary at *matt.will@alpo-astronomy.org* with your name, address, the type of membership and amount paid.

If using the form below, please make payment by check or money order, payable (through a U.S. bank and encoded with U.S. standard banking numbers) to “ALPO” There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice. Send to: ALPO Membership Secretary, P.O. Box 13456, Springfield, Illinois 62791-3456 USA.

Please Print:
Name____
Street Address____
____
City, State, ZIP ____
E-mail Address____
Phone Number____
Please share your observing interests with the ALPO by entering the appropriate codes on the blank line below.
Interest____

Interest Abbreviations
0 = Sun 1 = Mercury 2 = Venus 3 = Moon 4 = Mars 5 = Jupiter 6 = Saturn 7 = Uranus 8 = Neptune 9 = Pluto A = Asteroids C = Comets D = CCD Imaging E = Eclipses & Transits H = History I = Instruments M = Meteors & Meteorites P = Photography R = Radio Astronomy S = Computing & Astronomical Software T = Tutoring & Training Program (including Youth)

Hold the Solar System in Your Hands



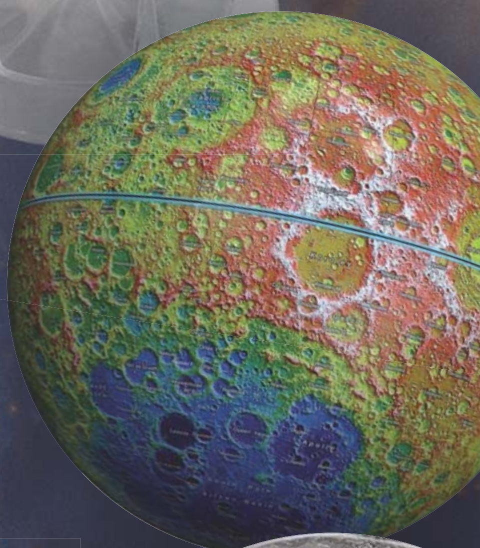
Sky & Telescope's Earth Globe

Showcasing Earth as a planetary body, this unique globe of our home world is based on NASA satellite imagery and other data. We combined two separate datasets: one showing Earth's landmasses very close to their natural color and the other depicting the fascinating topography hidden underwater.

Item #EARTHGLB ***$99.^{95} plus shipping***

Sky & Telescope's Mars Globe

Even the Hubble Space Telescope can't show you all the details found on this updated edition of our classic Mars globe. Created from more than 6,000 images taken by the Viking orbiters, our 12-inch globe approximates the planet's true color. Produced in cooperation with NASA and the U.S. Geological Survey, the globe includes official names for 140 features. ***Item #4676X*** ***$99.^{99} plus shipping***



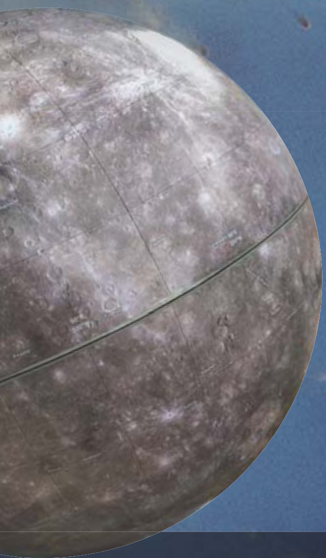
S&T's Topographic Moon Globe

The Topographic Moon Globe shows our home planet's constant companion in greater detail than ever before. Color-coded to highlight the dramatic differences in lunar elevations, deep impact basins show up clearly in blue, whereas the highest peaks and rugged terrain show up as white, red, and orange.

Item #TPMNGLB ***$109.^{95} plus shipping***

Sky & Telescope's Moon Globe

A beautiful and extremely accurate globe of the Moon. Unlike previous Moon globes based on artistic renderings, this globe is a mosaic of digital photos taken in high resolution by NASA's Lunar Reconnaissance Orbiter. The globe shows the Moon's surface in glorious detail, and how the nearside actually appears when viewed through a telescope. ***Item #MOONGLB*** ***$99.^{95} plus shipping***



Sky & Telescope's Mercury Globe

To create this dramatic portrayal, the editors of *Sky & Telescope* worked with scientists on NASA's Messenger mission to produce the globe's custom base map. Special image processing has preserved the natural light and dark shading of Mercury's surface while allowing the labels to stand out clearly. The names of more than 350 craters and other features are shown. ***Item #MERCGLB*** ***$99.^{95} plus shipping***

888-253-0230 **shopatsky.com**

SHOP at SKY