ISSN-0039-2502

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

ALPO — Association of Lunar & Planetary Observers — Founded in 1947

Volume 63, Number 1, Winter 2021

Now in Portable Document Format (PDF) for
Macintosh and PC-compatible computers
Online and in COLOR at http://www.alpo-astronomy.org

Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 63, No.1, Winter 2021
This issue published in January 2021 for distribution in both portable document format (pdf) and hardcopy format. Hard copy printing and distribution by Sheridan Press.

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)

Founded by Walter H. Haas, 1947

Board of Directors

Executive Director (Chair); Julius L. Benton, Jr.
Associate Executive Director; Carl Hergenrother
Member of the Board; Sanjay Limaye
Member of the Board; Ken Poshedly
Member of the Board; Timothy J. Robertson
Member of the Board; Richard W. Schmude, Jr.
Member of the Board & Secretary/Treasurer; Matthew Will

Primary Observing Section & Interest Section Staff

(See full listing in *ALPO Resources*)
Publications: Ken Poshedly
Online Section: Larry Owens
Outreach Section:
Lunar & Planetary Training, Timothy J. Robertson
Podcasts, Timothy J. Robertson
Youth Activities, Pamela Shivak
Eclipse Section: Keith Spring
Mercury/Venus Transit Section: Keith Spring
Meteors Section: Robert D. Lunsford
Meteorites Section: Dolores Hill
Comets Section: Carl Hergenrother
Solar Section: Rik Hill
Mercury Section: Frank Melillo
Venus Section: Julius L. Benton, Jr.
Lunar Section:
Lunar Topographical Studies & Selected Areas Program: David Teske
Lunar Domes Studies Program: Raffaello Lena
Lunar Meteoritic Impact Search: Brian Cudnik
Lunar Transient Phenomena: Anthony Cook
Mars Section: Roger Venable
Minor Planets Section: Frederick Pilcher
Jupiter Section: (Open)
Saturn Section: Julius L. Benton, Jr.
Remote Planets Section: Richard W. Schmude, Jr.
Exoplanets Section: Gerry Hubbell

Point of View:
Is It Time to Expand the ALPO Universe?

By Jerry Hubbell, assistant coordinator, Lunar Topographical Studies Program

Amateur astronomers are a resourceful lot. I prefer to just call us astronomers that are members of the "amateur community". I do this to try and emphasize that we are very capable of doing great science with small telescope systems that are the most cost-effective use of the limited resources available to the greater astronomical community. Today, ALPO members are doing great work providing continuous observations of all the Solar System bodies, big and small.

ALPO members are interested in not only observing our local planets but also interested in observing exoplanets. Today, we have the technology to do this work, as our team and I have been able to demonstrate over the past few years at the Mark Slade Remote Observatory (MSRO) *https://msrocience.org*. Let's face it, exoplanets are planets. I think it is time that the ALPO expands our universe to include exoplanets.

The pace of discovery by the professionals is going to soon overwhelm the capability to do the necessary ground-based follow-up work needed to keep track of all these planets. As is currently done in the observation of minor planets, ALPO members have the tools, knowledge, time and skill to do exoplanet transit observations and to contribute their data to professional groups including the TESS Follow-up Program (TFOP) and JPL's Exoplanet Watch.

I propose that we create a new ALPO Exoplanet Observing Section where we can coordinate members' efforts to perform exoplanet observations to store in our own database and forward any and all observations that meet the requirements to the professional teams that will welcome the data with open arms. In this way, the ALPO can help to train and mentor members in this exciting new planetary science and open the rest of the universe to ALPO.

If you have an interest in observing exoplanets, or are already observing them, drop me a note at the e-mail address above. Thank you for your consideration of this new ALPO observing section.

Founded in 1947

Inside the ALPO
Member, section and activity news

News of General Interest

Our Cover: Water, Water Everywhere?

With the recent mentions of more and more possible sites for water molecules on the lunar surface, we present to you one possible candidate, Clavius Crater, located at latitude +45°50', longitude +009°20'.

Our cover photo this month is that feature which was taken by Fabio Verza of Milan, Italy, on July 29, 2020 at 20:34:16 UT. Equipment included a Celestron CPC800 GPS computerized Schmidt-Cassegrain telescope (aperture = 200 mm/8 in., fl = 2,000 mm/79 in.) equipped with a 1.3x Barlow, a ZWO ASI290MM camera and an Astronomik ProPlanet 807 IR-pass filter. The lunar phase was an 8-day old waxing gibbous Moon, colongitude 25.5°.

Organizational Changes and Appointments

New ALPO Section Announced

Per the unanimous vote by the ALPO executive board at its online meeting in October approving the formation of an ALPO Exoplanet Observing Section, Executive Director Julius Benton has named Gerry Hubbell as its acting coordinator of the new section. The appointment was effective Friday, November 6, 2020.

Due to the new workload, plus demands on him by his outside job, Gerry has chosen to leave his position as an assistant coordinator for the ALPO Lunar Section Topographical Studies Program.

See the Exoplanets Section report on page 25 for more about Gerry and his goals for this new section.

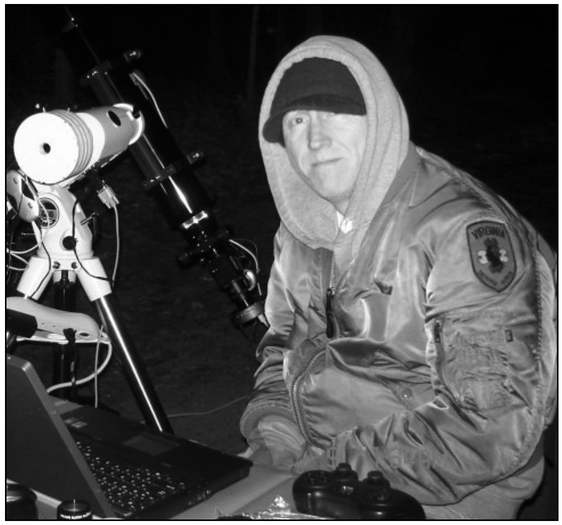
The Jupiter-Saturn conjunction as imaged by Daniel Herron of Alpharetta (near Atlanta) Georgia, USA, Monday, December 21, 2020. Galilean satellites from left to right are Callisto, Io, Ganymede, and Europa. Photo taken at Swift-Cantrell Park in Kennessaw, Georgia. Equipment details: Celestron 8-inch Schmidt-Cassegrain telescope equipped with a 0.63 focal reducer and ZWO ASI290MC (color) camera. Raw 16 full sensor size Imaging: Gain was approximately 150, video exposure 32ms using *SharpCap* software (*https://www.sharpcap.co.uk/*); final image stacked from 25% of 5,000 frames, then post-processed in *Adobe Lightroom* (*https://www.adobe.com/products/photoshop-lightroom-classic.html*) to bring out Saturn and the moons a bit.

Inside the ALPO
Member, section and activity news

New Appointment to LTS Program

With the vacancy created with Gerry Hubbell now heading his own observing section, ALPO member Alberto Anunziato of Entre Ríos, Argentina, has been named as an acting assistant coordinator for the Lunar Topographical Studies Program. He will work with David Teske, Wayne Bailey and William Dembowski in the production of *The Lunar Observer* newsletter. His main responsibility will be handling the bi-monthly *Focus-On* articles, which uses submissions from lunar observations on specific lunar targets.

Alberto's contact information can be found on page 82 in the *ALPO Resources* section of this Journal.



(Left) Gerry Hubbell, new acting coordinator of the ALPO Exoplanets Section. *(Photo by Gerry Hubbell.)*
(Right) Jim Phillips, assistant coordinator, ALPO Lunar Domes Studies Program. *(Photo source: https://today.cofc.edu/2020/11/23/alumnus-gives-a-heavenly-gift/)*

Goodbye to Another Jupiter Section Volunteer

John McAnally, who served as an assistant coordinator in the ALPO Jupiter Section for the Jupiter Transit Timings Program, has officially retired from the section following the discontinuation of that program some months ago.

John joined the ALPO in May 1996, was appointed as an assistant coordinator to the Jupiter Section in January 1998 and became permanent in July 1999.

During his tenure, John contributed heavily.

Citing from John's letter of notice to ALPO Executive Director Julius Benton:

> *It has been a great privilege and an even greater honor for me to have served the ALPO.*
>
> *One of the first achievements I remember is putting out the internet alert regarding the dark spot on Jupiter in 1997. . . That alert got the attention of Dr. Glenn Orton at the Jet Propulsion Lab and started a really rewarding relationship with him. I wrote a paper about the behavior of the spot for our Journal and Glen wrote the forward for it. Later in the year, he recounted the story to a professional conference in Europe as a great example of amateur/professional cooperation in our science. During our convention in Ventura, California, Glenn had me as his guest at JPL in one of the mission control rooms.*
>
> *One of my duties was to provide Sky & Telescope magazine with GRS positions for their magazine. I did that for quite a while. Sky & Telescope also asked me to write a Jupiter article for the magazine (which I did) which turned out to be five full pages; later, the magazine asked me to write an observing guide for their website. I see that my observing guide is still displayed at the magazine website.*
>
> *Other publishers over time asked me to write short essays/ papers as well which I did, of course giving credit to the ALPO. I was often quoted at club websites around the world. I particularly remember being featured as a resource on the website for The Astronomical Society of Victoria, Australia!*
>
> *I have had airline pilots, in flight, send an e-mail to me asking me to confirm what they were seeing in the sky as Jupiter, before they communicated it to the passengers.*
>
> *I also remember an astronomer in Germany asking me for GRS longitudes on certain dates so he could confirm whether the GRS would have appeared in data from a Galileo scan he was using for his research*

Inside the ALPO
Member, section and activity news

because the GRS would have affected his data interpretation. I was able to provide that information to him, and he was able to complete an important paper he was participating in. Later, as a way of thanking me, he sent me a copy of the book his paper was published in and, in the book, he placed an acknowledgement and thank you to me. That was very gratifying and it demonstrated how powerful the work is that ALPO does.

Of course, I did a large number of charting of transit timings and provided those for publication, at least while visual transit timing was still popular.

I know there are many more things that do not immediately come to mind; but, one of the things that is most gratifying is that I was able to point and encourage Springer Publishing to the other ALPO observing sections, and the book deals that resulted for the rest of you. I hope you found that rewarding.

And of course, my own Jupiter book; it is still being purchased and when it came out, it received really good reviews by Sky & Telescope magazine and Astronomy magazine. That book, as you know, was a lot of work. I never read so many peer reviewed papers as I did for that, but it was very rewarding. I am glad I spent the three years doing it.

I love the ALPO. I believe in its mission and I intend to continue my membership. And of course, I will be happy to lend my assistance to the Jupiter Section whenever I can.

Search Continues for Jupiter Section Lead Coordinator

Interested individuals should contact the ALPO executive director for more information.

ALPO Lunar Domes Program's Jim Phillips Donates Lunar Atlas to His Alma Mater

The ALPO is pleased to publicly recognize Jim Phillips, assistant coordinator for the ALPO Lunar Domes Studies Program, for his donation of historical lunar materials to his alma mater, the College of Charleston (South Carolina, USA). Now semi-retired as a pathologist, Jim lives in Charleston, SC, with his wife and three kids.

Says Jim, "I grew up in North Charleston, South Carolina, in a heavily light-polluted area. I became interested in amateur astronomy and the Moon in particular because 'we' were headed to the Moon! Even in my small telescopes, great detail was visible on the lunar surface and light pollution was of no consequence"

While progressing through his schooling to achieve board certification in anatomic pathology, clinical pathology and dermatopathology, Jim continued observing the Moon, planets and double stars primarily with larger and better quality telescopes. He explains, "My reading suggested that there was an opportunity in the area of lunar domes. I became a recorder (now called "coordinator") for the ALPO, opening up the New Lunar Dome Survey. While putting in significant time and effort, the results were disappointing. I primarily did imaging and came across many either undiscovered and/or uncataloged lunar domes which were then characterized by Raffaello Lena and other members of the GLR (Geologic Lunar Research). The effort was a great success, ending up with the publication of the book, *Lunar Domes: Properties and Formation Processes*, published by Springer in 2013."

Jim received an e-mail from Raffaello Lena saying that he had been asked to take over the Lunar Dome program of the ALPO, but would only agree to do it if Jim would agree to being an assistant coordinator. During this entire 40-year period, he collected old and rare astronomy books and maps, primarily related to the Moon. Finally, he says, "I ended up donating a large collection of rare lunar maps and books to the College of Charleston. Most recently, I donated the photographic Lunar Atlas."

Here then follows a statement from the school's website detailing his donation:

> *It's not often that the College gets a donation that's out of this world, but that's just the case – literally – with the gift Jim Phillips '73 gave the College Libraries last December.*
>
> *Special Collections is now home to Carte photographique et systematique de la Lune, the first photographic atlas to map the Moon's entire visible surface.*
>
> *The atlas is astonishing in its beauty and completeness, with all paper covers and tissue guards intact," says Harlan Greene, the Libraries' scholar-in-residence.*
>
> *The six-volume atlas includes 48 heliogravures, images pro-*

Inside the ALPO
Member, section and activity news

duced from a photographic negative transferred to a metal plate and etched in; overlaid transparent papers spotlight salient surface features. Complete sets are exceedingly rare, with only one other publicly accessible in the U.S.

“The large-print format and fine detail of the photographs bring the Moon’s features up close,” says George Chartas, associate professor of astronomy and director of the College’s Observatory. “The light graininess reminds you of the pre-digital era, when photographs were taken with film cameras and developed in dark rooms.”

Upon its 1914 publication, the atlas represented the bleeding edge of lunar photography and scientific rigor. So striking are the atlas’ images, captured at the Paris Observatory, that it wasn’t only stargazers and scientists pulled into its orbit. Many artists were, too.

The atlas’s scientific significance isn’t limited to the early 20th century, either. When President John F. Kennedy promised to land a man on the Moon, the question begged: Land where, exactly?

Detailed photographs like these and others to follow were important in providing the accurate topology of the Moon that would later allow humans to land safely,” says Chartas. “The atlas is still amazing to look through today and an important resource for our students.”

For longtime Friend of the Library Phillips, this lunar interest has featured prominently throughout his life.

“I was given my first telescope by my mom in September 1965,” says the semi-retired physician. “I have owned and used telescopes ever since. I have always kept journals of my observations.”

With a personal observatory in his downtown Charleston home, Phillips tracks and photographs the Moon daily.

“When my wife and I were looking for a new home, my only requirement was that it have a southern facing window,” he says.

The atlas joins a large collection of original maps of the

Inside the ALPO
Member, section and activity news

Moon from the 18th and 19th centuries previously donated by Phillips.

"I truly believe this collection of early lunar books and maps is one of the very best in the entire country," he says. "There is something mystical about the Moon that captures the imagination of the public."

Hardcopy JALPO Issues Still Available

Please note that for those who still wish to add to their library of hard-copy ALPO Journals, we still have a healthy number of various issues left, some dating back to 1962. One oft overlooked thing about these early Journals is that they pre-date the age of satellite exploration of the Moon, the Sun, the planets and comets. Thus, the observing reports are full of the enthusiasm that comes with knowing that we were not competing with high tech gadgets already orbiting these celestial bodies.

And while the photos in those pages are crude when compared to the CCD and webcam images of today, the text captions that accompany them express how much work went into trying to squeeze out every little detail, no matter how grainy.

Please check the list of available issues in the back of this Journal to see what might suit your own interests.

ALPO Website Updates

Various announcements have been posted to the ALPO website home page.

Call for JALPO Papers

The ALPO encourages its members to submit written works (with images, if possible) for publication in this Journal. 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

Report by Jim Tomney, acting assistant section coordinator
jim@tomney.com

The ALPO website (*http://alpo-astronomy.org*) was up and available for the 3rd quarter of 2020 (Jul-Sep) with no reported issues. During that time approximately 24,000 visits were made to the website with an average visit lasting 5 minutes (over 2,000 hours of viewing time).

It is interesting to see how events in the sky are reflected in the web site statistics. For example, we note trends in the accompanying graph that likely arose from the appearance of Comet NEOWISE in July, NTB outbreaks being reported on Jupiter in August, and "Martian Fever" setting in before October's favorable opposition with the Red Planet.

Submission of sketches and images have kept the ALPO Online Section busy as always. Fifty-two observers from 16 different countries submitted 2,073 files representing their solar and major planet observations to the ALPO gallery. Some of the most active contributors were Theo Ramakers (296), Clyde Foster (263), Howard Eskildsen (200), Vlamir da Silva Junior (58), and another half-dozen observers who sent approximately 100 of their images and drawings – great work and dedication!

We encourage everyone to continue to submit their observations for inclusion in the ALPO gallery by sending them to the appropriate e-mail address listed on the website's Gallery Submission Guidelines page (*http://www.alpo-astronomy.org/alpo/?page_id=952*). The section coordinators also appreciate it when submitters adhere to the file naming guidelines listed there, as it greatly facilitates uploading your work into the gallery.

Looking forward, there are several tasks slated for the ALPO Online Section to accomplish over the next few months. As of this moment, the web site is experiencing an issue with the lunar galleries, where uploads of images are failing. This issue is ongoing and is under investigation – we hope to restore functionality by the time you read this report. We also are preparing to deal with the "end of life" for Adobe Flash, which will no longer function in browsers starting in 2021. A work-around has been identified and will hopefully be in place before the deadline.

Finally, we are attempting to look at the website in terms of quality (for instance, correcting or removing links and outdated content). Dr. Roger Venable has taken the time to review the ALPO Mars Section of the site to identify such issues and is beginning the task of resolving them. We thank Roger for his time and hope that other section coordinators will let us know if they have similar issues with their portion of the website.

Inside the ALPO
Member, section and activity news

If you'd like to offer any comments or feedback about the site please reach out to the ALPO Online Section coordinators using the contact information found at *http://www.alpo-astronomy.org/alpo/?page_id=179*.

Follow us on Twitter, "friend" us on FaceBook or join us on *MySpace*.

Outreach Section

Lunar & Planetary Training Program

Report by Tim Robertson, program coordinator
cometman@cometman.net

The ALPO Training Program currently has four active students at various stages of the program.

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

I would like to congratulate one current student, Vincent Giovannone for completing the Novice Level of the training program and for moving up to the Observers section. Well done, Vince!

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

The course of instruction for the Training Program is two-tiered:

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

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

For more information on the ALPO Training Program, contact Tim Robertson at 195 Tierra Rejada Rd #148, Simi Valley CA, 93065; e-mail to *cometman@cometman.net*

YouTube & 'Observers Notebook' Podcasts

Report by Tim Robertson, program coordinator
cometman@cometman.net

The ALPO now has a *YouTube* channel!! We can now post instructional videos, lectures and also have the ability to broadcast LIVE events on the internet! Check it out and subscribe to the channel!

https://www.youtube.com/channel/UCEmixiL-d5k2Fx27Ijfk41A?

The Observers Notebook podcast is going strong. I have recorded over 110 podcasts with various members of the ALPO, mostly section coordinators to highlight the programs within each section. The length of the podcast averages around 30 minutes in length. The longest podcast thus far is over one hour and 30 minutes. But we can record longer because there is no time limit — the hosting service that I use has unlimited space available for podcasts.

Did you subscribe? No? Then do it today!!

It takes a great amount of time and money to make and produce these podcasts, thus far it has been done with the help of a service called Patreon.

Podcasts are released on the 1st and 15th of every month, and if you subscribe to it via *iTunes*, it will automatically be downloaded to your device.

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

Inside the ALPO
Member, section and activity news

- Number of downloads as of October 1, 2020 – Over 39,000
- Number of Subscribers (all formats) – Over 250
- Average of number daily downloads (over the previous 3 months) – 88
- iTunes rating – 5 Stars!
- Locations of most downloads – USA, UK, Canada, Australia, South Africa and France.

We have two generous Patreon supporters who each donate $35 a month to the podcast, at that level they become producers of the podcast and also receive one-year membership to the ALPO! Thanks to Steve Siedentop and Michael Moyer for their generous support of the Observers Notebook.

You, too, can support the podcast by giving as little as $1 a month; for $5 you receive early access to the podcast before it goes public; for a monthly donation $10 you receive a copy of the *Novice Observers Handbook*; and for $35 a month you receive producer credits on the podcast and a years membership to the ALPO.

You can help us out by going to the link below:

https://www.patreon.com/ObserversNotebook

If you have an idea for a topic that you would like to hear covered on the podcast, please drop me a note. I am also looking for member profile pieces where we get to know the members of the ALPO.

These podcasts are also used to get the word out on any breaking astronomy news or events happening in the night sky. So once more, PLEASE let me know if you have any breaking news that you want out there.

Thanks for listening! For more information about the ALPO Lunar & Planetary Training Program or the *Observers Notebook* podcasts, contact Tim Robertson at195 Tierra Rejada Rd #148, Simi Valley CA, 93065; e-mail to *cometman@cometman.net*

Inside the ALPO
Member, section and activity news

Youth Activities Program

Report by Pamela Shivak, program coordinator
pamelashivak@yahoo.com

The goal of ALPO's Youth Activities Program is to encourage children and young adults to take an interest in astronomy, space and outreach. We plan to achieve this goal by forming an alliance with astronomy clubs, and other STEM and educational entities. It is our hope that with an ardent and ongoing effort formed with these organizations we can come up with fun and creative ways to get youths involved with any or all aspects of space and science while educating them in the process.

With your help and contributions, I feel we can achieve this goal as the ALPO Youth Activities Program continues to grow with the support, cooperation and commitment of others.

I'm excited to report the ongoing contributors to the ALPO Youth Program FaceBook group who are helping to bridge the information gap among young people globally. Just to name a few, we have contributors and influencers such as:

- David Eicher, editor-in-chief at *Astronomy* magazine
- Scott Harris, planetary geologist at the Fernbank Science Center (Atlanta, Georgia)
- Deirdre Kelleghan, Vatican Oberservatory blogger and educator
- Scott Roberts, founder & president of Explore Scientific, which has done many virtual astronomy Zoom "star parties"!

Just to name a few, we've welcomed worldwide contributors from countries such as Ireland, Tunisia, the UK, Puerto Rico and Australia!

We've featured historic space launches, amazing launch photographers, and "astronomy outreach" influencers like Joe Guzman - the Chicago Astronomer and Kevin Legore - Focus Astronomy.

Other contributors have shared programs like the Library Telescope Program, Astronomy Challenges for Young People by Star Walk, Binocular Observing Tips for Beginners and NASA STEM programs.

Again, the ALPO Youth Activities Program is an ongoing effort to provide resources that focuses on youth development. I encourage all of you to join, contribute and share!

Visit us at *https://www.facebook.com/groups/ALPOYOUTHPROGRAM/*

ALPO Observing Section Reports

Eclipse Section

Report by Keith Spring, section coordinator
star.man13@hotmail.com

Recent Eclipses

With the November 30 Penumbral Lunar Eclipse and December 14, 2020 Total Solar Eclipses now behind us, I invite everyone to submit eclipse reports. These can include photos, timings, equipment, viewing conditions, and any other observations you may have made during the events. For visual observations, please make sure to include the location of the observations.

We are still accepting reports for all of these eclipses.

Upcoming Eclipses

- 2021 May 26; Total Lunar Eclipse; Visible from South-East Asia, Australia, Pacific, Western North and South America, Antarctica
- 2021 Jun 10; Annular Solar Eclipse; Visible from Canada, Russia; Partial in North America, Europe, North Asia
- 2021 Nov 19; Partial Lunar Eclipse; Visible from Asia, Australia, Pacific, North America, South America
- 2021 Dec 4; Total Solar Eclipse; Duration 1 minute, 54 seconds; Visible from Antarctica.

Please send your reports via e-mail to *eclipse@alpo-astronomy.org* or via regular mail to Keith Spring, 2173 John Hart Circle, Orange Park, FL 32073.

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

Mercury / Venus Transit Section

Report by Keith Spring, section coordinator
star.man13@hotmail.com

Past Transits

This section is still accepting reports for the November 11, 2019 Mercury Transit for archival. Please send your reports via *eclipse@alpo-astronomy.org* or regular mail to the contact information in the *ALPO Resources* section of this Journal.

Future Mercury Transits

- November 12-13, 2032 - Visible from Europe, much of Asia, Australia, Africa, South/some coastal areas of East North America, South America, Pacific, Atlantic, Indian Ocean and Antarctica.

Inside the ALPO
Member, section and activity news

- November 6-7, 2039 - Europe, much of Asia, Australia, Africa, much of South America, Pacific, Atlantic, Indian Ocean and Antarctica.
- May 7-8, 2049 - Europe, Asia, Africa, North America, South America, Pacific, Atlantic, Indian Ocean, Arctic, Antarctica.

Future Venus Transits

- December 10-11, 2117
- December 8, 2125

Please send your reports via e-mail to *eclipse@alpo-astronomy.org* or regular mail to Keith Spring, 2173 John Hart Circle, Orange Park, FL 32073.

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

Meteors Section

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

Meteor enthusiasts have one last chance to view a major shower just after the new year begins as the Quadrantids peak on the morning of January 3, 2021.

Should your skies be clear that morning, we highly encourage everyone to put forth a maximum effort as you have three and a half months to recover until the next major meteor event. Look for details on how to watch for this display on the ALPO website at *www.alpo-astronomy.org/meteorblog/*.

I am encouraged by the reports that have arrived so far during the last quarter of 2020. While there are only few meteor observers, those who do report are providing quality data. 2020 has been a forgettable year so let's hope for brighter prospects in 2021!

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 July 5 - October 6, 2020 from the Meteoritical Society's Nomenclature Committee with 196 new meteorites approved or revised.

Inside the ALPO
Member, section and activity news

As of October 6, 2020, *The Meteoritical Bulletin* contains a total of 64,066 meteorites. Noteworthy are 3 approved falls and 2 finds that may be falls (all chondrites): Kolang, Indonesia (CM1/2); Cavezo, Italy (L5-an); Oslo, Norway (H3-6); Tanezrouft 090, Algeria (L6); Valley, Norway (H5).

Meteorites range in size from the 2.6 g Tungsten Mountain 121 (H5) meteorite found on a dry lakebed in Nevada, USA to the 191 kg Loulan Yizhi 047 (L6) from China with more than 100 pieces recovered.

Newly approved meteorites include 140 ordinary chondrites (63 H, 68 L, 9 LL); 1 EH; 18 carbonaceous chondrites (1 C3-ungr, 1 CH, 6 CK, 2 CM, 4 CO, 4 CV); 2 irons; 2 ureilites; 17 HEDs (3 Howardites, 9 Eucrites, 5 Diogenites); 1 lodranite; 1 angrite; 2 achondrites; 5 Lunar; 7 Martian.

More information and official details on particular meteorites can be found at: https://www.lpi.usra.edu/meteor/metbull.php

Visit the ALPO Meteorites Section online at www.alpo-astronomy.org/meteorite/ for a very detailed explanation of all facets of meteorite studies.

Comets Section

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

***Editor's Note**: Carl found time between shooting his cameo appearances on PBS's NOVA, doing science that will rewrite text books about the secret active life of space rocks, and helping NASA collect samples from asteroid Bennu to submit the following Comet Section Report.*

Table Ephemerides for Comets 7P Pons-Winnecke, 141P Machholz and C/2020 M3 (ATLAS)

Date	R.A.	Decl.	r (au)	d (au)	Elong (deg)	m1	Const	Max El 40N	Max El 40S
7P/Pons-Winnecke									
2021 Jan 01	14 01.7	+11 32	2.055	2.029	77	17.4	Boo	55	7
2021 Jan 11	14 23.4	+10 55	1.978	1.861	81	17.1	Boo	56	12
2021 Jan 21	14 45.9	+10 26	1.901	1.700	85	16.8	Boo	57	18
2021 Jan 31	15 09.2	+10 06	1.824	1.545	89	16.6	Boo	58	24
2021 Feb 10	15 33.5	+09 54	1.749	1.399	92	16.2	Ser	58	29
2021 Feb 20	15 58.7	+09 48	1.675	1.262	95	15.9	Ser	58	33
2021 Mar 02	16 25.0	+09 45	1.603	1.135	97	15.6	Her	58	36
2021 Mar 12	16 52.4	+09 42	1.534	1.018	99	14.8	Oph	58	38
2021 Mar 22	17 21.0	+09 31	1.469	0.911	100	13.7	Oph	57	39
2021 Apr 01	17 51.0	+09 04	1.410	0.813	101	12.5	Oph	56	41
141P/Machholz									
2021 Jan 01	22 47.3	-08 31	0.852	0.589	59	11.1	Aqr	33	12
2021 Jan 11	00 01.2	-07 32	0.915	0.533	66	11.2	Cet	37	19
2021 Jan 21	01 21.8	-05 48	0.997	0.521	76	11.8	Cet	41	27
2021 Jan 31	02 38.9	-03 27	1.091	0.556	85	12.7	Cet	45	35
2021 Feb 10	03 44.3	-01 01	1.193	0.634	92	13.8	Tau	48	39
2021 Feb 20	04 36.9	+01 07	1.298	0.744	96	14.9	Tau	51	42
2021 Mar 02	05 19.2	+02 49	1.405	0.877	97	16.0	Ori	52	42
2021 Mar 12	05 54.0	+04 07	1.511	1.029	96	17.0	Ori	52	42
2021 Mar 22	06 23.7	+05 03	1.617	1.195	94	18.0	Ori	51	42
2021 Apr 01	06 49.8	+05 40	1.721	1.372	91	18.9	Mon	49	42
C/2020 M3 (ATLAS)									
2021 Jan 01	05 13.9	+45 28	1.603	0.672	150	10.2	Aur	84	4
2021 Jan 11	05 16.3	+47 30	1.692	0.799	142	10.8	Aur	82	2
2021 Jan 21	05 22.7	+48 28	1.785	0.943	135	11.4	Aur	82	2
2021 Jan 31	05 32.6	+48 45	1.882	1.100	128	12.0	Aur	81	1
2021 Feb 10	05 45.2	+48 35	1.981	1.270	122	12.5	Aur	81	1
2021 Feb 20	05 59.7	+48 08	2.082	1.452	115	13.0	Aur	82	2
2021 Mar 02	06 15.6	+47 29	2.185	1.643	109	13.5	Aur	83	2
2021 Mar 12	06 32.4	+46 42	2.288	1.843	103	13.9	Aur	83	3
2021 Mar 22	06 49.6	+45 48	2.392	2.050	97	14.3	Aur	79	4
2021 Apr 01	07 07.0	+44 49	2.496	2.263	91	14.7	Lyn	74	5

Inside the ALPO
Member, section and activity news

After an active 2020 for comets, 2021 starts off slowly. Barring a new discovery or outburst, it is possible that no bright comets will be easily visible until later in the year when a number of bright short-period comets come to perihelion.

The brightest comet in the January-March 2021 period may be C/2020 S3 (Erasmus), which could be as bright as 7th magnitude as the year begins. Unfortunately, Erasmus will be located too close to the Sun to be seen from the ground, so perhaps we will be able to watch it in data taken by SOHO or other Sun-watching spacecraft. C/2020 S3 was discovered on 2020 September 17 by Nicolas Erasmus of the South African Astronomical Observatory as part of the ATLAS (Asteroid Terrestrial-Impact Last Alert System) survey. Perihelion occurred on 2020 December 12 at 0.39 au.

Intermediate-period comet C/2020 M3 (ATLAS) should have peaked around 8th magnitude in November 2020. By January 2021, it will be 10th magnitude and fading fast (see the accompanying table). C/2020 M3 was also discovered as part of the ATLAS survey. It was a faint 19th magnitude object when discovered on 2020 June 27. Due to a rapid period of brightening, the comet is expected to peak around 8th magnitude at its 2020 October 27 perihelion at 1.27 au and closest approach to Earth on November 15 at 0.36 au. C/2020 M3 (ATLAS) has an orbital period of 139 years. Short-period comet 141P/Machholz was introduced in the previous JALPO issue. Discovered by former ALPO Comets Section Recorder Don Machholz, 141P will be around 11th magnitude as January starts and fading fast.

Looking ahead to the rest of 2021, eight other short-period comets are expected to reach magnitude 11 or brighter: 4P/Faye (peak at V~10 in Sept/Oct), 6P/d'Arrest (V~10 in Oct/Nov), 7P/Pons-Winnecke (V~8.5 in May/Jun), 8P/Tuttle (V~8.5 in Sep), 15P/Finlay (V~10 in Jul/Aug), 19P/Borrelly (V~9 in Jan/Feb 2022), 67P/Churyumov-Gerasimenko (V~9 in Nov/Dec), and 104P/Kowal (V~10.5 in Jan 2022).

CCD imagers and large aperture visual observers can observe 7P/Pons-Winnecke as it brightens from magnitude 17 to 12 from January to March. Pons-Winnecke was discovered in 1819 and re-discovered in 1858. The current return marks its 25th observed apparition. Perihelion occurs on 2021 May 27 at 1.23 au. The comet will also be 0.44 au from Earth at that time. As a result, Pons-Winnecke is expected to reach magnitude 8.4.

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

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

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

Solar Section

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

NASA announced on September 17, 2020 that we have passed through Solar Minimum and are now officially in Solar Cycle 25. The minimum was statistically determined to have occurred in December 2019 with the last maximum having been April 2014.

Solar Section Assistant Coordinator Kim Hay has taken over the writing of summaries for each rotation as they end and these are posted on the Solar Section webpage. She also cites much of the work that Theo Ramakers has done and is doing on reverse polarity sunspot regions. Observers are encouraged to check this out from time to time to keep up with current activity.

I am happy to report that staffing in the ALPO Solar Section remains stable and we look forward to more activity as we put 2020 behind us (thank God!) and move on into 2021!

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

Mercury Section

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

As 2020, the year of the pandemic, comes to a close, I am hoping 2021 will be a better year for everyone. A lot of people were home nearly the whole year and had more time to do planetary observing. This included Mercury, too. In 2020, this section received a good amount of observations, with Italian amateur Luigi Morrone contributing the most.

On August 1, I did some imaging of Mercury (see image on this page). Seeing conditions were nearly excellent and Mercury was near the meridian at 70 degrees above the southern horizon. This was perhaps under the best condition that anyone could have asked for! Mercury displayed a gibbous phase with

Inside the ALPO
Member, section and activity news

several rayed craters on the disk, which appeared as bright white patches.

As 2021 opens, you will find Mercury in the evening sky. Like every winter in the northern hemisphere, we must brave the cold weather. The planet will be easily visible during the latter part of January. But if you want to observe Mercury sooner, I would suggest you get a pair of binoculars and search for Mercury with nearby Jupiter and Saturn on January 10. All three planets will form a triangle about 13 degrees east of the Sun. This means you MUST observe them through binoculars about 15 to 20 minutes after sundown when they will be about 5 degrees above the southwest (SW) horizon. All three planets will be within 2 degrees of each other. It is a challenge, but if you have a very clear SW horizon, it should be an impressive sight.

As January continues, Mercury will be easily visible with the naked eye. Look for it on January 24 when it will be at its greatest elongation — 18.6 degrees east of the Sun. When viewed through a telescope, Mercury will show a half-phase, 6.9 arc seconds in disk diameter and will shine at -0.6 magnitude. The view will not last long, because Mercury will go through inferior conjunction with the Sun on February 8, 2021.

Mercury as imaged by Frank Melillo of Holtsville, NY, USA, on August 1, 2020 at 14:11 UT. Equipment: Meade 10-inch Schmidt-Cassegrain equipped with a Baader 610 nm longpass filter and a DMK 21AU618.AS monochrome camera. CM = 116 degrees. Seeing: 9/10.

Unfortunately, for the upcoming morning apparition, Mercury won't be favorable for northern hemisphere viewers. The ecliptic will be too shallow to see it before sunrise — however, there are certain days you can catch Mercury. On February 26, it will be visible between Jupiter and Saturn before sunrise low in the southeast. A pair of binoculars will able to show them. Then on March 5, Mercury will slide north of Jupiter less than a half-degree away. It should be an impressive sight in a low-power eyepiece. One day later, Mercury will be at its greatest elongation, 27 degrees west of the Sun.

Please, send in your observations of Mercury. Visit the ALPO Mercury Section online at *www.alpo-astronomy.org/mercury*

Venus Section

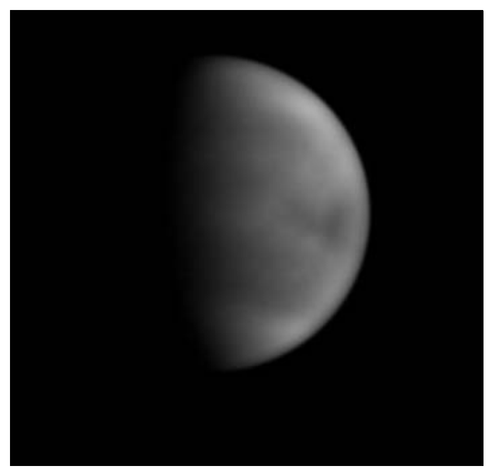
Report by Julius Benton, section coordinator
jlbaina@msn.com

Venus is now visible before sunrise in the morning sky as the 2020-21 Western (Morning) Apparition continues. Throughout the current 2020-21 Western (Morning) Apparition, Venus is passing through its waxing phases as it shrinks in angular diameter, slowly changing from a thin crescent to a gibbous and ultimately a fully illuminated disk as it progresses toward Superior Conjunction on March 26, 2021.

For the convenience of observers, the accompanying table of Geocentric Phenomena in Universal Time (UT) pertains to the current 2020-21 Western) Morning) apparition and is included here for the convenience of interested observers.

As of the date of this report, ALPO Venus observers have submitted over 350 observations in the form of digital images of the planet at UV, visual, and near IR wavelengths, as well as numerous drawings in integrated light (no filter) and with different color filters.

Regular readers of this Journal should be familiar with our continuing collaboration with professional astronomers as exemplified by our sharing of visual observations and digital images at various wavelengths during ESA's previous Venus Express (VEX) mission that ran for about nine years, from 2006 until the mission ended in 2015. It remains as one of the



Luigi Morrone of Agerola, Italy submitted this image of Venus on September 11, 2020, at 05:13 UT with a 35.6 cm (14.0 in.) SCT using a 320-380 nm UV filter to capture the horizontal V, Y, or ψ (psi) shaped dusky clouds that are roughly aligned along the planet’s terminator Venus in good seeing conditions. The apparent diameter of Venus is 18.1”, phase k=0.640 (64.0% illuminated), and visual magnitude -4.1. South is at the top of drawing.

Inside the ALPO
Member, section and activity news

most successful Pro-Am efforts to date, involving ALPO Venus observers around the globe. Such observations will remain important for further study and will continue to be analyzed for several years to come as a result of this endeavor.

For reference, the VEX website is *http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38833&fbodylongid=1856.*

A follow-up collaborative Pro-Am effort remains underway during the 2020-21 Western (Morning) Apparition in continuing support of Japan's (JAXA) *Akatsuki* mission that began full-scale observations starting back in April of 2016. The website for the *Akatsuki* mission remains active so interested and adequately equipped ALPO observers can still register and start submitting images if they have not already done so.

As always, more information will continue to be provided on the progress of the mission in forthcoming reports in this Journal. It is extremely important that all observers participating in the programs of the ALPO Venus Section always first contribute their observations to the ALPO Venus Section at the same time submittals are sent to the Akatsuki mission.

Breaking recent news from the *Akatzuki* mission at the time of this report is the mission's discovery of some interesting atmospheric phenomena on Venus in the form of a giant discontinuity and disruption rapidly propagating along the middle and lower clouds of Venus that is not readily visible in the upper clouds of the planet. This atmospheric phenomenon is comparable with other planetary patterns spotted at the super-rotating upper cloud levels like the horizontal V, Y, or ψ (psi)-shaped dusky clouds that are roughly aligned along the planet's terminator typically seen in images captured UV wavelengths. A study of past observations with ground-based telescopes and data from the earlier Venus Express mission shows evidence that this is a quasi-permanent feature of the atmosphere of Venus that presumably has been missed since at least the year 1984.

While this phenomenon is very challenging to observe on the dayside upper clouds with usual UV imaging techniques, it may be that the dayside middle clouds could be marginally noticeable on images taken at visible and near-IR wavelengths). In fact, wavelengths longer than 700nm seem to be better suited for earth-based observers participating in our pro-Am efforts to see what they can accomplish with perhaps detecting the middle cloud phenomena reported by Akatsuki scientists. More on these developments will be forthcoming in a subsequent update.

We are continuing our full coordination and strong teamwork with the *Akatsuki* mission team in collection and analysis of all observations. If anyone has questions about our Pro-Am efforts, please do not hesitate to contact the ALPO Venus Section for guidance and assistance. Those still wishing to register to participate in the coordinated observing effort between the ALPO and Japan's (JAXA) *Akatsuki* mission should utilize the following link:

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

The observation programs of the ALPO Venus Section are listed on the Venus page of the ALPO website at http://www.alpo-astronomy.org/ as well as in considerable detail in the author's *ALPO Venus Handbook* available free as ALPO Monograph 15 on the ALPO website. (Go to www.alpo-astronomy.org, click on the ALPO home page, lick on the *ALPO Section Galleries* link near the top-right corner of the page, click on Publication Section, click on ALPO Monographs, then click on "ALPO Monograph 15 - Venus Handbook (Revised Edition 2016)".)

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 drawings of the planet at visual wavelengths. Regular imaging of Venus in both UV, near-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 (e.g., 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 forms will help observers know what should be reported in addition to supporting information such as telescope aperture and type, UT date and time, magnifications and filters used, seeing and transparency conditions, etc.

Table Geocentric Phenomena of the 2020-21 Western (Morning) Apparition of Venus in Universal Time (UT)

Inferior Conjunction	2020 Jun 03^d 00^h UT (angular diameter = 58.3″)
Greatest Illuminated Extent	2020 July 10^d 08^h UT ($-4.7m_v$)
Theoretical Dichotomy	2020 August 12.88^d UT (Venus is predicted to be exactly half phase)
Greatest Elongation West	2020 August 13^d 00^h UT (46.0°)
Superior Conjunction	2021 March 26^d 00^h UT (angular diameter = 9.8″)

Inside the ALPO
Member, section and activity news

Under favorable circumstances during future apparitions, 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 planet as a cooperative simultaneous observing endeavor with visual observers. Also, observers should undertake imaging of the planet at near-IR wavelengths (for instance, 1000 nm) around the dates on either side of inferior conjunction, 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 the many challenges ahead.

Routine use of the standard ALPO Venus observing form will help observers know what should be reported in addition to supporting information such as telescope aperture and type, UT date and time, magnifications and filters used, seeing and transparency conditions, etc. The ALPO Venus observing form is located online at:

http://alpo-astronomy.org/gallery3/var/albums/Publications-Section/Observing-Section-Publications/Venus/VenusReportForm.pdf?m=1521162039

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

Lunar Section

Lunar Topographical Studies / Selected Areas Program

Report by David Teske, program coordinator
drteske@yahoo.com

The ALPO Lunar Topographic Studies Section (ALPO LTSS) received a total of 448 observations from 48 observers in 11 countries during the July-September 2020 quarter. The countries represented by observers were Argentina (18), USA (11), Italy (3), Columbia (1), Uruguay (6), France (1), Belgium (1), Bolivia (2), Spain (2), China (1) and Guatemala (1). In addition, we had one report from an observer who did not identify his location.

In mid-October, NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) confirmed, for the first time, water on the sunlit surface of the Moon. This discovery indicates that water may be distributed across the lunar surface, and not limited to cold, shadowed places. SOFIA detected the water molecules in Clavius Crater, one of the largest craters visible from Earth, located in the Moon's southern hemisphere. Our cover photo this issue is a recent image of Clavius taken by Fabio Verza of Milan, Italy.

It is most impressive to have so many high-quality lunar observations submitted from so many observers throughout the world, particularly Latin America. Thirty-two articles were published in addition to numerous commentaries on images selected in the monthly newsletter *The Lunar Observer*. This newsletter had an average page count of 107 pages per issue during the quarter. Throughout the quarter, *The Lunar Observer* contained a section "By the Numbers", which looked at observer's locations and telescopes used for Moon gazing. In all three months, Schmidt-Cassegrain telescopes were the most common telescope for lunar observations. *The Lunar Observer* was placed on the *Cloudy Nights* website and viewed an average of 174 times in each month of the quarter.

The *Focus-On* series continued under Jerry Hubbell, with the continuation of the "Lunar 100" features during this quarter. These are based on the "Lunar 100" list compiled by Charles Wood. Every other month, starting in May 2020, we explored 10 of the "Lunar 100" targets. In June 2020, the second 10 sites were featured and September 2020 followed with the third 10. An incredible response from across the globe provided many images and drawings of these lunar subjects. As we progress through "The Lunar 100" list, the lunar features become more challenging to observe and image. Future *Focus-On* articles will continue to highlight observations from "The Lunar 100" observing list. January 2021 will feature targets 41-50 and March will feature targets 51-60.

Each month *The Lunar Observer* also features an in-depth article from Dr. Anthony Cook on the Lunar Geologic Change Detection Program, the BAA's equivalent of the ALPO's Lunar Transient Phenomena program. Other articles are about lunar features, including lunar domes and images of recent lunar topographic studies.

Electronic submissions can now be made through the ALPO website, (*lunar@alpo-astronomy.org*). The former method of submitting them directly to the coordinators will still work, but please don't submit through both the website and directly to the coordinators. See the most recent issue of *The Lunar Observer* on the ALPO website (*http://www.alpo-astronomy.org/gallery3/index.php/Lunar*) for instructions. Hard

Inside the ALPO
Member, section and activity news

Introducing Alberto Anunziato

Alberto is the newest assistant coordinator in the Lunar Topographical Studies Program. Here, in his own words, is how he entered the world of astronomy and the ALPO:

I've been a lover of astronomy since I was a child. The first astronomical work that I remember was tracking the orbits of the planets for months after the highly publicized 1982 conjunction (a useless but important job for my 11 years at the time).

In 2008, I began my path as an amateur astronomer, when I began to observe with the telescope of the Oro Verde Observatory of the Entre Rios Astronomy Association, a Meade LX 200, 250 mm Schmidt-Cassegrain.

My first passion was comet observations, which I return to whenever I can. When I bought my telescope (a Meade EX 105mm. Maksutov-Cassegrain) in 2010 (the one which I usually observe with), I began to observe the planets and the Moon. At the Oro Verde Observatory, they were exclusively dedicated to astrophotography, which bored me. I didn't want a nice photograph of a nebula. I wanted my observations to be useful.

Discovering the ALPO website was a moment of enlightenment at a stage when I was beginning to think about another hobby. Together with several friends we began to observe the Moon regularly (with whom we later founded the Sociedad Lunar Argentina). I remember seeing our first observation published in *The Lunar Observer* newsletter in August 2015 as it was one of the happiest moments of my life.

Since then, we have collaborated continuously with the TLO and with the different lunar observation programs of the ALPO Lunar Section. I'm not very fond of technology, so I usually take advantage of the telescopes and cameras of my fellow observers; rather, I am a visual observer, and I like to think that with my primitive sketches, I continue a centuries-old tradition.

In addition to my Maksutov scope, I have a pair of 10x50 mm binoculars. Lunar observation is fascinating because we can observe incredibly small details of another world and at the same time educate ourselves in its geology and thus improve our observations.

And for all lunar observers, the ALPO is the place where you learn how to be an amateur astronomer. It is with great pride that I am a part of the ALPO.

copy submissions should continue to be mailed to this coordinator at the address listed in the ALPO Resources Section of this Journal.

The lunar image gallery/archive is now active. At the time of this writing, all of the images received after December 2017 are now in the gallery. Wayne Bailey continues to submit archived images to the Lunar Gallery. This coordinator is now adding current lunar image submissions to the Lunar Gallery. Also, all issues of *The Lunar Observer*, including those from its beginning in 1997 as an American Lunar Society publication to June 2004 when it became the newsletter of this ALPO program, are now available on the ALPO website due to hard work by Theo Ramakers.

For more info, including current and archived issues of *The Lunar Observer*, go to moon.scopesandscapes.com.

Lunar Meteoritic Impacts

Report by Brian Cudnik, program coordinator

cudnik@sbcglobal.net

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

Lunar Transient Phenomena

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

The following reports have been received since the last summary, however they should not necessarily be regarded as LTP reports:

- 2020 Feb 01 Ptolemaeus, 19:40-19:30 UT; Phil Sheperdson (UK)

Inside the ALPO
Member, section and activity news

saw an ashen sliver of light across the floor of the crater.

- 2020 Jul 27 Ptolemaeus, 23:00 UT; Nelson Travnik (Brazil) saw a glimmering mist effect on the floor. The observer thinks it was due to effect of atmospheric seeing on the shadow spires on the floor.
- 2020 Sep 23 Proclus, Romer, Theophilus and Carmichael, 01:18 UT; Leandro Sid (AEA) imaged pink on the floors of these craters but not much evidence for color elsewhere inside other craters. He also saw color visually on the floor of Proclus. This is almost certainly some effect originating in our atmosphere and/ or the observer's optics.

The reason why we are interested in these is that the ashen light effect of flat-floored craters has been reported in past TLP. Although Nelson Travnik is almost certainly correct in his explanation, it would be nice to obtain some video or images that accurately portray this effect, and help eliminate past reports. Leandro Sid's report similarly, probably, has some Earth atmosphere explanation, but it would be nice to have an image sequence showing how these colors fade over time, so we can better understand how it affects some craters and not others. This might also solve some past TLP reports where colors have been seen in widely separated craters, at the same time but not elsewhere.

We continue to have success, though, in eliminating some past LTP reports via our repeat illumination program http://users.aber.ac.uk/atc/lunar_schedule.htm, though, interestingly, others remain unresolved.

General Information: For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . By re-observing and submitting your observations, only this way can we fully resolve past observational puzzles. To keep yourself busy on cloudy nights, why not try “Spot the Difference” between spacecraft imagery taken on different dates? This can be found on: http://users.aber.ac.uk/atc/tlp/spot_the_difference.htm . If in the unlikely event you do ever see a LTP, firstly read the LTP checklist on http://users.aber.ac.uk/atc/alpo/ltp.htm , and if this does not explain what you are seeing, please give me a call on my cell phone: +44 (0)798 505 5681 and I will alert other observers. Note when telephoning from outside the UK you must not use the (0). When phoning from within the UK please do not use the +44! Twitter LTP alerts can be accessed on https://twitter.com/lunarnaut .

Dr Anthony Cook, Department of Physics, Aberystwyth University, Penglais, Aberystwyth, Ceredigion, SY23 3BZ, Wales, United Kingdom. E-mail to atc@aber.ac.uk

Monthly summaries of the observations received as well as the best observation from each observer that can provide useful science on re-evaluation past LTP reports are published in the ALPO Lunar Section newsletter *The Lunar Observer* (http://moon.scopesandscapes.com/tlo.pdf) – often 10 or more pages per month.

We receive repeat illumination reports from astronomers across the world, most notably the UAI in Italy, the BAA in the UK, the AEA and SLA in Argentina, and LIADA members in Bolivia and Uruguay. In the U.S., our most active ALPO contributors are Jay Albert, Rik Hill and Gary Varney.

We welcome observations from visual observers, and also astronomers with

Water on the Moon by cartoonist Zohar Lazer. Published 31 October 2020 in the online edition of the *Wall Street Journal*. Used with express permission of Zohar Lazer.

Inside the ALPO
Member, section and activity news

color imaging capability, who are able to record subtle natural colors on the lunar surface.

We also welcome new participants, whether they are experienced visual observers or high-resolution lunar imagers.

LTP observational alerts are given on the Twitter page: https://twitter.com/lunarnaut

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

Lunar Domes Studies

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

We have received 95 images including some by Michael Barbieri, Alessandro Bianconi, Jean Pierre Brahic, Gerard Coute, Vincenzo Della Vecchia, Howard Eskildsen, Guy Heinen, Richard Hill, Raffaello Lena, Luigi Morrone, Roberto Paletta, Jim Phillips, K.C. Pau, Frank Schenck, Maximilian Teodorescu and Ivica Zajac. Many images are of high resolution and of great interest for our program.

Bianconi has imaged the region near Gambart, including the domes named Gambart 1-3 and Sommering 1, the dome Teneriffe 1 and the Gassendi region. Bianconi and Barbieri have submitted images of the dome Laplace 1, first identified by Teodorescu (see http://www.alpo-astronomy.org/lunarblog/wp-content/uploads/2019/10/dome-sinus-iridum-alpo.pdf). The dome Laplace 1 (page 20) is a newly detected dome 230 ± 20 m high.

Hill submitted many images including Fracastorius dome; Sinus Aestuum and Mare Insularum (two wide volcanic regions), and the Maraldi domes.

Schenck has imaged the domes near Luther crater; Putredinis 1 dome, Fracastorius dome and the dome Hall-1. Like most small domes, Hall-1 can be detected only when it is close to the terminator. He has been trying to image this one for over a year.

Della Vecchia has sent some images including the known dome M15 near the Copernicus-Milichius region; the swell Plato-1 of intrusive origin; and the Apennine Bench Formation, which is a wide volcanic region with domes, cones and pyroclastic deposits. The features located in the Apennine Bench Formation, along with their spectral and morphometric properties, are the subject of a previous article which can be found at http://articles.adsabs.harvard.edu/pdf/2019JBAA..129..329L.

Heinen has imaged the domes Aristillus 1; Autolycus 1; Yangel 1 and domes in Hyginus Menelaus and Manilius regions. He has also imaged Fracastorius dome, the Gambart domes including Hortensius-Milichius domes, Piccolomini dome and the wide region including the domes in Cauchy and Maraldi D, where some domes have been recently described in an our preliminary report (see http://www.alpo-astronomy.org/lunarblog/wp-content/uploads/2020/01/domes-maraldi.pdf). He has also imaged Mons Rümker on the terminator, and the domes termed Cavalerius 1 and Grimaldi 1.

Morrone has submitted images including domes in Hyginus region, the Marius volcanic shield, the dome Herodotus omega, the dome in Hyginus, the dome inside Meton crater, the dome Putredinis 1 and the two domes Archytas 1 and 2.

Brahic has submitted an image of the region of Hyginus and Triesnecker; the geological color layers were produced by Alain Paillou. He also imaged Mare Crisium under high solar illumination angle.

Zajac has imaged the Milichius Hortenius domes, the region including Montes Riphaeus and the Lansberg domes termed La1-La3. The latter are well known domes previously described in a past study (https://www.hou.usra.edu/meetings/lpsc2014/pdf/1010.pdf).

Lena has imaged the Birt domes, Capuanus domes, domes near Reiner, Mons Rümker, M24 dome and Marius hills.

Phillips has sent in some earlier observations including a drawing of Beer dome and the Valentine dome.

Teodorescu has imaged the domes Archytas 1-2, Marth dome, the Milichius-T. Mayer domes field, Capuanus domes, Petavius 1 dome, the Sinus Iridum region and the Gruituisen highland domes. Among the volcanic edifices on the Moon, the highland domes Gruithuisen γ and δ, the nearby Northwest Dome, situated at the border of Mare Imbrium, are formed from viscous, highly silicic, non-mare lavas – most likely dacitic or rhyolitic lavas. For this reason, these highland domes are characterized by steep flank slopes, large sizes and red spectral signatures. These traits give rise to the assumption that they have been formed by lava of significantly different composition which erupted over a long period of time. He has submitted images of some suspect domes near the crater Delisle and Agatharchides. Teodorescu also has submitted an image where a previously unreported dome in Mare Crisium is visible near the crater Cleomedes G. These features are now

Inside the ALPO
Member, section and activity news

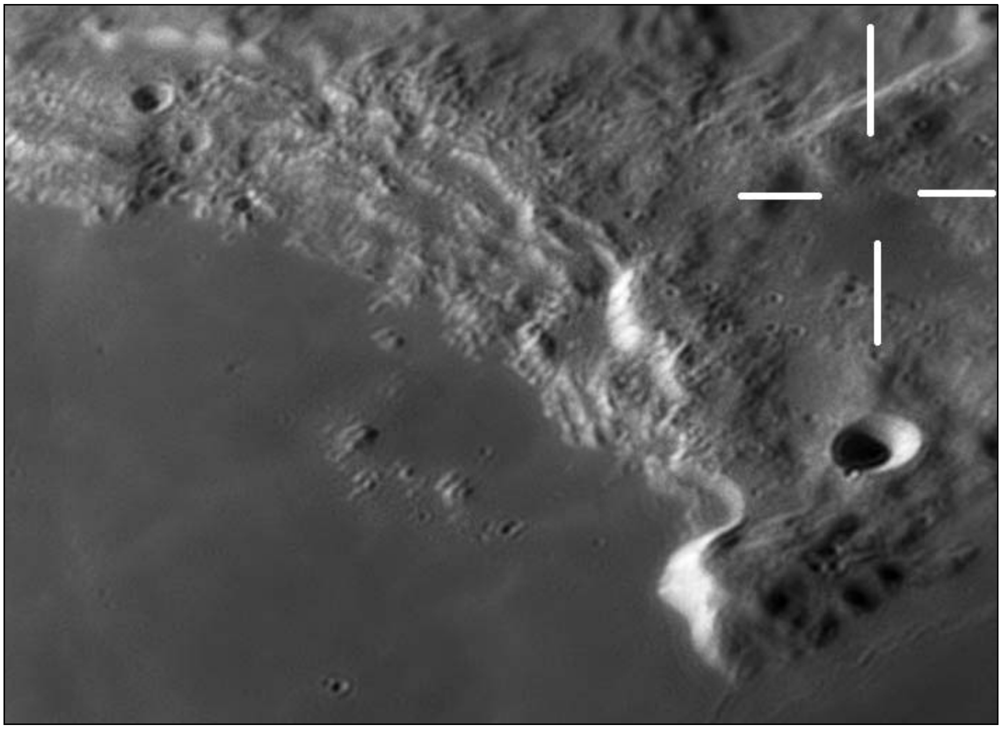
under investigation. It once again shows that with modern imaging technology, there is still a chance for amateurs to study elusive features on the moon. In combination with high-resolution images, such investigations might greatly extend our present knowledge of the processes occurred on the Moon.

Pau has imaged the Mason dome, the domes near Luther crater, Piccolomini dome (under two different solar illumination angles) and the Valentine domes. He also has submitted an image where an unreported dome in Mare Crisium, also imaged by Teodorescu and Heinen in different sessions, is detectable. He has imaged four domes near Lavoisier K, which we named Lav1-4. A full study is ongoing.

Coute has reported an investigation of an unnamed crater just west Eimmart K which has a bump inside. Clementine spacecraft spectral imagery along with the polygonal shape indicate this bump is of highland composition and is not a classic dome.

Paletta has imaged the pyroclastic deposits in Mare Vaporum, including some volcanic domes in Manilius region and the dome Teneriffe 1, a swell detectable in the Lunar Orbiter imagery and LROC WAC imagery. It can be viewed at: *http://www.alpo-astronomy.org/gallery3/var/albums/Lunar/Lunar-Domes/2019-Images/Follow_up_dome_Ten1.pdf?m=1566946399*.

Eskildsen has submitted many images, including ones of the Birt bisected domes, the Beer dome located in Apennine bench formation, Mons Rümker, Marius hills, the Reiner domes, Herodotus 1 dome, the Mairan T domes, two domes named Archytas 1-2, M24 near Brayley D, the Lansberg domes,



Dome Laplace 1 as imaged by Barbieri on August 11, 2020 at 03:47 UT. Equipment: Celestron C11, ZWO ASI178MM Monochrome CMOS camera, Baader 2.25x Barlow. See text for details.

Grimaldi 1 dome, the highland domes Gruithuisen γ and δ with the nearby Northwest dome, and domes south of Wallace.

Finally, I have recently described for ALPO the Strombolian-type volcanic eruptions which may have formed the largest dark mantle deposits on the Moon:

http://www.alpo-astronomy.org/gallery3/var/albums/Lunar/Lunar-Domes/2020-Images/The%20Strombolian%20eruption%20style.pdf?m=1596990746&fbclid=IwAR1mM6tRBqn5HfCYADxP9oe4qTQUbP3SiNxYHP52rE6M3DydWeL2aHt6jcI

I also reported on the Plinian eruptions including the Vesuvius volcano and the Phlegraean Fields caldera:

http://www.alpo-astronomy.org/gallery3/var/albums/Lunar/Lunar-Domes/2020-Images/Vesuvius%2C%20the%20Plinian%20eruption%20style%20and%20the%20Phlegraen%20Fields%20Caldera.pdf?m=1599319927 and on the volcanic Amiata complex compared with the known highland domes:

(*http://www.alpo-astronomy.org/gallery3/var/albums/Lunar/Lunar-Domes/2020-Images/Amiata%20highland%20domes.pdf?m=1600534022&fbclid=IwAR3-K_2VlJgO-SxXNUNt3Nh0YOn4aIfCsV-cg5e1MPnS-jaHKcaVxvL_WXE*).

Inside the ALPO
Member, section and activity news

Interested observers can publish their newly acquired images using the e-mail lunar-domes@alpo-astronomy.org. Preference for the filename would be to start with the date as YYYY-MM-DD-HHMM with leading zeros where appropriate. This would then be followed by the observer's ID. This would be followed by the name(s) of the features shown.

Images received are also shared in our Facebook group Lunar Dome Atlas Project: https://www.facebook.com/groups/814815478531774/.

Interested observers can also participate in the lunar domes program by contacting and e-mailing their observations to both Raffaello Lena, Lunar Dome Studies Program coordinator, at (raffaello.lena@alpo-astronomy.org) and Jim Phillips, assistant coordinator, at (thefamily90@gmail.com).

Mars Section

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

This has been an unusual and fascinating apparition, in addition to being the closest opposition since 2003. Observations began when Mars was no more that 4.5 arc seconds in subtended diameter, and even at that size, observers managed to clearly document the albedo features. Dust storms were recurrent from the middle of southern winter and throughout the spring and into the summer. The south polar front along the edge of the South Polar Hood spawned most of these, and the south polar cloud fronts were identifiable. The dust repeatedly obscured the view of Hellas and nearby areas to the east and west. As of this writing (October 30), the storms have calmed down but the atmosphere continues to be hazy with dust.

Probably due to the dust storms, the appearances of Argyre, Solis Lacus, Hellas, and Ausonia are peculiar, unlike any appearances in the past.

Meanwhile, as Martian northern winter is occurring, the North Polar Hood has been prominent, and observers have documented its bluish color as well as irregularities in its shape and density. Morning clouds are often present now, and they, too, show a bluish color. Orographic clouds have been increasing in Tharsis.

Now in the evening sky and north of the celestial equator, Mars is well positioned for observation. In the last month, the Mars Section has received daily an average of 13 image sets, drawings and descriptive observations. We hope that yours will be among them. You'll not get another chance to see the Red Planet this well until 2035. You should send your observations to mars@alpo-astronomy.org and to the section coordinator at rjvmd@hughes.net.

We invite you to join the 1,000 members of the marsobservers group of groups.io (https://groups.io/g/marsobservers). Observers upload their images or drawings to the photos section there, and share their thoughts about their observations.

To check the ALPO Mars image gallery on the ALPO website, first, go to http://www.alpo-astronomy.org, then click on the "ALPO Section Galleries" link at the upper right corner of the screen. Next click on the "Mars images and observations" icon, then click on the Mars image folder for the desired year.

Minor Planets Section

Report by Frederick Pilcher, section coordinator
pilcher35@gmail.com

Following here are highlights published in the *Minor Planet Bulletin*, Volume 47, No. 4, 2020 October-December. These represent the recent achievements of the ALPO Minor Planets Section.

Robert Werner announces his retirement as producer of the *Minor Planet Bulletin* after more than 35 years of service in this responsible position, beginning with issue 12-3. Since this time the *Minor Planet Bulletin* has grown from about 10 pages per quarterly issue to 100 or more pages. The ALPO Minor Planets Section expresses its gratitude by announcing that Bob has received a Meritorious Service Award in recognition and appreciation of his work. Bob is succeeded by Pedro Valdes Sada, who advances from his previous position as associate producer.

Lorenzo Franco and Brian Warner publish new spin-shape models of several asteroids. The lightcurve inversion technique of obtaining spin and shape usually provides two equally likely solutions for the celestial longitude and celestial latitude of the rotation pole. For the Earth approacher 1685 Toro, a unique rotational axis was found. The spin parameter set or sets for each asteroid, and their authors, are presented in the "Spin Parameters for Selected Asteroids" portion of the table that accompanies this report.

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

Inside the ALPO
Member, section and activity news

from the observed combined lightcurve. Six asteroids with satellite events were reported in the most recent *Minor Planet Bulletin*. The primary rotation period (PROT), orbital revolution period (PORB), both in hours, and authors of the studies are listed in the "Satellite Events of Six Selected Asteroids" portion of the table that accompanies this report.

Tumbling behavior is a simultaneous rotation about one axis and a precession of the rotation axis about another axis, usually with periods that differ by a factor of not more than 2 or 3. In contrast with principal axis rotation, the lightcurve does not repeat from cycle to cycle. B. Warner and R. D. Stephens found tumbling behavior in two small Earth approachers, 331471 1984 QY1 and 2001 GS2.

Newly discovered Earth approaching asteroid 2020 KP3 was found by B. Warner and R. D. Stephens to have a rotation period 0.062793 hours, at which rate the centrifugal force at the equator exceeds gravitational attraction force. Any loose debris is spun off. This object is a solid rock, a monolith.

In addition to asteroids specifically identified above, lightcurves with derived rotation periods are published for 111 other asteroids as listed below:

50, 57, 58, 59, 78, 414, 435, 529, 549, 652, 722, 738, 768, 781, 904, 913, 949, 952, 992, 1016, 1025, 1074, 1130, 1132, 1145, 1184, 1215, 1239, 1247, 1269, 1303, 1443, 1451, 1457, 1579, 1592, 1594, 1618, 1628, 1667, 1685, 1784, 2050, 2162, 2283, 2363, 2415, 2847, 2893, 2895, 3096, 3151, 3222, 3225, 3317, 3356, 3451, 3459, 3615, 3637, 3656, 3683, 3800, 4041, 4148, 4353, 4408, 4570, 4582, 5144, 5476, 5534, 5875, 5947, 6163, 6517, 6569, 6635, 7910, 8014, 8278, 10111, 11190, 14923, 15710, 19125, 38635, 39197, 42609, 52768, 66251, 85989, 86667, 136874, 137064, 137199, 175189, 306461, 349063, 373428, 382503, 441987, 477885, 495615, 498066, 2000 KA, 2004 LU3, 2005 MR5, 2013 XA22, 2015 HH10, 2020 GD2.

Secure periods have been found for some of these asteroids, and for others only tentative or ambiguous periods. Some are of asteroids with no previous lightcurve photometry, others are of asteroids with previously published periods that may or may not be consistent with the newly determined values.

Newly found periods that are consistent with periods previously reported are of more value than the uninitiated may realize. Observations of asteroids at multiple oppositions widely spaced around the sky are necessary to find axes of rotation and highly accurate sidereal periods.

The Minor Planet Bulletin is a refereed publication and that it is available online at *http://www.MinorPlanet.info/MPB/mpb.php*

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

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

Table of Minor Planets Detailed in This Report

Spin Parameters for Selected Asteroids

Minor Planet	Period (hours)	Longitude (degrees)	Latitude (degrees)	Author
50 Virginia	14.31233	111	+42	Franco
		295	+47	
755 Quintilla	4.55204	109	-12	
		288	-3	
1443 Ruppina	5.879288	120	-15	Warner
		295	-22	
1667 Pels	3.268280	182	-53	
		16	-63	
1685 Toro	10.197796	85	-67	

Satellite Events of Six Selected Asteroids

Minor Planet	PROT	PORB	Authors
1656 Suomi	2.5885	57.92	B. Warner, R. D. Stephens, A. W. Harris
2171 Kiev	3.1714	23.443	R. Bonamico
85275 1994 LY	2.68600	16.624	B. Warner, R. D. Stephens, A. W. Harris
85628 1998 KV2	2.8228	21.173	
184990 2006 KE89	2.5435	13.457	
539940 2017 HW	2.633	26.2	

Jupiter Section

Report compiled by section staff members Richard Schmude, Craig MacDougal

Jupiter underwent several changes in 2020. One change was the development of bright spots in the North Temperate Region. These spots moved very fast with rotation rates even faster than System I. The Great Red Spot also dropped from a length of 14 degrees of longitude in October 2019 to 12.5 degrees in mid-2020. This is about a

Inside the ALPO
Member, section and activity news

10% drop in length. Finally, Clyde Foster discovered an interesting spot in the late spring of 2020. It was imaged by the Juno Spacecraft.

This coordinator has submitted Jupiter apparition reports through 2019 for publication in this Journal. He plans to work on the 2020-2021 report sometime in the coming year.

The image accompanying this report was taken by Clyde Foster using a 0.36 m (14 in.) Schmidt-Cassegrain telescope. It was taken on October 22, 2020 at 16:39 UT. The Equatorial Zone is slowly getting back to normal but the North Equatorial Belt appears to be growing fainter. North is at the top in this image.

Assistant Jupiter Section Coordinator Craig MacDougal reports that the ALPO Jupiter e-mail group will be moving from Yahoo to a new provider. Yahoo has announced that it will discontinue its "Groups" programs in December. If you are already a member of the ALPO_Jupiter Yahoo Group you will receive an invitation to join the new group when it is set up.

A continuing request from the ALPO Jupiter Section staff: The NASA Juno mission is currently enthusiastically accepting images of Jupiter from amateur observers. And because Juno is not primarily an imaging mission, the mission coordinators are especially interested in our (ALPO member) contributions. Please check this article for general background: *https://skyandtelescope.org/astronomy-news/observing-news/juno-pro-am-workshop-05252016/* . After sending your images to us, you're invited to also send your Jupiter images to the JunoCam homepage at: *https://www.missionjuno.swri.edu/junocam* . The JPL hopes the Juno mission will be extended for another three years past July of 2021.

Finally, this is to reminds all that the updated Jupiter manual, "Observing Jupiter in the 21st Century" is now available from the Astronomical League. Because there are several important updates in this revised version, all who observe or image Jupiter are strongly urged to obtain a copy.

It is available at *https://store.astroleague.org/index.php?main_page=index&cPath=1*

Another reminder, all contributors are advised to send all images ONLY to *Jupiter@alpo-astronomy.org* where they will be scanned for viruses before being forwarded on to me. Those received images will also be posted in the ALPO Jupiter Images and Observations gallery.

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

Saturn Section

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

The 2020-21 apparition of Saturn is continuing to wind down as of this report (October 2020), with the planet becoming less favorable for viewing until it enters conjunction with the Sun on January 24, 2021, bringing the apparition to an end. Saturn passed opposition on July 20, 2020, and remains located in Sagittarius but sets in the early evening.

The accompanying Table of Geocentric Phenomena for the 2021-22 Apparition in Universal Time (UT) is included here for the convenience of observers.

As of this writing (October 2020), the ALPO Saturn Section has received more than 800 individual visual observations and multi-wavelength images for the 2020-2021 observing season. Observers contributing digital images have consistently been reporting considerable discrete atmospheric phenomena in Saturn's northern hemisphere, including small white spots in the EZn (northern half of the Equatorial Zone) interacting with the adjacent EB (Equatorial Band), plus sporadic small white spots in the EZs (southern half of the Equatorial Zone), as well as a curious persistent white ripple or streak midway within the EB (Equatorial Belt). Another strangelooking narrow white streak has also been imaged regularly within the NEBs (North Equatorial Belt, southern component). Small white and dark spots continue to appear the NNNTeB (North North North Temperate Belt as well as in the NPR (North Polar Region). The aforementioned atmospheric phenomena have shown up well in most images captured using RGB, red, 685nm IR filters. It is very important for observers to continue to monitor Saturn and capture images with the same multi-wavelength filters to determine if the same or similar features persist and change morphologically with time during the new 2021-22 apparition.

Observers should be watchful for any new atmospheric phenomena that might suddenly evolve. With the rings tilted by about +18° toward our line of sight from Earth in 2021-2022, observers still have reasonably favorable opportunities to view, draw, or image the northern hemisphere of the globe and north face of the rings even though the inclination of the rings toward Earth is diminishing slowly and with Saturn's southerly declination of -18o for Northern Hemisphere observers.

Inside the ALPO

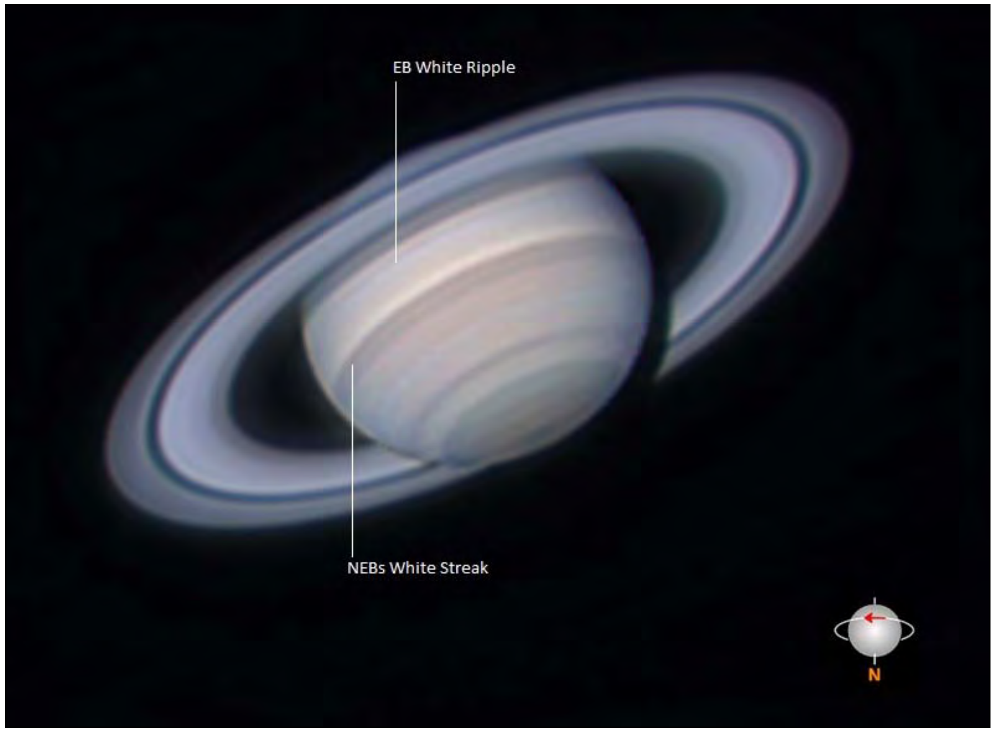
Member, section and activity news

Pro-Am cooperation continues uninterrupted during the 2021-2022 apparition of Saturn, and our team of observers is routinely monitoring Saturn for atmospheric phenomena and actively sharing our results and images with the professional community. This maintains our collaborative historical efforts with the Cassini mission that started its amazing odyssey back on April 1, 2004 until the spacecraft plunged into Saturn's atmosphere on September 15, 2017. For many years to come, planetary scientists will be carefully studying the vast database of images and data gleaned from the Cassini mission, including images provided during the mission by ALPO observers. Therefore, anyone around the globe who wants to join us in our observational endeavors is highly encouraged to submit systematic observations and digital images of the planet at various wavelengths throughout the current observing season.

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

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



Detailed RGB image of Saturn taken by Trevor Barry of Broken Hill, Australia, on September 15, 2020, at 10:17 UT. His image was captured in good seeing using RGB filters with a 40.6 cm (16.0 in.) NEW and it reveals the curious elongated white streak or ripple within the EB (Equatorial Belt), as well as what appears to be a white streak in the NEBs (North Equatorial Belt, southern half). The Sh G on R (Shadow of the Globe on the Rings) is visible in this image as well as Cassini's Division (A0 or B10) and Encke's Complex (A5). The apparent diameter of Saturn's globe in this image is 17.6" with a ring tilt of +22.7°. and CMI = 253.0°, CMII = 289.7°, CMIII = 102.2°. The apparent visual magnitude = +0.4. South is at the top of the image.

Table Table of Geocentric Phenomena for the 2021-22 Apparition of Saturn in Universal Time (UT)

Conjunction	2021 Jan 24^d 00^h UT
Opposition	2021 Aug 02^d 06^h UT
Conjunction	2022 Feb 04^d 00h UT
Opposition Data for August 2, 2021	
Equatorial Diameter Globe	18.5″
Polar Diameter Globe	16.3″
Major Axis of Rings	42.0″
Minor Axis of Rings	13.0″
Visual Magnitude (m_v)	+0.2
B = Declination Constellation	+18.1° +18.4° Sagittarius

Inside the ALPO
Member, section and activity news

the planet (i.e., simultaneous observations).

The ALPO Saturn Section thanks all observers for their dedication and perseverance in regularly submitting so many excellent reports and images in recent years. 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

Uranus will be well-placed in the evening sky during January of 2021 in the constellation of Aries. The sub-Earth latitude will be 50° N, which means the center of Uranian disk is at 50° N. The northern hemisphere of the planet will reach its summer solstice (thus, the winter solstice for the southern hemisphere) in 2029. At that time, the sub-Earth latitude will be near 83° N.

Neptune will also be well-placed during January evenings and also in Aries. Its sub-Earth latitude will be 24° S.

Pluto will be close to the Sun in January and, hence, will be difficult to observe. It will be better placed in March.

This coordinator submitted the 2019-2020 remote planets apparition reports to the editor several months ago, and it will appear in a future issue of this Journal.

Several people have already starting observing the remote planets. Luigi Morrone, Marc Delcroix and Charles White all have submitted images of either Uranus or Neptune. Jim Fox submitted his first brightness measurement of Neptune on September 23; its brightness was magnitude +7.716 in the V filter with a B – V value of 0.361.

To find any of the remote planets for telescopic observations, it is suggested that you first use a star chart which shows the position of the target, then use binoculars to find the target. Note that skyandtelescope.org is a great source to find specific locations of sky objects.

Next, locate the target in the finder scope of your telescope. Finally, center your target in the field of view using a low-power eyepiece. You may need a dark site to locate Neptune both in binoculars and in your finder scope.

Both planets have albedo features which can be imaged with a near-infrared filter. Uranus has a bright North Polar Region while Neptune may have irregular bright spots.

Finally, my usual reminder that the book *Uranus, Neptune and Pluto and How to Observe Them* 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*).

Visit the ALPO Remote Planets Section online at *www.alpoastronomy.org/remote*

Exoplanets Section

Report by Gerry Hubbell
acting section coordinator
schmude@gordonstate.edu

Below ais a basic outline of the goals and objectives as set forth for the ALPO's newest observing section:

Why do we need an Exoplanet Section in the ALPO?

- We do focus on Planetary Objects, the first system is the Solar System of course.
- There is a large amount of member interest in learning about and observing Exoplanet transits.
- There is a great need in the astronomy community for follow-up, long-term monitoring of an ever-increasing number of Exoplanet systems.
- Provides an avenue for our membership to discover new things about our Universe and maintain their excitement for the hobby.
- There is a need to get as many amateur astronomers we can to observe and report their observations to the professional groups.
- Several "Citizen Science" groups have formed since the launch of TESS and are actively working to perform the needed follow-up work. ALPO needs to take up some of the load for this.
- Finally, it is the most exciting field in planetary science to emerge over the last 10 years where amateurs can contribute to the astronomy research community.

Do we have the technology?

- Over the past 5 years consumer level equipment has vastly improved to where it can be use to effectively observe Exoplanets.

Inside the ALPO
Member, section and activity news

- Our members doing astrophotography already have the needed equipment to observe exoplanet transits.
- Our members already do similar light curve work in the Minor Planets Section and are familiar with the procedures.
- The ALPO Exoplanet Section will provide training, procedures, document products to get our membership up to speed. The section will also coordinate the scheduling of observations, and the reporting of results.
- The ALPO members will be taught to perform all the different tasks needed for effective observing, including:

  i. Theory of Exoplanet Observing and Terminology

  ii. Equipment Requirements and Configuration

  iii. Accessing Professional Sources for Exoplanet Data

  iv. Picking Targets and Planning and Coordinating Observations

  v. Requirements for Effective Data Acquisition

  vi. Data Processing and Archiving Strategies

  vii. Data Analysis and Modeling

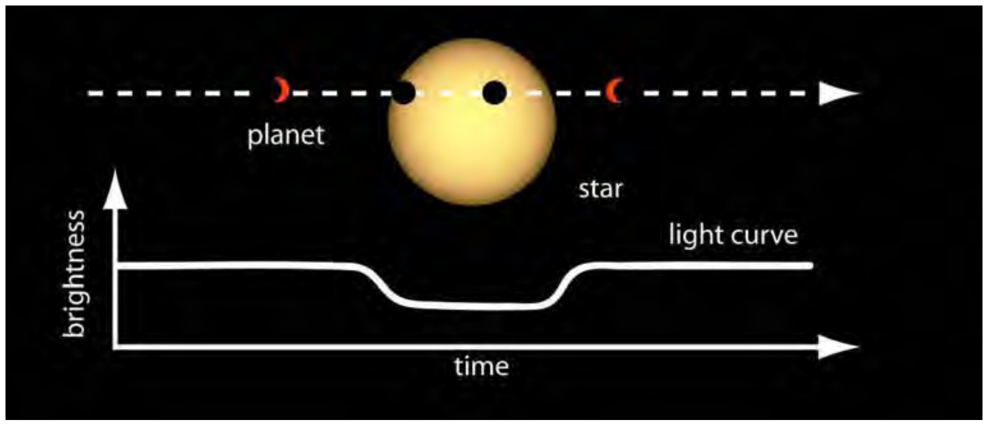
  viii. Data Reporting Requirements

What are the Benefits to the ALPO?

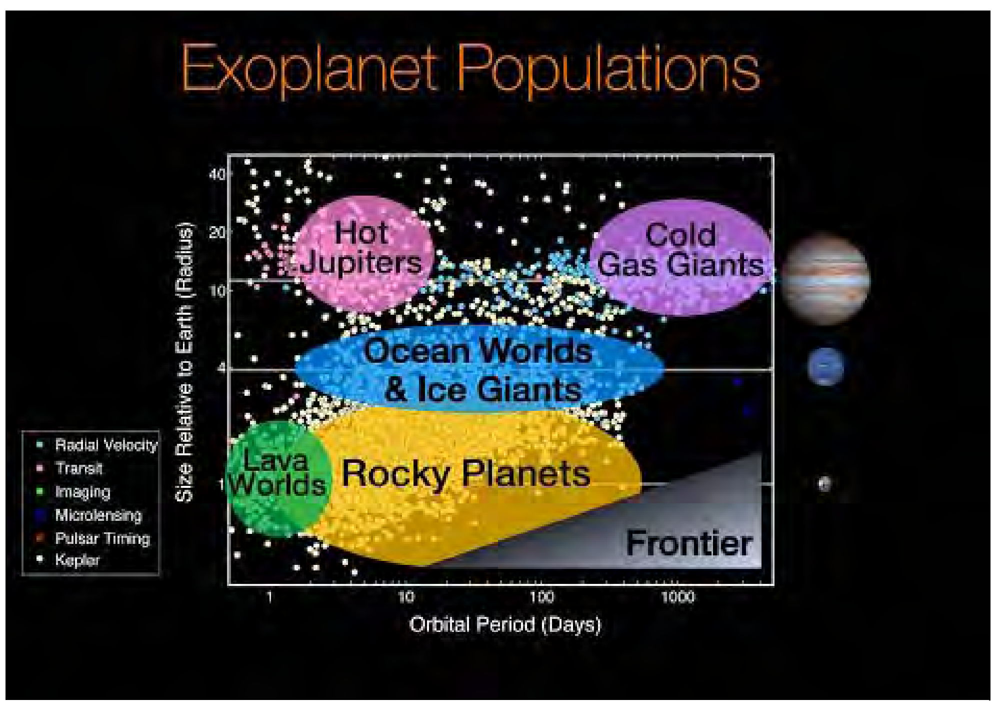
- Provides another avenue to promote the ALPO and provide another avenue for recruiting members to the organization.
- Provides another avenue for the ALPO to highlight the work of our dedicated members.
- Ensures that the ALPO continues to be seen as a contributor of cutting edge observations to the greater community.

Exoplanet Section Member Benefits

- A possible monthly Exoplanet Section newsletter "The Exoplanet Observer" (TEO)
- Access to publicly accessible professional Exoplanet data
- Possible invitation to join a Pro/Am Exoplanet observing program
- Access to Exoplanet Section member transit data (controlled by each contributor)
- Further benefits to be discussed and realized in the future



Detecting Exoplanets Using Light Curve Photometry. (*Image courtesy of NASA Ames*)



Types of exoplanets. (*Image courtesy of NASA Ames*)

Inside the ALPO

Member, section and activity news

Membership Report: (October 25, 2020)

by Matthew L. Will, ALPO Membership Secretary/Treasurer

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

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

Member	City	State
John Centala	Marion	IA
Carl Hergenrother	Tucson	AZ
Mike Hood	Kathleen	GA
Gregory Macievic	Camden	OH
John R Nagle	Baton Rouge	LA
Thomas R Williams	Houston	TX

SPONSORS Members - Giving $250 or more per membership

Member	City	State	Country
John Bedsole	Mobile	AL	
Brian Combs	Macon	GA	
Howard Eskildsen	Ocala	FL	
Robert A Garfinkle	Union City	CA	
Ed Grafton	Houston	TX	
Carl Hergenrother	Tucson	AZ	
Robert Maxey	Summit	MS	
John W McAnally	Waco	TX	
John R Nagle	Baton Rouge	LA	
Detlev Niechoy	Goettingen		GERMANY
Roy Parish	Shreveport	LA	
Steve Siedentop	Snellville	GA	
Berton & Janet Stevens	Las Cruces	NM	
Roger Venable	Chester	GA	
Gary K Walker, MD	Macon	GA	
Christopher Will	Springfield	IL	

Inside the ALPO
Member, section and activity news

SUSTAINING MEMBERS - Members giving $75 per membership

Name	City	State	Country
Jay Albert	Lake Worth	FL	USA
Stephen Bennett	Flossmoor	IL	
Raffaello Braga	Milano	MI	ITALY
Orville H Brettman	Huntley	IL	USA
Bruce Cordell	Tucson	AZ	
Dan Davis	Stoney Brook	NY	
William Dembowski	Windber	PA	
Jeffrey Edmonds	Washington	DC	
Thomas Wesley Erickson	Coolidge	AZ	
William Flanagan	Houston	TX	
Gordon Garcia	Bartlett	IL	
Joe Gianninoto	Tucson	AZ	
Ed Grafton	Houston	TX	
Dr John M Hill, Ph D	Tucson	AZ	
David Houlihan	Wichita	KS	
William Howes	Holliston	MA	
Roy A Kaelin	Flossmoor	IL	
Vince Laman	San Clemente	CA	
Jim Lamm	Stallings	NC	
Michael Lawson	Chester	VA	
Jean-christophe Meriaux	Concord	CA	
Abbas Mokhtarzadeh	Waxhaw	NC	
Seanan Murphy	Arlington	MA	
Marla Pinaire	Goshen	KY	
Theo Ramakers	Oxford	GA	
Douglass F Rohrman	Escondido	CA	
Guido E Santacana	San Juan	PR	
Mark L Schmidt	Elmwood Park	WI	
Steven Siedentop	Snellville	GA	
Maura Smith-mitsky	Camp Hill	PA	
Bob Soltys	Lakewood	OH	
Lawrence Trutter	Springfield	IL	
Eric Utt	Stonington	CT	
Stephen Vance	Napa	CA	
Robert Williams	Tallahassee	FL	
Richard S Wright, Jr	Lake Mary	FL	

Special thank you notices are given to ALPO members who have made special donations in the past year. These include contributions from Wayne Bailey $250, Trey Benton $150, John Centala $75,000 (previously recognized in issue Vo. 62, No. 2), Geoffrey Chester $25, Shawn Dilles $500, Robert H. Hays, Jr. $100, David Houlihan $25 (in addition to a Sustaining Membership), Mike Mattie $150, Marla Pinaire $25 (in addition to a Sustaining Membership), Philip Plante, Jr. $8, Lugi Testa $2, Dennis Trevino $25, Andrew J. Salthouse $100, Elizabeth Westfall $100, and Matthew Will $1,000.

If you wish to make a contribution to the ALPO, please send your check or money order to the ALPO, PO Box 13456, Springfield, IL 62791-3456, or you can pay by PayPal or credit card on the Astronomical League online store at this URL:

https://www.astroleague.org/store/index.php?main_page=product_info&cPath=10&products_id=50&zenid=g29852ugiccivalvfgkjc5i185

Inside the ALPO
Member, section and activity news

NEWEST MEMBERS...

The ALPO hereby welcomes our newest members. Below are those who have become new members from November 13, 2019 through October 25, 2020 along with their locations and interests in lunar and planetary astronomy. The legend for the interest codes are located at the bottom the table on the following page. Welcome aboard!

Name	City	State/Region	Country	Interests
Paul Abel	Leicester	Leicestershire	United Kingdom	
Alan Agrawal	Lafayette	CA	USA	
Stephen Altic	Columbus	OH		
Paul Andrew	Kent		United Kingdom	
Cal Barton	Tyler	TX	USA	
Mark Barton	Santa Clarita	CA		
Glenn Basore	Castic	CA		
Matthew Benton	Savannah	GA		
Eliud Bonilla	Kensington	MD		
Nicholas Chudolij	Fall River	MA		1
Lawrence Conrad Ii	Sandstone	MN		
Jonathan Doupe	Edmonton	AB		
Paul Fiorino	Irving	TX		
Richard Friedrich	Severna Park	MD		
John Fusto	Massapequa	NY		
Scott Harris	Atlanta	GA		
Mmh Heijen	Landgraaf		Netherlands	
Greg Hemmings	Glasgow	VA	USA	
Ernest Jacobs	Eden	NY		
Dawn Jenkins	Lakewood	OH		
Steve Johannes	Mahnhattan	KS		
Robert Johnson	Williamsfield	IL		
Marc Johnson	Atlanta	GA		
John Johnston	Silver Spring	MD		
Kevin Kell	Yarker	ON	Canada	
Zsolt Kereszty	Gyor	GYMS	Hungary	
Terry Kinlock	Wellington		New Zealand	
Joseph Komjathy	St. Augustine	FL	USA	
Mark Lovett	Lebanon	PA		
Albert Lozano	Dallas	PA		
David Malaro	Revere	MA		
William K Malkames	Allentown	PA		
John Maikner	New Ringgold	PA		
Stanley Max	Towson	MD		
Abbas Mokhtarzadeh	Waxhaw	NC		

Inside the ALPO
Member, section and activity news

Member	City	State	Country	Interests
Seanan Murphy	Arlington	MA	USA	
Vikas Nath	Toronto	ON	CANADA	
Joshua Novak	Worth	IL		
Christine P Parkyn	Nebraska City	NE		
Douglass F Rohrman	Escondido	CA		3P
Andres Salaverria	Houston	TX	USA	
Edward Scott	Georgetown	SC		
Tim Sherrill	Noblesville	IN		
Philmore Smith	Myrtle Beach	SC		
Maura Smith-mitsky	Camp Hill	PA		
Luigi Testa	Parma		Italy	2,4,5,6
Randy Trank	Winnebago	IL		
Thomas Treadway	Livermore	CA		
Stephen Vance	Napa	CA		
David Warner	Colorado Springs	CO		
Richard Warren	Wilsons Mills	NC		
Thomas Watson	Tucson	AZ	USA	
Robert Williams	Tallahassee	FL		
James Williams	Herndon	VA		
Ron Whitehead	Beavercreek	OH		
Alexander Zadrazil	Appleton	WI		

Table of Interest Codes

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

Papers & Presentations

ALPO Virtual Board Meeting Minutes, October 2, 2020

Minutes provided by Matt Will, ALPO Secretary / Treasurer
matt.will@alpo-astronomy.org
***Zoom* screen conference images provided by Tim Robertson**
cometman@cometman.net

Call to Order

On Friday, October 2, 2020, at 4.15 p.m. PDT (Pacific Daylight Time), ALPO Executive Director and Board Chairman Julius L. Benton, Jr., called the ALPO Board of Directors meeting to order. This meeting was conducted as a virtual event through the teleconferencing capabilities of Zoom Video Communications, Inc., offering audio and video communications of the proceedings to participants at the meeting. The ALPO Board was grateful to ALPO Board member Tim Robertson for providing technical support to make this happen. This ALPO Board meeting was held during the 2020 virtual annual conference of the ALPO, where paper presentations were given via Zoom, on October 2nd and 3rd.

Board Members & Attendees Present

ALPO Board members Julius L. Benton, Jr. (Executive Director and Chairman), Carl Hergenrother (Associate Executive Director), Matthew L. Will (Corporation Secretary and Treasurer), Richard W. Schmude, Jr., Kenneth T. Poshedly, and Tim Robertson were present for the Board meeting. Board member Sanjay Limaye could not attend or participate in this year's annual meeting due to a prior commitment. Also, in attendance were ALPO staff members Wayne Bailey, Shawn Dilles, Rik Hill, Dolores Hill, Bob Lunsford, Keith Spring, David Teske, and Roger Venable, along with ALPO members Stephen Bennet, John Nagle, John Sillasen, Stephen Tzikas, plus a few unidentified individuals that may have joined the meeting in progress.

Issue One: Approval of the Board Meeting Minutes of 2019

(Introduced by Matthew Will)

The Board meeting minutes for our 2019 ALPO Board meeting were approved by all the Board members last fall.

Issue Two: Future Annual Meeting Venues

(Introduced by Carol Hergenrother)

Carl Hergenrother introduced to the ALPO Board possibilities for next year's annual meeting. Because of the Covid-19 Pandemic, the Astronomical League had cancelled the 2020 ALCON and plans to hold next year's ALCON at the same site that would have been used for this year's ALCON, in Albuquerque, New Mexico, from August 4 - 7, 2021. Since the format for 2020 ALCON did not include ALPO presentations integrated into the main presentation proceedings, the ALPO opted out of participating in this meeting. It is presumed that the format for the 2021 ALCON has not changed, so that leaves the ALPO to look elsewhere to meet with other groups in 2021. Looking forward to 2022, there is the possibility that the League will meet in Cleveland, Ohio, as a part of a combined Great Lakes Region and national ALCON meeting in that year. Ken Poshedly has discussed briefly with Terry Mann of the League this proposed meeting and our interest in being a part of an integrated program of presentations. This venue could serve as a destination for a possible 2022 ALPO annual meeting and will be something for the ALPO Board to keep in mind.

Along the same lines as with the Astronomical League's Great Lakes Region annual meeting, other League regions put on good annual meetings as well, such as the Mid-States Region and the North Central Region. Their meetings can occur generally around April or May. This timing may be too early for the ALPO to meet, but does offer a possibility for meeting at a well-organized affair.

Richard Schmude offered the Society of Astronomical Sciences as another possible venue. We had met with SAS in 2018 and found that organization to be a very welcoming to the ALPO.

PARI (Pisgah Astronomical Research Institute) had extended a standing invitation to meet at its complex in North Carolina. PARI is located in a remote part of western North Carolina near Brevard, which is about 50 miles south of Asheville. PARI has meeting space and facilities for giving presentations though accommodations onsite might be limited and outlying lodgings might be located some distance from their facilities.

SARA (Society of Amateur Radio Astronomers) has an annual conference that meets in June, usually at the Green Bank Radio Observatory in West Virginia. Ken Poshedly mentioned that registration fees for SARA meetings may be steep when compared to ALCONs or other ALPO meetings, around $190, which includes a $20, one- year membership in SARA. One caveat for meeting with SARA is that cell phone usage is not permitted in or near the Green Bank site, since it is a remote radio receiving complex and easily susceptible to radio interference.

The RASC (Royal Astronomical Society of Canada) has its annual General Assembly meetings late in June. We met with the RASC once before, in Calgary in 2007, and found them to be most accommodating. Planning with the RASC requires that we work with them two years in advance of a meeting. The ALPO would have to contact the RASC and let them know our intentions to meet with them for a future year, other than 2021.

Richard also thought that meeting with the AAS (American Astronomical Society) was another possibility. Matt Will had contacted the AAS last summer, expressing a desire for a possible joint meeting. Although the AAS is an organization that promotes and supports professional astronomers, it has recently embraced amateur astronomers with a special amateur membership class. While the AAS was quite open to a joint meeting, prospects were not favorable in the coming year since next year's summer meeting is schedule in Anchorage, Alaska, and might be too remote for most ALPO members to attend in person.

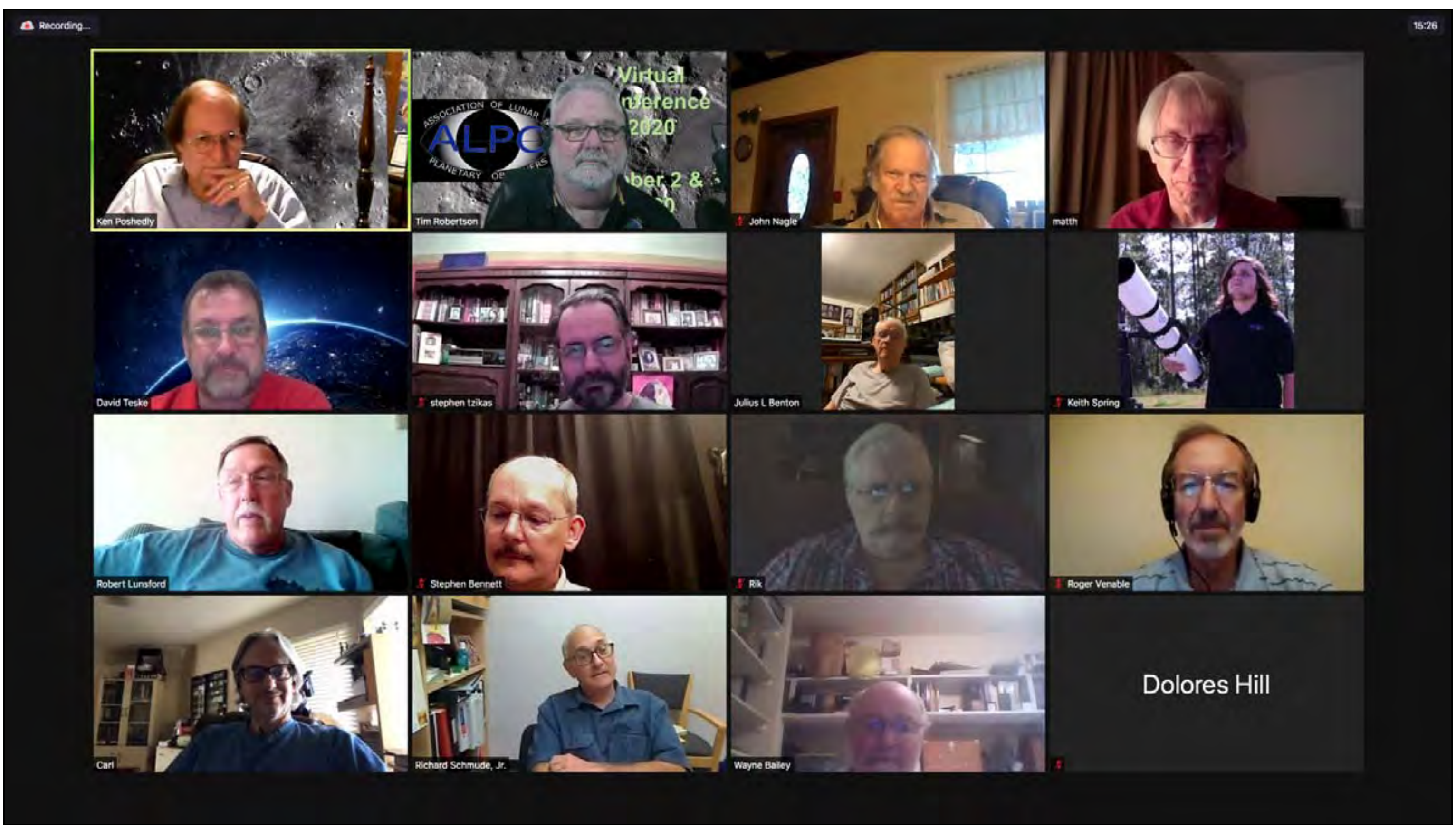
Since the 2020 ALPO virtual conference first day's proceedings had ran smoothly on Zoom, and also considering the uncertain future of the ongoing pandemic, it was suggested by other Board members that the ALPO might want to consider going virtual again with the next summer's conference. This year's conference gave many ALPO members that had never traveled to a past conference, the chance to experience our audio/visual presentations, see the faces behind the names of staff and other members, and speak to them directly in much the same way we do at our in-person meetings. Indeed, we had many persons outside the United States not available to travel to the U.S. participating in this year's Zoom conference. It was suggested by Richard, Ken, and Tim that perhaps we could include other organizations in a virtual conference next year. Possible organizations might include the BAA (British Astronomical Association) and the RASC. The Board thought this was an excellent idea. Julius Benton agreed to contact the BAA and Matt Will said that he could contact the RASC, inviting them to participate in a virtual conference next year.

Issue Three: ALPO Journal Status

(Introduced by Ken Poshedly)

Ken Poshedly was pleased for the most part that the Journal is able to keep its high standards for publication in a period of transition. Shawn Dilles has done an outstanding job as our new editor over the past year. Shawn reviews initial submissions, assigns a peer review editor that reviews the content and accuracy, and then does the final editing for readability. Scientific quality may vary from paper to paper but Shawn said at the meeting that he hasn't read a paper that wasn't worthy of being printed in the Journal. Shawn concluded that he has found the whole experience of being editor to be quite enjoyable.

Ken mentioned that he is getting help with the layout of the Journal from a



contractor. Ken may need more help putting together the Journal. Matt suggested that Ken submit a proposed cost for additional help and that Matt would evaluate what revenue increases would be needed to support the help.

Having a completely full-color Journal has always been a dream of the Publications Section. In the past, costs for printing in color have been prohibitive. Revenue to support printing in color would more than double and would mean a similar increase in membership dues for the hard copy version of the Journal. A couple of year ago, our professional printer, Sheridan, suggested that the cost could be reduced significantly by selectively printing in color only certain pages that need color. Sheridan shared a guide for projected costs for color printing and Matt Will crunched the numbers on hypothetical cases for printing. While that cost for color printing increased compared to a typical black printed Journal, they weren't as high as printing completely in color. The general consensus from the ALPO Board was that Ken and Matt reevaluate printing in color based on present costs in the method Sheridan has proposed and report back to the Board on what it would take to finance such an undertaking.

Issue Four: Status of Membership and Finances

(Introduced by Matthew Will)

The ALPO has experienced more growth in membership over the past year. The ALPO had 404 members at the time of the conference. This is up from 378 from July 2019 and 337 members in May 2018. This increase in membership could be attributed to the interest in the recent perihelic Mars apparitions of 2018 and 2020, greater exposure the ALPO has had from the ALPO podcasts, along with interest in the traditional outlets of the ALPO, the Journal and recent developments with our website such at the complete library of published issues of the Journal downloadable for anyone.

The ALPO is also using social media such as Facebook and Twitter to raise its profile with this form of digital media. Rik Hill mentioned that many observers use Facebook to share observations. Solar Section Assistant Coordinator Pam Shivak's has worked to attract solar observers with social media. She is now using Facebook to promote youth involvement in Solar System astronomy as coordinator of the Youth Program.

The ALPO still has international appeal as 1 out of 5 paid members are from abroad. Rik Hill commented a large number of lunar observations done for the ALPO come from Argentina. Indeed, there are many more that observe for the ALPO than are paid members. Rik said that he, like other coordinators, while accepting observations from all, gives preference to presenting observations in reports from dues-paying ALPO members. Without dues-paying members, the ALPO could not support its website or Journal.

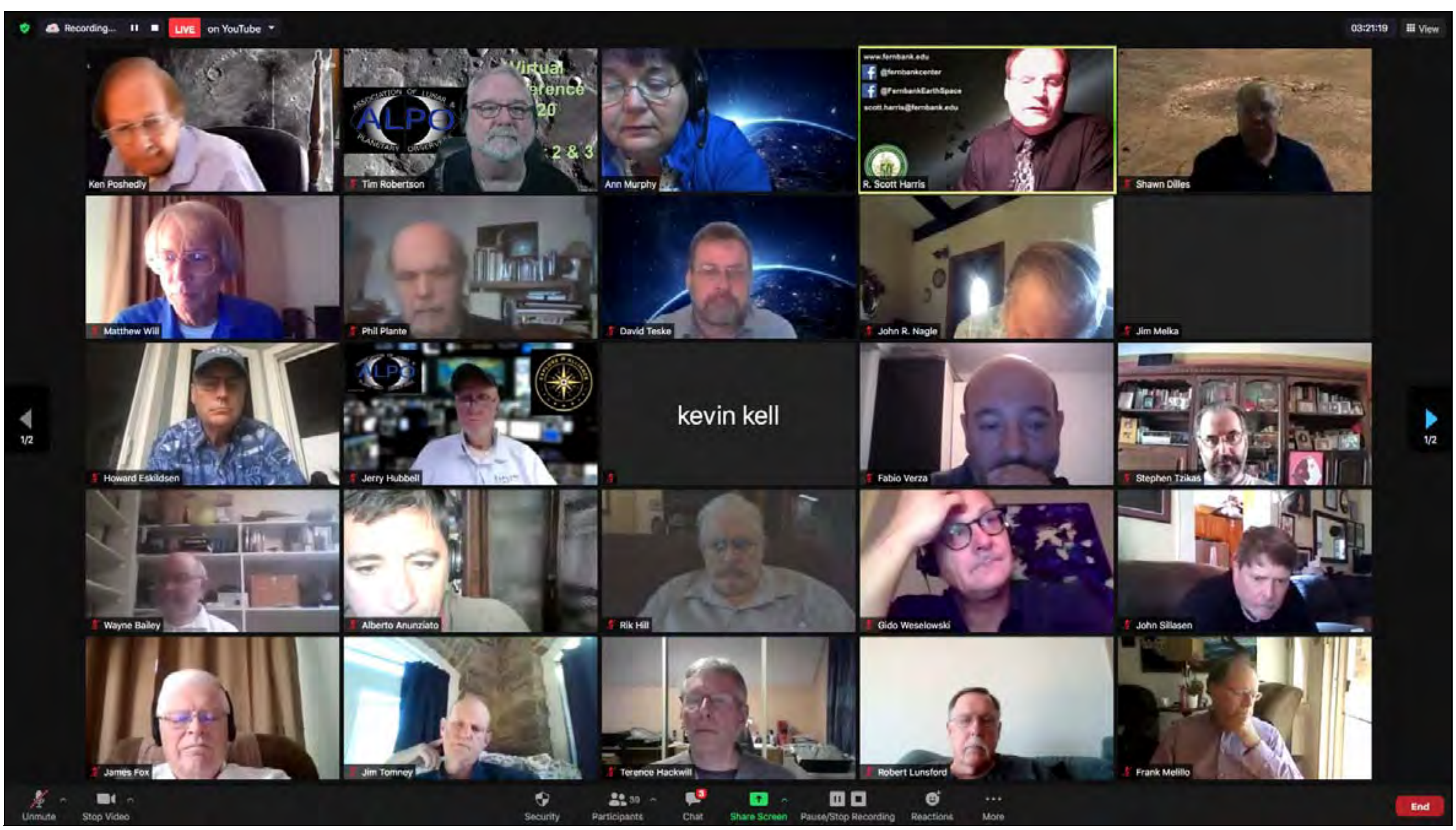
Some ALPO members at the meeting cited some confusing aspects to the Astronomical League's online page for purchases of ALPO memberships as a possible reason for some not becoming members. Matt Will commented that he had heard others make similar comments in frustration and would talk to the League about making some changes in the design of the web page. Although the ALPO enjoys a high profile on the League's online store, more options for purchase including an alternative means of online purchasing, like with PayPal directly from the ALPO website, could offset technical issues some have using the League's website. Matt Will agreed to investigate further and work with the ALPO's own Online Section in using PayPal options on our own website.

The ALPO still has an appeal to amateurs both inside and outside our organization. Tim Robertson said that his ALPO Observers Notebook podcast website gets on average 85 downloads a day. So, the ALPO's presence is being felt by the greater amateur community and this is encouraging given that we are experiencing some growth in the past two years.

ALPO finances are stable at the present time. The Springfield, Illinois, business account had $5336.64 at the time of the meeting. Roughly, the business account floats between $3,000 to $6,000 between printings of the Journal. While that cushion of $3,000 in the business account buffers as additional funds in case the ALPO is met with other one-time costs from time to time, that buffer is starting to shrink due to expenses incurred from seeking professional help in the production of the Journal. Matt Will, as our Treasurer, said that the ALPO could absorb these additional costs for a while, but that a dues increase was inevitable. Typically, the ALPO increases dues every three years as costs increase not just for the printing and mailing of the Journal, but for other administrative expenses in operating the organization as well. A dues increase in January 2022 would be well-timed and consistent with the manner in which dues increases have appeared over the last 20 years.

The ALPO Endowment fund has experienced some growth since the start of the year. The Endowment stands at $327,003.72, having gained $6,622.76 through interest and contributions over the past eight months. The purpose of the Endowment is to hopefully help finance a central headquarters operation for the ALPO in the future. Monies in the ALPO Endowment fund are now being reinvested as U.S. Treasury Bills; however, with interest rates dropping, the Treasurer is reevaluating investing the funds in certificates of deposit from banks since the interest rates with CDs are once again competitive with T-Bills.

Last November, the ALPO Board agreed to the concept of a separate Board of Trustees to help manage the ALPO Endowment. Matt Will is assessing recruitment of members to this special board to help manage the Endowment. The process will get underway in the coming months and an active board



could find creative ways of better investing these funds while providing more accountability in managing the Endowment.

The ALPO Board currently has a separate treasury committee to oversee the work of the treasurer and to act if needed to resolve any issues beyond the treasurer's control. The treasury committee is usually composed of three independent Board members that are not corporate officers in the ALPO. With Mike Reynolds' recent passing, Tim Robertson agreed to join this committee which includes Ken Poshedly and Richard Schmude.

Issue Five: ALPO Jupiter Section Coordinator

(Introduced by Julius Benton)

The position of lead coordinator for the ALPO Jupiter Section is in need of being filled. While Richard Schmude continues to write apparition reports for the section as well as providing guidance and support to Jupiter observers, administrative tasks of answering mail, forwarding observations, writing quarterly reports, and participating in web page management are best served by a separate section coordinator that has the time and energy to complete these tasks. Executive Director Julius Benton said that he has someone in mind that could play this role and assist the Jupiter Section in meeting its basic aims, and will report back to the Board later on.

Carl Hergenrother wondered if the approach to managing observing sections in general, especially for the more active ones, needed to be reexamined. Carl suggest that the division of work within a section might be better shared by three persons. The first person would be responsible for the scientific analysis of observational data, i.e., apparition reports for most sections. The second person would handle correspondence with observers and other administrative duties. The third person would be responsible for the section's web page management. Carl's observation was that some coordinators were being over burdened by handling too many tasks that they didn't have time or energy for.

ALPO Board and staff chimed in that some of these jobs were being met by individually skilled persons. For example, Rik Hill said that the Solar Section had such persons on staff like Kim Hay that had expertise in web development. Roger Venable wondered, though, if there were very many persons that might be willing to do such tedious work like web page support for particular sections.

Archiving images including deciding and enforcing standards for imaging and visual observations can also be challenging. When it comes to managing images on the website, appropriate standards can vary. In the discussion, most staff members preferred raw images while some might accept some processed images. Size of the files can be another issue depending on the host server.

In sum, there can be plenty of work to go around for three persons managing a section.

Issue Six: A Possible Proposed ALPO Exoplanets Section

(Introduced by Julius Benton)

For some time now, there has been some discussion among ALPO Board members concerning the possible creation of an observing section within the ALPO dedicated to collecting observational data on planets orbiting other star systems. While professional astronomers have been recording and collecting observations, amateurs have been increasingly involved in making such observations and sharing data with other amateur organizations. The AAVSO (American Association of Variable Star Observers) has a well-developed section for exoplanets that has been operating for at least the last five years. Obviously, an exoplanet section within the ALPO would have to operate in harmony with the AAVSO exoplanets section. Ken Poshedly expressed that we would not want to duplicate what the AAVSO was doing. Matt Will further added that the proposed section would need to offer a fresh approach in exoplanet research in contrast to the AAVSO. Rik Hill said that when the ALPO started up its Solar Section in the earlier 1980s, he had some positive input from the AAVSO and fruitful discussions led to definitions of where the AAVSO's focus was in solar observations and where the ALPO could maintain studies without any overlap between the two organizations. The Board was in general agreement that given the interest in amateur observations of exoplanets, the ALPO could contribute studies in this field. In accordance with our standing rules, Executive Director Julius Benton agreed to establish a “provisional” observing section for the purpose of studying exoplanets. Julius further appointed Gerald Hubbell as the new Exoplanets Section Acting Coordinator. Julius and the ALPO Board will monitor the progress of the section and decide over the next two years if interest level and activity of this provisional section are sufficient enough to grant it permanent status among our well-established ALPO observing sections.

Issue Seven: Staff Status

(Introduced by Carl Hergenrother)

Acting ALPO staff are eligible for permanent status, contingent on a vote of the ALPO Board.

The usual probationary period for review before the Board decides whether or not to grant permanent status is usually two years. Acting ALPO staff are eligible for permanent status contingent on a vote by the ALPO Board.

After a discussion and review of the table shown here, Richard Schmude made a motion to promote Keith Spring, David Teske and Shawn Dilles to permanent

Table of ALPO Current Acting Staff Appointments

Staff Member	Section	Title	Date of Appointment
Pamela Shivak	Outreach Section Youth Program	Acting Coordinator	Apr 2020
Keith Spring	Eclipse Section	Acting Assistant Coordinator	Sept 2018
Keith Spring	Mercury and Venus Transits Section	Acting Assistant Coordinator	Sept 2018
David Teske	Lunar Topographic Studies Program	Acting Coordinator	July 2019
Shawn Dilles	Publications Section	Acting Assistant Coordinator (*Journal* Editor) *	July 2019
* Shawn Dilles was appointed by then outgoing Executive Director Richard Schmude as "acting" in the capacity of Journal editor according to the 2019 Board meeting minutes.			

status. Julius Benton seconded. The Board vote was 6 to 0 in favor of granting these three acting staff members, permanent status.

Issue Eight: ALPO Website: Status, Updating, and Possible Redesign

(Introduced by Carl Hergenrother)

With the introduction of this topic, Rik Hill, the ALPO's founding and former webmaster, noted that the ALPO website has now been around for 25 years. In that time, the ALPO website has from time to time undergone updating through changes in format and content. Lately, while some section web pages are quite up-to-date in content, some appear to be a bit stagnant or stale both in content and appearance. There may be legitimate reasons for this highlighted in Issue 5 of these minutes involving manpower and resources of each section. However, presentability and flow of content for information and observations sometimes do not lead the user of the website to places where more material can be obtained. Website design should be flexible enough to entertain inquiries from beginners while sophisticated enough to accommodate seasoned observers. Julius Benton said that he has talked to his son Matthew Benton who has some acquaintance with concepts in web design and through educational practices and said that his son had some ideas and approaches for better adapting the website to meet the expectations of ALPO members and observers.

Carl Hergenrother proposed the creation of a committee that could examine possible approaches toward making the ALPO website more user friendly at many levels. Carl and Tim Robertson have agreed to be a part of this committee. Naturally, ALPO Online Coordinator Larry Owen would be a part of this committee for his commanding expertise with website management. Matt Benton will be invited to serve on the committee to offer his insights as well.

Carl also alluded to social media as being a part of this expanded effort. As mentioned earlier in Issue Four of these minutes, the ALPO already has a presence on Facebook and Twitter, with a separate Facebook page for the ALPO Youth Program administered by Acting Coordinator Pam Shivak. Carl pointed out that amateurs are making great use of social media to share knowledge and observations and the ALPO online resources should take advantage of the amateur's presence in social media.

Issue Nine: Lunar Nomenclature, Status Report – Naming of Craters or Lunar Features for Walter H. Haas, Donald C. Parker, Anton Rükl, Winifred S. Cameron and John Westfall

(Introduced by Matthew Will)

Three years ago, a discussion was led by former Board member, the late John Westfall, regarding the naming of lunar features for ALPO members. The governing organization that sanctions the naming of such features for any astronomical body is the IAU (International Astronomical Union). The reader is referred to a fuller discussion of this topic in the past Board meeting minutes of 2017 and 2018.

The pathway toward naming a lunar feature on the Moon is fraught with complicated protocols and standards that might not be easily met. Only an active lunar researcher that is a member of the IAU has naming privileges, and the naming must be for the feature he or she is doing research on. Ken Poshedly suggested contacting lunar astronomer Charles Wood, who has served on the naming committee of the IAU, and may have some better insights on what the ALPO can do to campaign for the naming of lunar features for these distinguish lunar devotees. Matt Will agreed to contact Charles Wood about this matter. Rik said that he could forward to Matt recent contact info for Charles Wood.

Issue Ten: Observer and Service Awards

(Introduced by Matthew Will)

The Walter H. Haas Observer Award is bestowed annually to an amateur astronomer for excellence in observational Solar System astronomy. This award is named after our founder and director emeritus and was established in 1985. The selection of this award is conducted by a committee convened by its committee

Howard Eskildsen, winner of the 2020 Walter H. Haas Observer Award. (*Photo courtesy of Howard Eskildsen.*)

chairman, Timothy J. Robertson. The Walter H. Haas Observer Award recipient was selected from that committee that was composed of ALPO members, some of whom are on staff and all are experienced observers that are familiar with the ALPO observing community. The award itself consists of an engraved plaque. The awardee also receives a two-year complimentary membership in the ALPO.

This year's Walter H. Haas Observer Award recipient is ALPO member Howard Eskildsen. Howard has been an ALPO member since 2003. A retired MD, Howard makes his home in Ocala, Florida. Howard has been noted for his outstanding imaging of the Sun for the ALPO's Solar Section and his observations of lunar features for the ALPO's Lunar Topographic Studies Program. In recent years, Howard was also a contributor of multiple papers to the Journal of the ALPO and was a presenter at the ALPO's annual meeting in 2013. Congratulations Howard!

As always, thanks are extended to our newest ALPO Board member Tim Robertson for continuing on as our chairman of the Observer Award Committee. By no small measure, this is not an easy task, requiring both patience and persistence in finishing out the entire process with the other committee members. The ALPO also wishes to thank those that took the time to participate in this year's committee.

The Peggy Haas Service Award was established to recognize a member of the ALPO for outstanding service to our organization. This award was named after our founder's late wife for her past support of the ALPO in many meaningful and indispensable ways, from assisting her husband with the Journal to performing such functions the ALPO's Librarian for its book-lending service from 1966 to 1985. The award was inaugurated in 1997. The current executive director solely selects the recipient for this award. The Peggy Haas Award can recognize an ALPO officer, board member, volunteer staff member, or non-staff member who has contributed outstanding service in some way to the organization, in a capacity excluding observational skills (observational skills are recognized by the Walter H. Haas Award). Considered not to be an annual award, presentation will occur when appropriate and not at any specific time interval. The Award itself consists of an engraved plaque. The awardee also receives a lifetime membership in the ALPO.

At this time, no recipient was selected for the Peggy Haas Service Award, though Executive Director Julius Benton reserves the right to make a selection at a later date.

Adjournment

With no new business to conduct at this year's ALPO Board meeting, Matt Will made a motion to adjourn, and Richard Schmude seconded. The motion passed with the Board members present voting unanimously in the affirmative with the Board meeting adjourning at 6:28 pm PDT on Friday, October 2, 2020.

Papers & Presentations
Index to Volume 57 (2015) of The Strolling Astronomer

By Shawn Dilles and Michael Mattei
E-Mail SJDilles@gmail.com

PUBLICATION DATA

Issue	Month	Year	Pages
1. Winter	December	2014	1 - 51
2. Spring	March	2015	1 - 79
3. Summer	June	2015	1 - 56
4. Autumn	October	2015	1 - 60

AUTHOR INDEX

SUBJECT INDEX

ALPO

ALPO Convention (ALCON 2015)

ALPO Interest and Observing Section Reports

ALPO Member, Section and Activity News

Comets

Computing

Eclipse (Galilean Satellites)

Index (The Strolling Astronomer)

In Memoriam

Instruments, Hardware and Software

Jupiter

Transits (Solar)

Venus

Our Advertisers

Papers & Presentations:

A Report on Carrington Rotations 2226 through 2230 (2020 01 06.3826 UT to 2020 05 21.8750 UT)

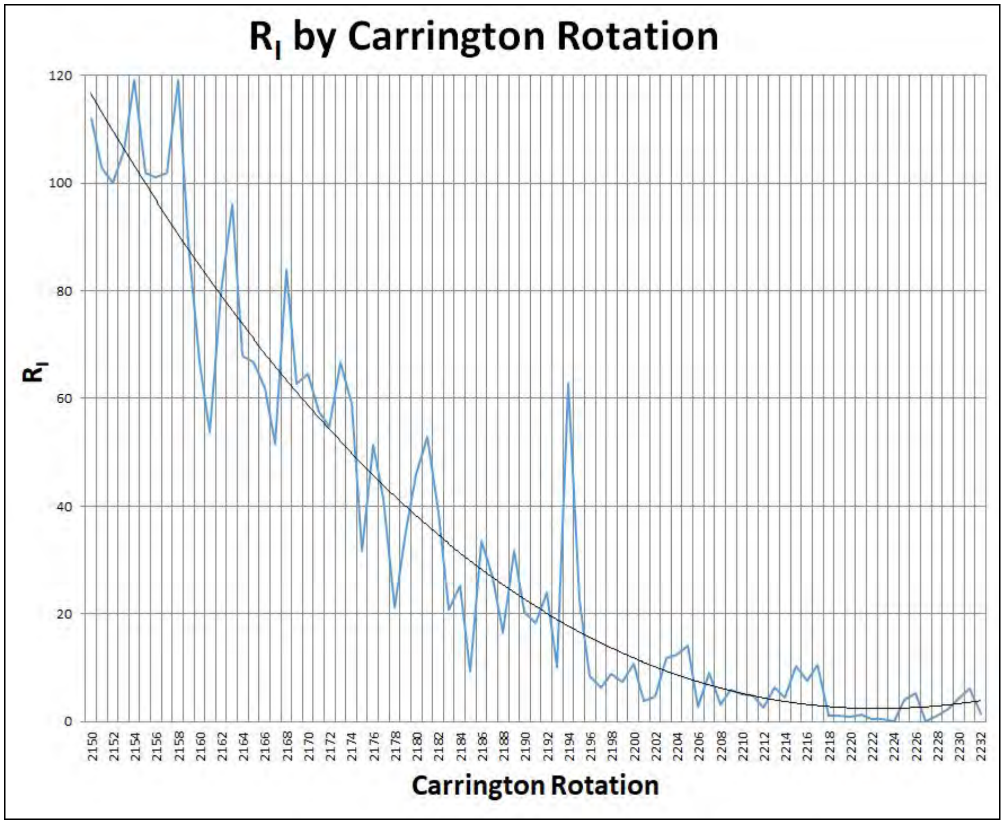
By Richard (Rik) Hill,
Coordinator &
Scientific Advisor,
ALPO Solar Section
rhill@lpl.arizona.edu

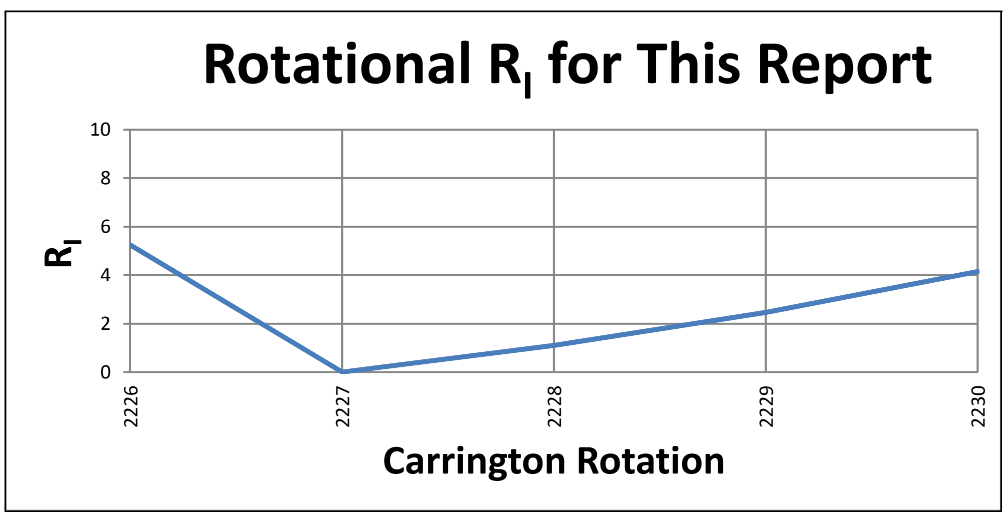
To our hard-copy readers: This paper can be viewed in full-color in the online (pdf) version of this Journal.

Overview

Activity in this reporting period went from very low to extremely low with one rotation, CR 2227, which had no spots at all! This was to be expected but it's always a surprise when it happens. Plot 1a shows where we are with respect to previous rotations and the solar cycles as a whole. Plot 1b shows what the International Sunspot Number (R_I) was like for this reporting period. This is the lowest activity we have seen yet and we could be at or very near minimum. The highest R_I was 5.25 in the first rotation, CR 2226. The next rotation had an average of 0, from which activity slowly rose to 4.15 in CR 2230. The highest daily R_I was 29 on 4/27 with 107 days of no spots.

Sixteen observers from eight countries contributed to this report. Their equipment and modes of observing are summarized in Table 1. It will be used as a reference throughout this report rather than repeating this information on every image or mention.





Carrington Rotation 2226

Dates: 2020 01 06.3826 to 2020 02 02.7229
Avg. R_I = 5.25
High R_I = 19 (1/26)
Low R_I = 0 (14 days)

There were 14 spotless days in this rotation according to WDC-SILSO, 13 of which were from 1/11-1/23. The average R_I was 5.25, the high of this reporting period (Plot 2). All the activity of this rotation was confined to three small active regions, two at the beginning (ARs 2755 & 2756) and then the largest one (AR 2757) on the last week of the rotation. The first, AR 2755 did not

Terms and Abbreviations

Readers are encouraged to return here as needed for definitions of any unfamiliar terms and abbreviations.

AR = Active Regions, that is, areas which include all activity in all wavelengths for that area of the Sun as designated by NOAA; only the last four digits of the full identification number is used here

CaK = Calcium K-line observations

CM = Central Meridian of the visible disk

CR = Carrington Rotations

faculae = bright regions of the Sun's photosphere seen most easily near the Sun's edge

groups = visible light or “white light” sunspots associated with an Active Region

H-a = hydrogen-alpha observations

“leader” and “follower” = “east” and “west” on the Sun; using the “right-hand rule” where, using your right hand, your thumb pointing up is the North Pole and the rotation follows the curl of your fingers. Orientation of all images is with north up and celestial west to the right.

Na-D = Sodium-D observations

Naked-eye sunspots = those spots visible on the Sun without amplification but through proper and safe solar filtration; never look at the Sun, however briefly, without such filtration even at sunrise/sunset.

NOAA = National Oceanic and Atmospheric Administration

N, S, E and W = north, south, east, west

plage = a luminous area in the Sun's chromosphere that appears in the vicinity of an active region

w-l = white light observations

****

Statistics compiled by this author have their origin in the finalized daily International Sunspot Number data published by the World Data Center - Solar Index and Long Term Solar Observations (WDC-SILSO) at the Royal Observatory of Belgium. All times used here are Coordinated Universal Time and dates are reckoned from that and will be expressed numerically with month/day (for example, “9/6” and “10/23”). Carrington Rotation commencement dates are obtained from the table listed on the ALPO Solar Section web page at:

http://www.alpo-astronomy.org/solarblog/?page_id=3423

Areas of regions and groups are expressed in the standard units of millionths of the solar disk, with a naked-eye spot generally being about 900-1,000 millionths for the average observer. The McIntosh Sunspot Classification used here is the one defined by Patrick McIntosh formerly of NOAA (McIntosh 1981, 1989) and detailed in an article in the Journal of the ALPO, Volume 33 (Hill 1989). This description is also included in an online article on white-light flare observation located at:

http://www.alpo-astronomy.org/solarblog/?page_id=200

This will be referred to as the McIntosh Class. The magnetic class of regions is assigned by NOAA and will be entered parenthetically after the McIntosh Class unless specifically referred to as “mag. class”.

Lastly, due to the constraints of publishing, most of the images in this report have been cropped, reduced or otherwise edited. The reader is advised that all images in this report, and a hundred times more, can be viewed at full resolution in the ALPO Solar Archives. The archives can be accessed by going to www.alpo-astronomy.org, then clicking on the ALPO Section Galleries link near the top-right corner of the page, then clicking on “Solar Observations Archive”. You can also access the archives directly through this link: http://alpo-astronomy.org/gallery3/index.php/Solar-Observations-Archive .

Table of Contributors to the ALPO Solar Section

Observer	Location	Telescope (aperture, type)	Camera	Mode	Format
Raffaello Braga	Milano, Italy	112 mm, RFR	PGR Chameleon Mono 2.0	H-a	digital images
Tony Broxton	Launceston, Cornwall, UK	127 mm, SCT	N/A	w-l	drawings
Jeffery Carels	Bruges, Belgium	100 mm, RFR	ZWO ASI120MM	w-l	digital images
Gabriel Corban	Bucharest, Romania	120 mm, RFL-N	Point Grey GS3-U3	H-a	digital images
				w-l	
Michel Deconinck	Artignosc-sur-Verdon, Var, France	152 mm, RFR	N/A	w-l	drawings
Howard Eskildsen	Ocala, FL, USA	80 mm, RFR	DMK 41AF02	W-L wedge	digital images
				CaK	
Joe Gianninoto	Tucson, AZ, USA	85 mm, RFR	N/A	w-l	drawings
		60 mm, RFR		H-a	
Guilherme Grassmann	Curitiba, Brazil	60 mm, RFR	Lumenera Skynyx 2.0	H-a	digital images
Monty Leventhal	Sydney, New South Wales, Australia	250 mm, SCT	Canon Rebel T3i EOS 600D	w-l/H-a	drawings
				H-a	digital images
Tom Mangelsdorf	Wasilla, AK, USA	120 mm, RFR	N/A	w-l	drawings
Frank Mellilo	Holtsville, NY, USA	200 mm, SCT	DMK 21AU03.AS	H-a	digital images
Efrain Morales	Aguadilla, Puerto Rico, USA	50 mm, RFR	Point Grey Flea3	H-a	digital images
Theo Ramakers	Oxford, GA, USA	80 mm, RFR	ZWO ASI174MM	H-a	digital images
		279 mm, SCT	DMK 41AU02.AS	w-l	
		40 mm, H-a PST	DMK 21AU03.AS	H-a	
		40 mm, CaK PST		CaK	
David Teske	Louisville, MS, USA	60 mm, RFR	N/A	w-l/H-a	drawings
		100 mm, RFR	ZWO ASI120MM	H-a	digital images
David Tyler	Buckinghamshire, UK	178 mm, RFR	ZWO ASI120	w-l	digital images
		90 mm, RFR		H-a	
Christian Viladrich	Nattages, France	300 mm, RFN	Basler acA1920-155um	w-l	digital images

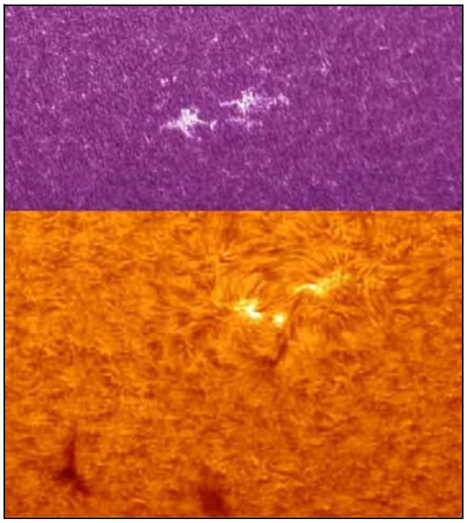
Telescope types: Refractor (RFR), Newtonian Reflector (RFN), Schmidt Cassegran (SCT), Maksutov-Cassegrain (MCT), Cassegrain (Cass)

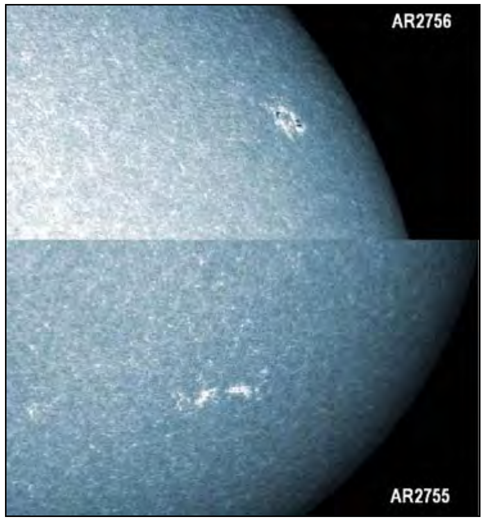
exceed 10 millionths. The second, AR 2756, lasted just two days, getting to 30 millionths and then dissolving. The last one, AR 2757, peaked at 100 millionths on January 28, reached class Cso (mag. Beta) for one day, and was the largest region in nearly six months.

AR 2755 was at its best on 1/6, the peak of its two-day long life. In W-L it was completely unimpressive, only a few spots without penumbra. But when seen in H-a and CaK by Ramakers, it was a little more interesting (**Figure 1**). The area was only listed as 10 millionths, but that seems like an underestimate and the class was Axx (mag. Alpha). Notice in H-a the two small dark filament pieces south of the region. There was no trace of these in CaK.

On 1/9 Grassmann shows both AR 2755 and AR 2756 in CaK (**Figure 2**). Both are rather small regions with only AR 2756 showing any spots a class Cro (mag. Beta) and an area of 30 millionths.

AR 2757 was best seen on 1/26 in a W-L image by Carels at 11:31 UT and CaK by Braga at 09:57 UT (**Figure 3**). Melillo caught a small flare in the region a little later the same day in H-a (**Figure 4**). Then Tyler got a high resolution W-L image of AR 2757 on 1/29 showing it as Hsx (mag. Alpha) of 70 millionths surrounded by sea of detailed granulation





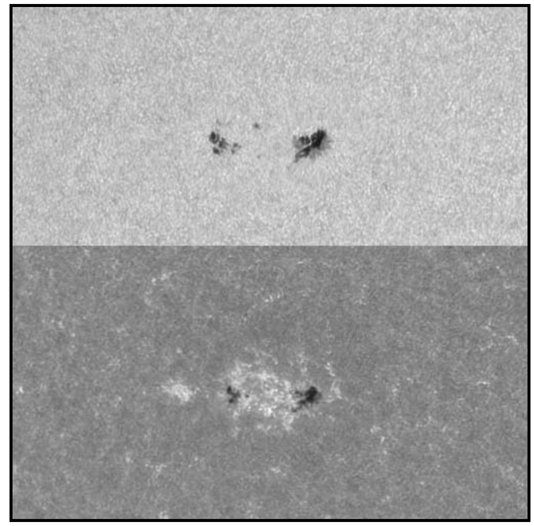
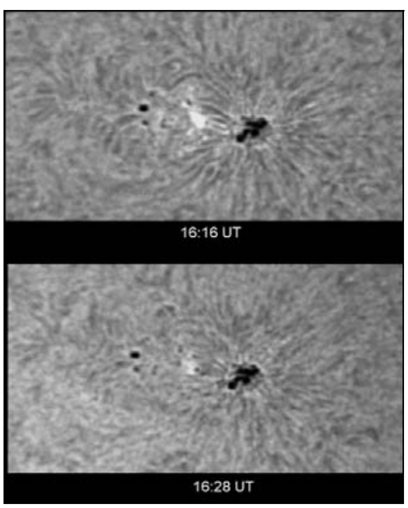


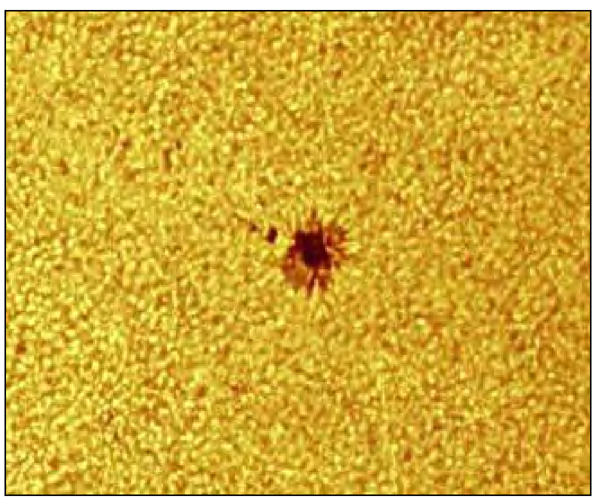
Figure 1. A two-pane view of AR 2755 by Ramakers on 01/06. Top pane is CaK at 14:40 UT and the lower is the H-a image at 14:58 UT.

Figure 2. The two active regions of 1/9 by Grassmann in CaK, AR 2756 in the upper pane at 12:04 UT and the lower is AR 2755 at 12:07 UT.

Figure 3. Two views of AR 2757 on 1/26, w-l above by Carels at 11:31 UT and H-a below by Braga at 09:57 UT.

Figure 4. A two-pane image of AR 2757 with a subflare in H-a by Melillo at 16:16 UT above and 16:28 UT below.





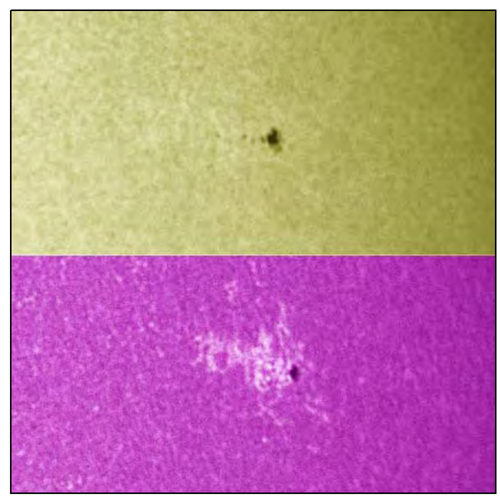


Figure 5. AR 2757 as seen in w-l by Tyler on 1/29 at 11:36 UT.

Figure 6. Two views of AR 2757 by Ramakers on 1/30. Above: w-l at 14:21 UT and below: CaK at 14:29 UT.

(**Figure 5**). Our final look of this region was by Ramakers on 1/30; a W-L image at 14:21 UT and CaK image at 14:29 UT as it was nearing the limb (**Figure 6**). It appeared to be a single spot trailing a few umbral spots and pores in a plage still Hsx with an area of 60 millionths.

Carrington Rotation 2227

Dates: 2020 02 02.7229 to 2020 03 01.0597

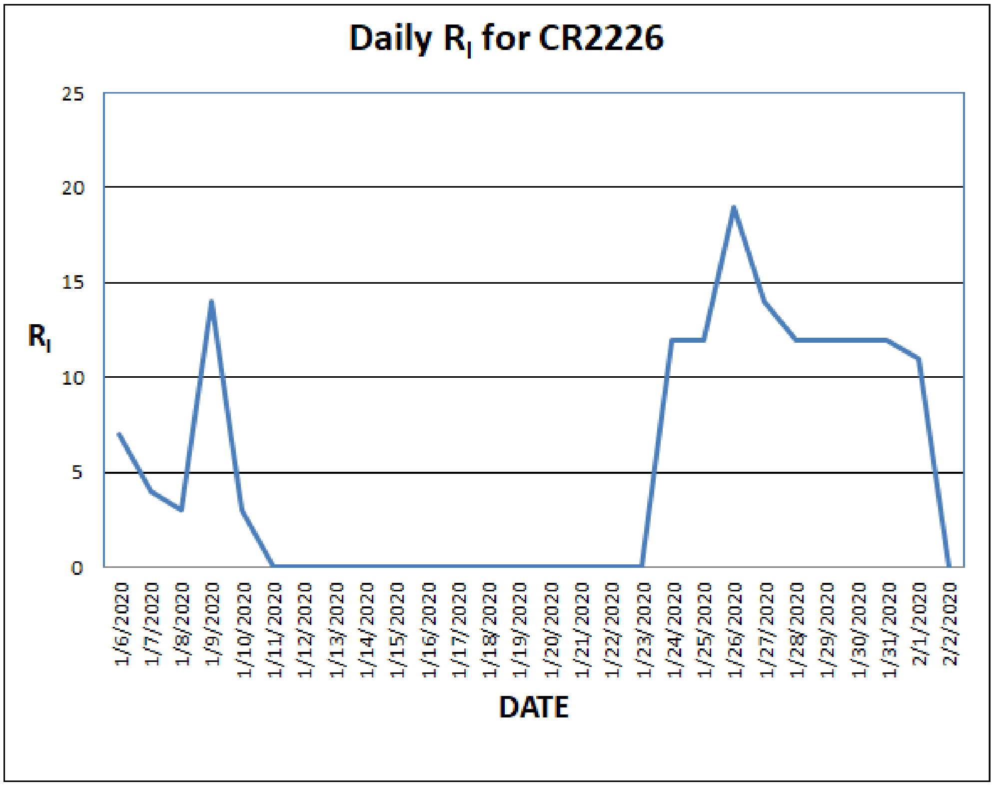
Avg. R_I = 0
High R_I = 0
Low R_I = 0 (27 days)

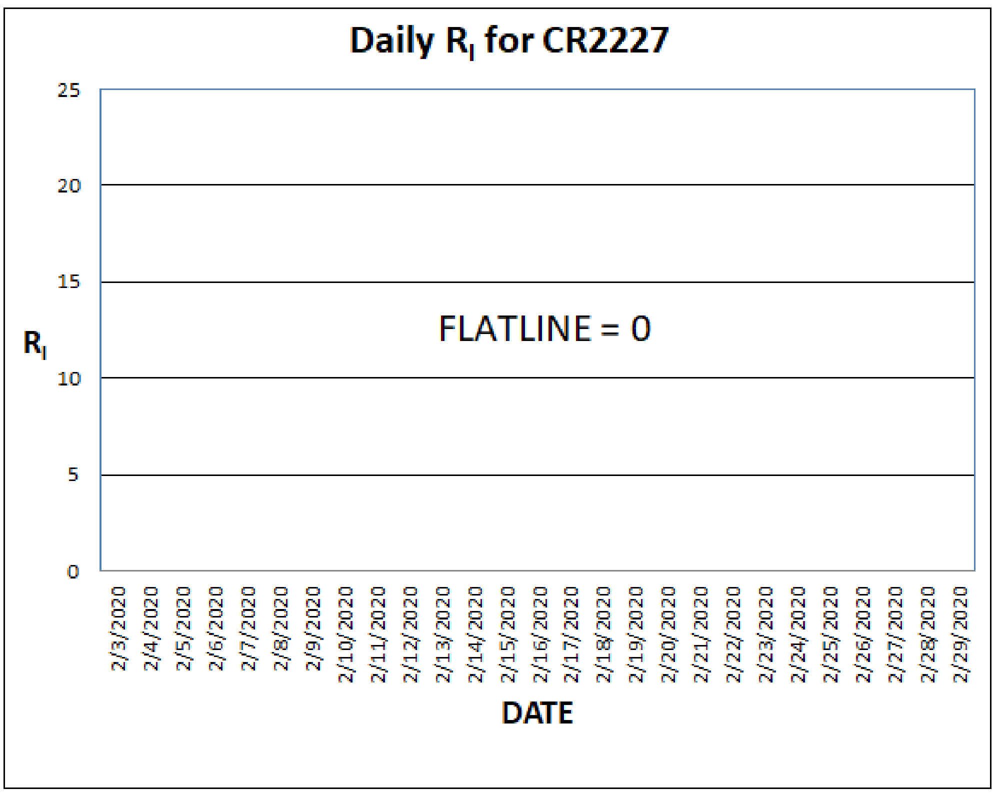
There were no active regions and no spots during this entire rotation for the first time since 2009 making activity extremely low. Even the daily Eskildsen images showed no potential regions and few isolated plages. However that does not mean there was nothing at all on the Sun. A few steadfast observers sent in images of limb prominences that were quite interesting.

On 2/8, Melillo took a two-pane image showing two such features, one on the NW limb at 15:53 UT and the other on the NE limb at 16:33 UT (**Figure 7**). They were small as prominences tend to be at solar minimum, but showed very nice detail.

Several more delicate limb prominences were captured by Ramakers on 2/9 (**Figure 8**). The upper image shows the SW limb at 17:35 UT and the lower image shows the NW limb at17:37 UT.

Then on 2/22, we have another two-pane Melillo H-a image at 15:50 UT and 16:13 UT showing the changes in a NW limb prominence over only 23 minutes (**Figure 9**). They might be small prominences but they were active.





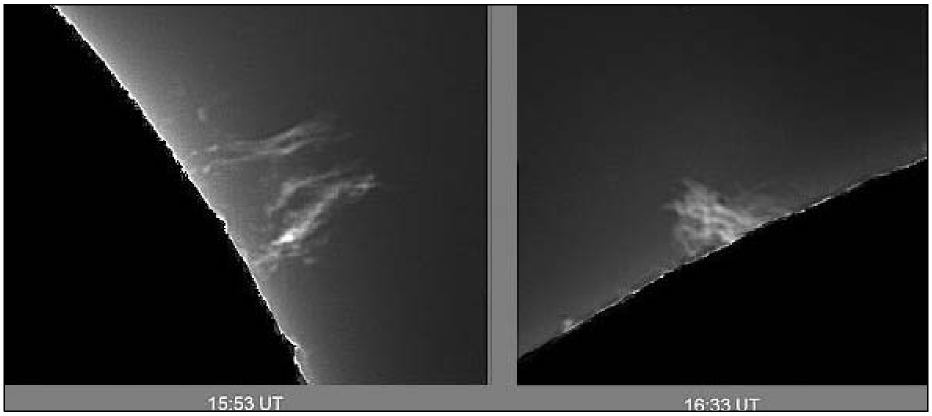


Figure 7. Two H-a limb prominences by Melillo on 2/8, the left one on the NW limb at 15:53 UT and the right on the NE limb a 16:33 UT.

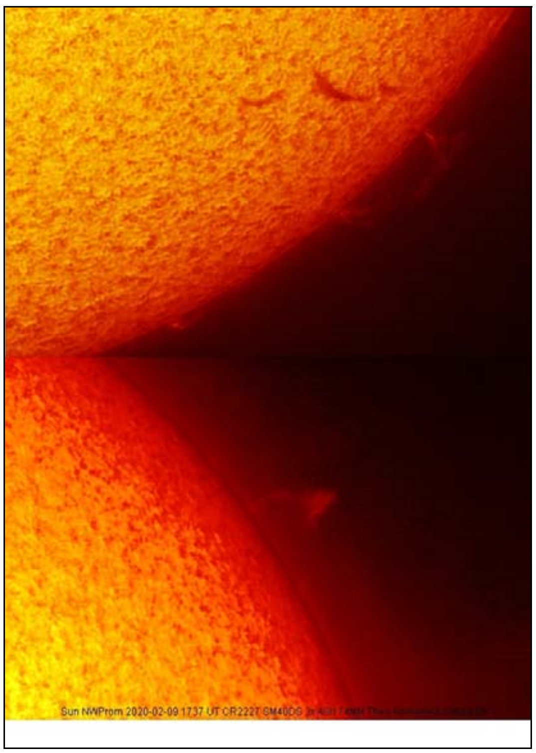


Figure 8. Two views of prominences on 2/9 by Ramakers above the SW limb at 17:32 UT and below the NW limb at 17:37 UT.

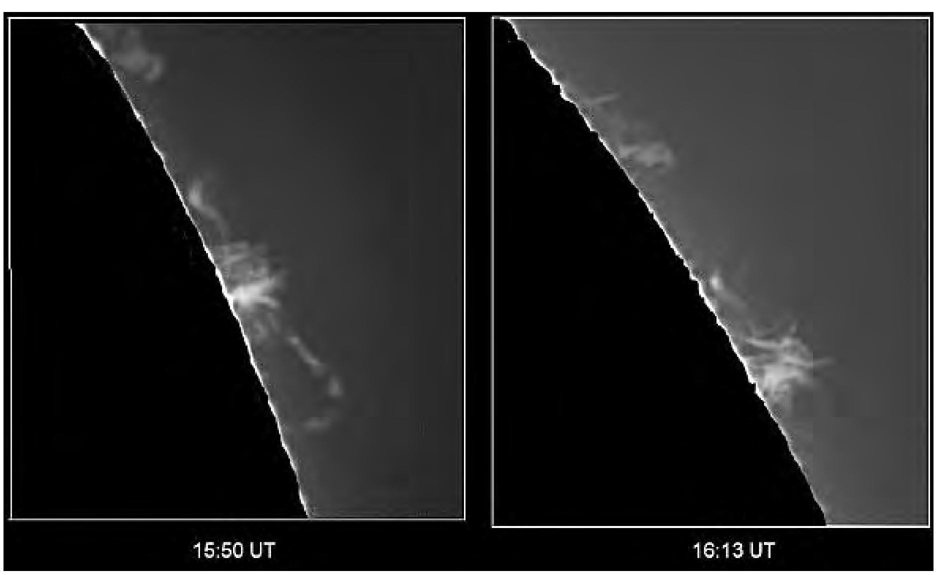


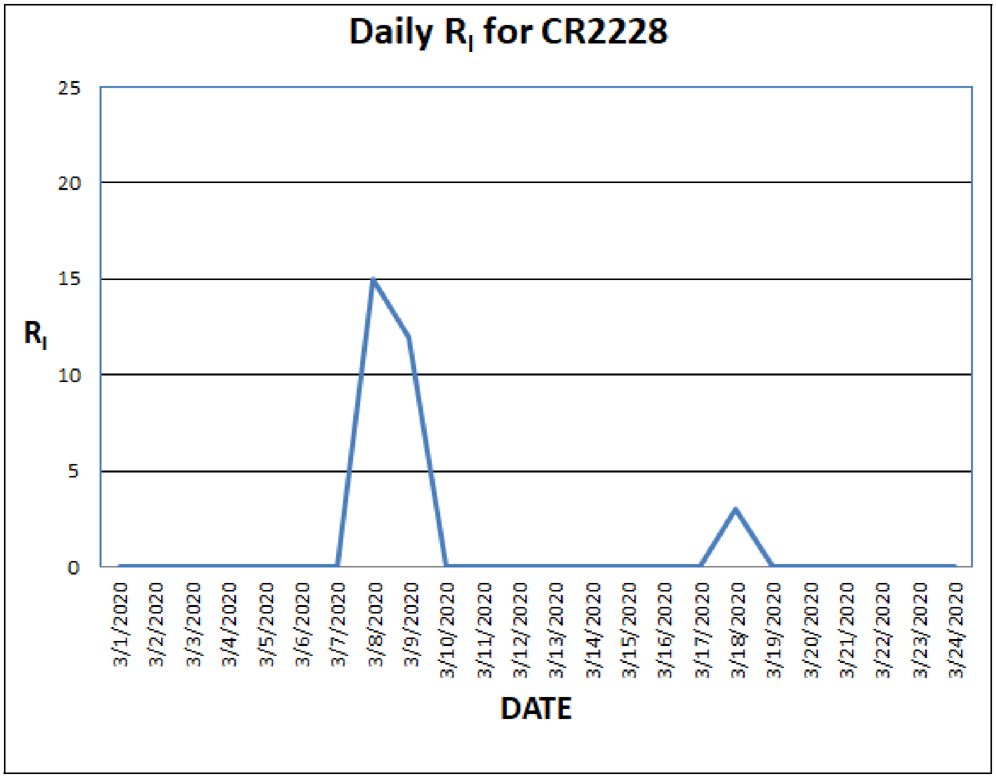
Figure 9. A two-pane image of NW limb prominences by Melillo showing changes from 15:50 UT on the left to 16:13 UT on the right.

Carrington Rotation 2228

Dates: 2020 03 01.0597 to 2020 03 28.3729
Avg. R_I = 1.11
High R_I = 15 (3/8)
Low R_I = 0 (24 days)

This rotation was a tiny bit more active but still there were 24 days with no spots and the average R_I was 1.11, so activity was still very low. Region AR 2758 reached a maximum of 20 millionths (Cro-Beta) on its first day on the disk, 3/8, and was noted by NASA's Solar Dynamics Observatory to belong to the new cycle, Cycle 25. AR 2758 went rapidly downhill from there as it was half that size on 3/9 and gone on 3/10.

We got several very good looks at the region. The first was an excellent drawing by Deconinck at 13:52 UT on 3/8 (**Figure 10**). He shows it to be an arc of about half a dozen spots and two small bits of detached penumbrae. Melillo shows it in a two-pane W-L/H-a image at 16:30 UT the same day (**Figure 11**). His H-a image very clearly shows the arc.

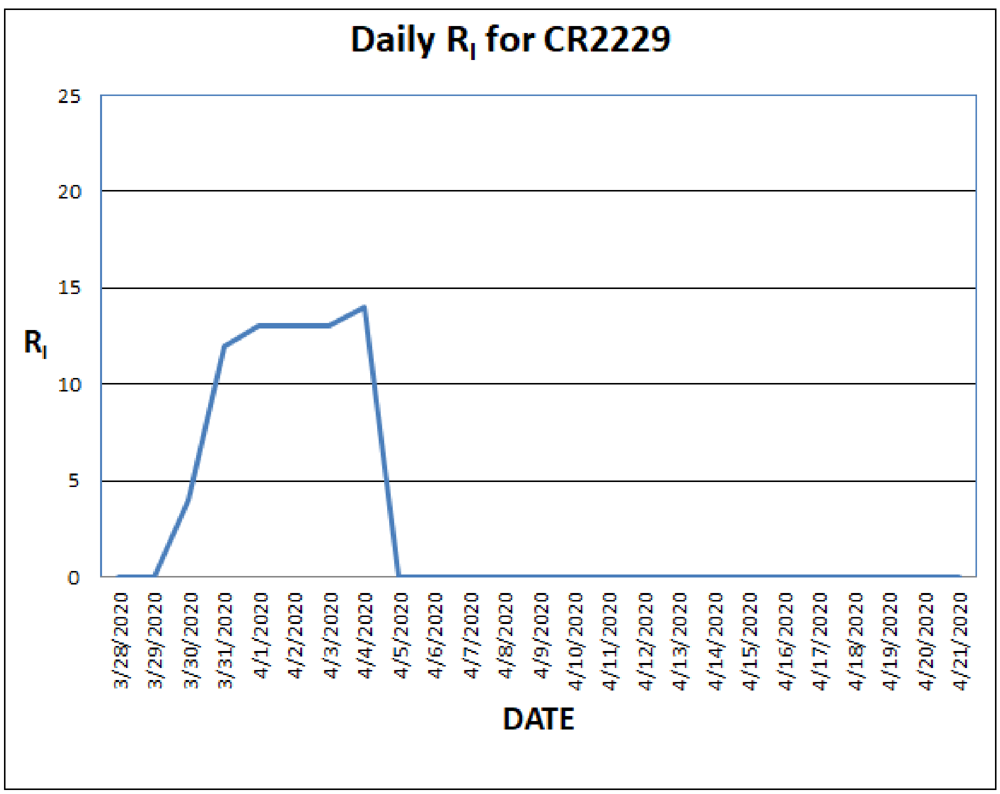


Carrington Rotation 2229

Dates: 2020 03 28.3729 to 2020 04 24.6451
Avg. R_I = 2.46
High R_I = 14 (4/4)
Low R_I = 0 (22 days)

There were 22 days of no spots, making this another rotation with very low activity. The average spot R_I was 2.46 mostly due to five 5 days of activity associated with AR 2759 which maxed out at 30 millionths after rotating onto the disk and then quickly disappearing three days later.

The first good high resolution look we have of AR 2759 was a two-pane Grassmann image on 3/30, with H-a at 12:27 UT and CaK at 12:49 UT (**Figure 12**). At that time, it had not yet received its official designation. It is not uncommon for Section members to observe emerging regions before they are officially recognized. Grassmann's images show a small region with a small but bright plage just barely over the limb. Ramakers imaged the region in W-L on the same day at 14:48 UT when it had visibly moved from the limb (**Figure 13**). It was a nice sinuous ribbon of faculae with a few small umbral spots in the lead. It was no more than an Axx region of about 10 millionths (mag. Alpha) at that time.



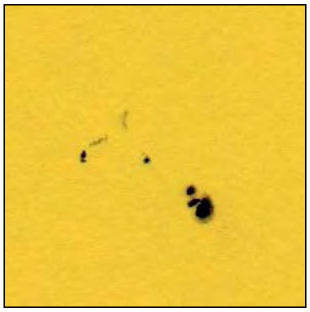


Figure 10. (Left) An excellent drawing of AR 2758 by Deconinck on 3/8 at 13:52 UT.

Figure 11. (Right) w-l (left) and H-a (right) images of AR 2758 by Melillo on 3/8.

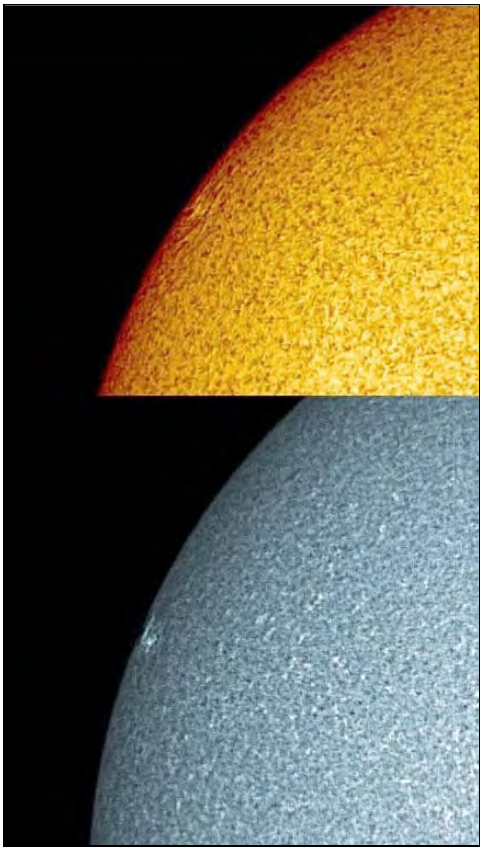
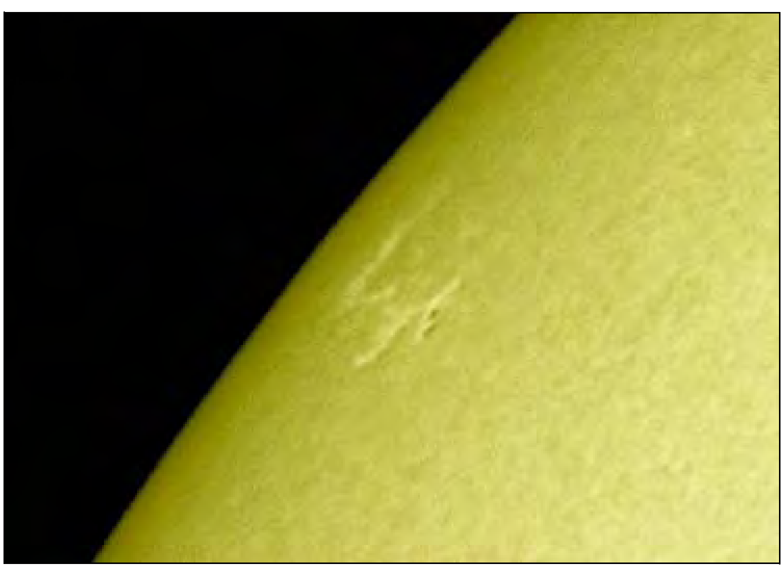


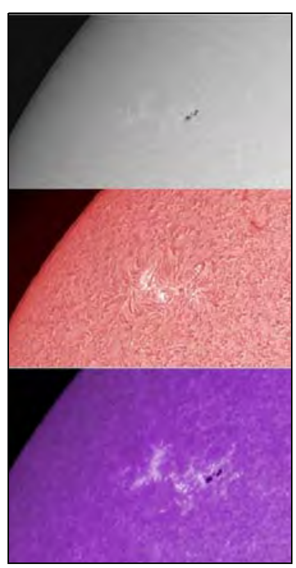
Figure 12. Two views of emerging AR 2759 by Grassmann in H-a (above) at 12:27 UT and Cak (below) at 12:49 UT.

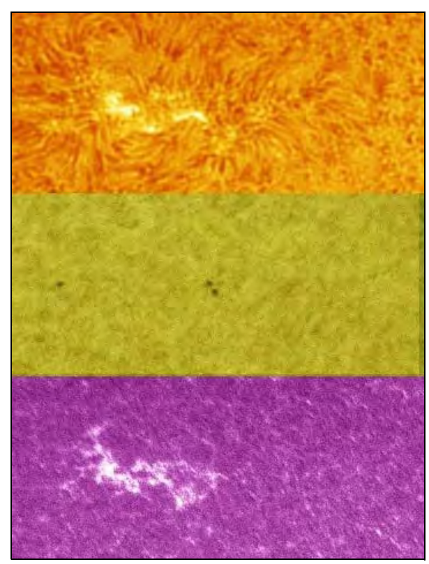
Figure 13. (Below left) A w-l view of emerging AR 2758 near the limb on 3/30 at 14:48 UT by Ramakers.

Figure 14. (Below center) Three views of AR 2759 by Eskildsen on 4/02 in w-l (top) at 14:48 UT, H-a (middle) at 14:41 UT and CaK (bottom) at 14:46 UT.

Figure 15. (Below right) A Ramakers three-pane view of AR 2759 on 4/4 at 21:38 UT, H-a at top, w-l middle and CaK at bottom.







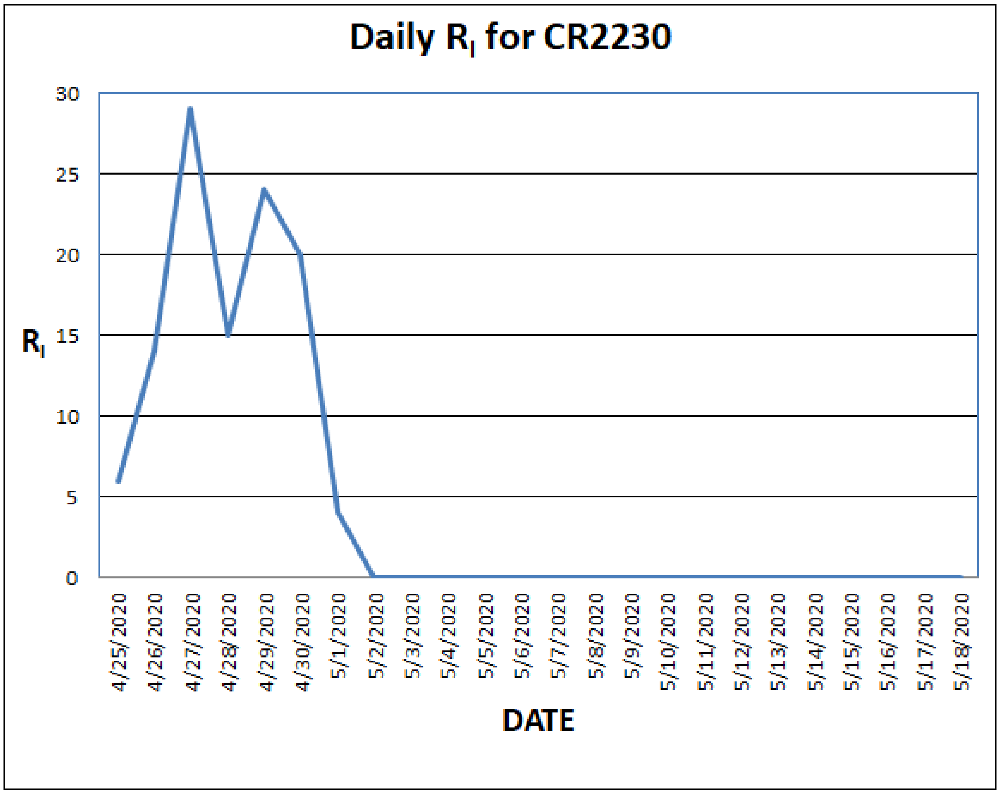
We have three views of this region by Eskildsen on 4/2 in W-L, H-a and CaK at 14:48, 14:41 and 14:46 UT respectively (**Figure 14**). Things were relatively unchanged but it was remarkable how prominent the region appeared in CaK; it was quite obvious in W-L, but was almost nonexistent in H-a!

Our last good look at this region (**Figure 15**) was another Ramakers three-pane image (H-a, W-L, CaK). The region is now just two umbral spots (and a couple of pores) trailing a sizable plage in CaK, but in H-a it's just a plage.

Carrington Rotation 2230

Dates: 2020 04 24.6451 to 2020 05 21.8750

Avg. R_I = 4.15
High R_I = 29 (4/27)
Low R_I = 0 (20 days)



This rotation had 20 days with no spots and an average R_I of 4.15, the second highest of this reporting period. There were four very small, short-lived regions (AR 2760- AR 2763), all concentrated in the first six days of the rotation! No region exceeded 20 millionths area with AR 2760 being the best of them when it reached Cro (mag. Beta) region of 20 millionths. We had very few images of these regions.

We did get many images of the spectacular limb prominences during this rotation, some by Section members and some by others (that we hope will soon be members!).

One of the earliest observations we have on file was a breathtaking image by Andrew of the small region AR 2760 in H-a taken at 08:56 UT on 5/2 (**Figure 16**). It was then only 20 millionths of the disk as a Cro group (mag. Beta). This image almost looks like a lithograph!

The first of the prominence images were from Vandenbulcke, who also shows his equipment in one of the four panes in his image (**Figure 17**). His images show delicate tendrils of thin solar material reaching out from the limb farther than the Earth-Moon distance.

Next, we have a fascinating three-pane view by Andrew on 5/9 in H-a of one prominence showing changes from 08:20 to 09:16 UT (**Figure 18**). Note in the middle pane how one spot of material is acting like a stellar image with diffraction around it! Corban on 5/10 at 12:59 UT shows us another long gossamer tendril reaching out from the sun, made up of very fine braided threads (**Figure 19**).

On 5/20, Andrew gives us a whole amazing solar landscape, if you will, in H-a at 08:43 UT (**Figure 20**). The image shows a large portion of the chromosphere covered with bright fibrils and features spectacular detail of the limb prominences. On the same day at 09:50 UT, Tyler did roughly the same region in H-a also with dramatic results (**Figure 21**). This demonstrates things that can be observed even when there are no active regions on the Sun!

Conclusion

It's not over yet but we're pretty close to the solar minimum. Unfortunately you can only truly know this in hindsight, after you've passed through the minimum. A number of images in this report and in our online archive show examples of what kind of activity can be observed during this time. Be sure to peruse this gallery for inspiration and ideas. For those with H-a and CaK filtered telescopes, there's still a lot to do and see so we wish you Sunny Skies!

For more information go to:

http://www.alpo-astronomy.org/member/ALPO_Standard_Memberships.html

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., (1981) “The Physics Of Sunspots”. Sacramento Peak National Observatory, Sunspot, NM; L.E. Cram and J.H.Thomas (eds.), p.7. *https://sourcelibraries.com/browse/the-physics-of-sunspots/*

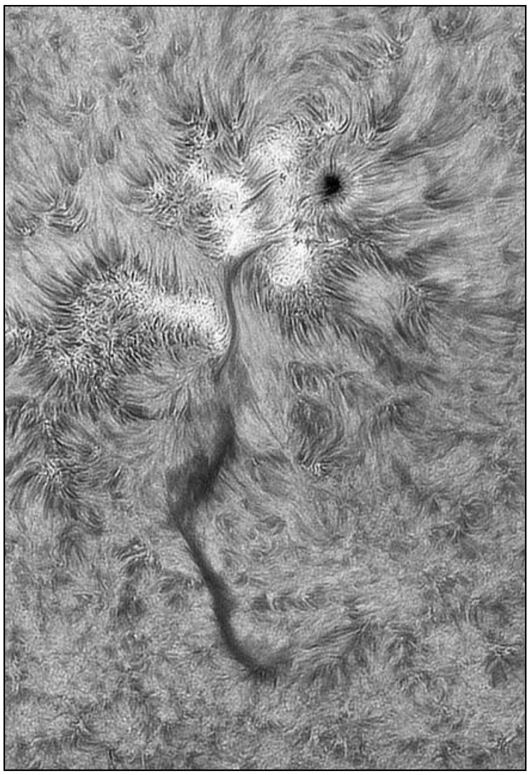
McIntosh, Patrick S., (1989) “The Classification of Sunspot Groups” *Solar Physics*, Vol. 125, Feb. 1990, pp. 251-267. *http://adsabs.harvard.edu/abs/1990SoPh..125..251M*

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/*



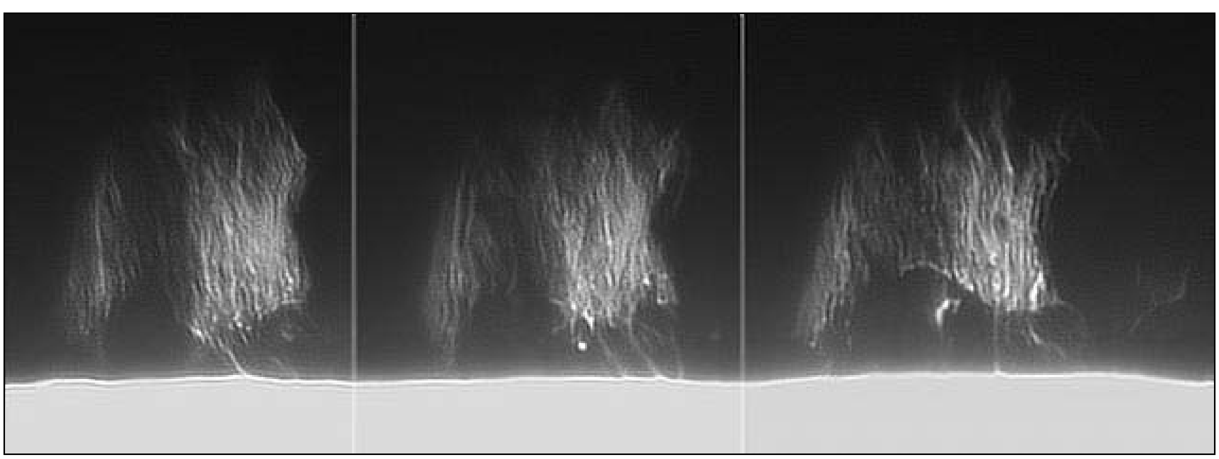


Figure 16. (Top left) A spectacular H-a image by Andrew of AR 2760 with an impressive dark filament associated. This image was taken on 5/2 at 08:56 UT.

Figure 17. (Top right) Limb prominences on 5/4 from 15:24-15:37 UT by Vendenbulcke also showing his instrumentation used.

Figure 18. (Bottom) A three-pane time-lapse view of a limb prominence on 5/9 from 08:20-09:16 by Andrew.

Figure 19. A beautiful limb prominence by Corban on 5/10 at 12:59 UT.

Figure 20. An H-a solar scape by Andrew on 5/20 at 08:43 UT showing the chromosphere and prominences.

Figure 21. Another solar scape by Tyler on 5/20 at 09:50 UT. Note the changes from the previous image.

ALPO 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)

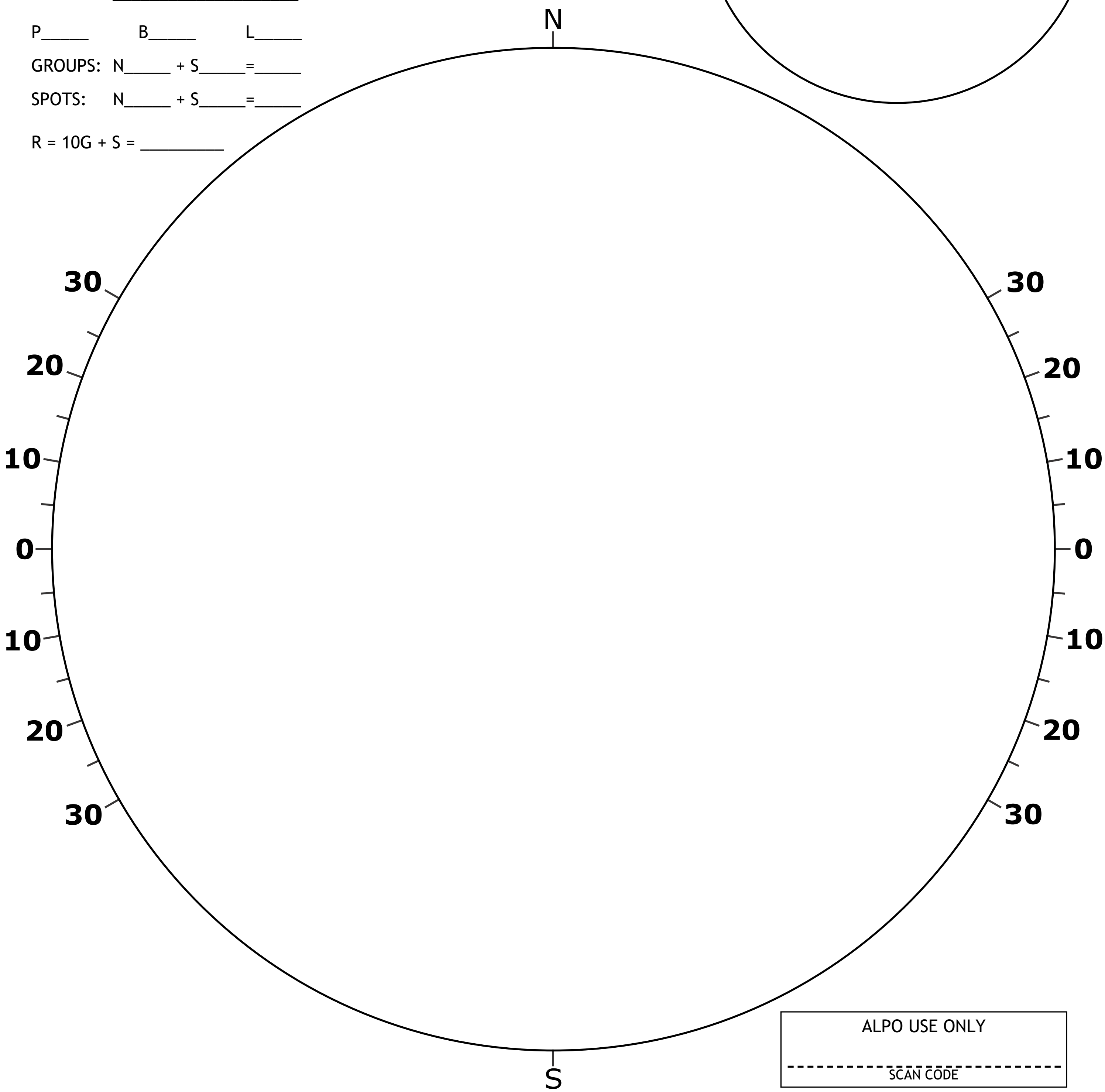
ROTATION______________

P_____ B_____ L_____

GROUPS: N_____ + S_____=_____

SPOTS: N_____ + S_____=_____

R = 10G + S = _________



ALPO USE ONLY

SCAN CODE

Papers & Presentations

ALPO Observations of Mercury During the 2019 Apparitions

By Frank J Melillo, coordinator,
ALPO Mercury Section
frankj12@aol.com

Abstract

There were six apparitions of Mercury in 2019, with six observers submitting 16 images and 5 drawings. They used telescopes with apertures ranging from 250 mm to 360 mm (10 in. to 14 in.). A number of albedo features were detected, and are identifiable by comparison with images from the MESSENGER flybys (Applied Coherent Technology Corporation, 2016; Melillo, 2010) and with the 1972 albedo chart prepared by Murray, Smith and Dollfus (Murray, Smith and Dollfus, 1972; see Figure 1).

Background

Methods of observing Mercury

With modern technology, the best way to detect detail on Mercury is by "lucky imaging." This technique involves the making of a great many short exposures (with a webcam) and then using a computer algorithm to select the best few of them - the ones that are least affected by the distortions caused by Earth's atmosphere - and stacking these best frames together into a single image. The resulting image can be enhanced by computer to accentuate details on the planet.

Nevertheless, drawing is a good option for documenting surface features, and one's skill in visual observing and in drawing what one sees will improve with practice. The use of colored filters assists one in discerning detail. Quality telescopes and eyepieces, together with observing skills honed by experience, and

Observing Scales

Standard ALPO Scale of Intensity:

0.0 = Completely black
10.0 = Very brightest features

Intermediate values are assigned along the scale to account for observed intensity of features

ALPO Scale of Seeing Conditions:

0 = Worst
10 = Perfect

Scale of Transparency Conditions:

- *Magnitude of the faintest star visible near Mercury when allowing for day-light and twilight*

The images and drawings described herein use planetary east and west, which is opposite to the east and west directions on the celestial sphere.

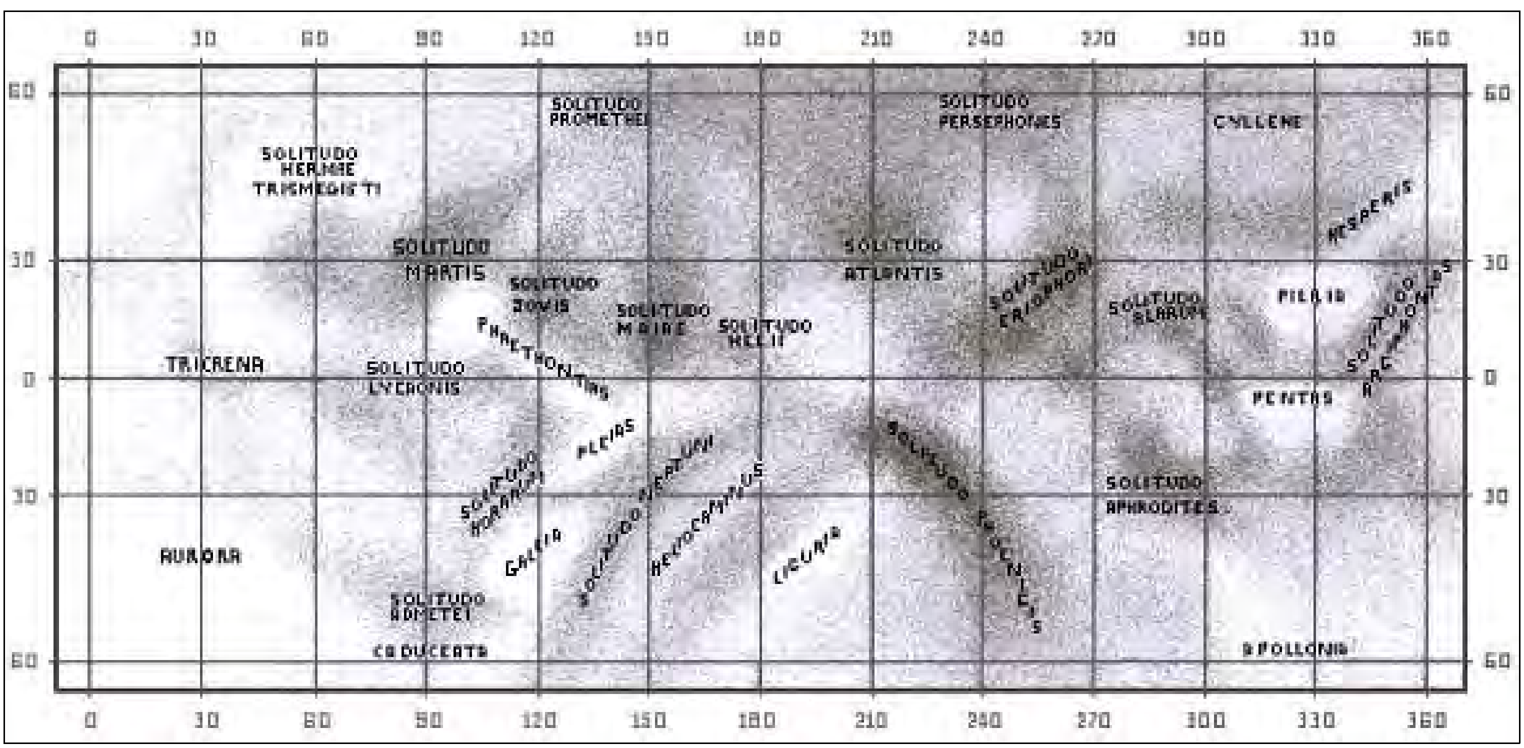


Figure 1. Albedo chart prepared by Murray, Smith and Dollfus

Table 1. Characteristics and UT Dates of the Apparitions of Mercury in 2019

Apparition Number & Type	Beginning Conjunction*	Greatest Elongation	Max Extent & Direction of Elongation	Magnitude at Elongation	Final Conjunction*
1. Evening	29 Jan (s)	27 Feb	18.1 deg E	– 0.4	14 Mar (i)
2. Morning	14 Mar (i)	11 Apr	27.7 deg W	+ 0.4	21 May (s)
3. Evening	21 May (s)	23 Jun	25.2 deg E	+ 0.5	20 Jul (i)
4. Morning	20 Jul (i)	9 Aug	19.0 deg W	+ 0.1	3 Sep (s)
5. Evening	3 Sep (s)	20 Oct	24.6 deg E	– 0.0	11 Nov (i) **
6. Morning	11 Nov (i) **	28 Nov	20.1 deg W	– 0.5	10 Jan 2020 (s)

* (i) is inferior conjunction, (s) is superior conjunction, when Mercury and Sun have the same right ascension.
** Angular distance and approximate direction (east or west) from Sun on sky, not with reference to right ascension, in degrees.

the use of filters, will reveal features on the surface of Mercury. Whether observing by eye or by camera, it helps to use a red filter such as a Wratten 25, because Mercury is usually observed when it is low in the sky where atmospheric turbulence has its greatest effect, and this atmospheric effect is less at longer wavelengths.

This author has found that to see Mercury under the best conditions, it must be observed in daylight with an orange Wratten 21 filter. The orange filter darkens the background sky and decreases the eye discomfort caused by the brightness. For those who do not have a sophisticated "goto" telescope mounting, the Moon or Venus can act as a guide to find Mercury in daylight. (For further information about observing methods, see Boudreau, 2009, and Melillo, 2004.) It is particularly exciting, whether observing visually or by imaging, to detect features that have been previously detected by the MESSENGER spacecraft.

The 2019 Apparitions

There were three evening and three morning apparitions during the course of 2019. The dates and fundamental characteristics of these apparitions are given in **Table 1**. Note that Mercury's superior and inferior conjunctions are not always on the dates of closest approach to the Sun on the celestial sphere, because a conjunction is defined as the time at which two Solar System objects share the same right ascension, not by the time of closest approach.

Note also that the magnitudes given in the table are not the brightest magnitudes that Mercury has during an apparition, because Mercury is always brighter when at gibbous phases near superior conjunction. The magnitudes given are useful for understanding the ease with which Mercury can be seen when near greatest elongation from the Sun, when most observations are made.

Summary of ALPO Observations of 2019

Six observers made observations of these apparitions, including this section coordinator. Four observers contributed lucky images and two observers contributed drawings (see **Table 2**). The ALPO Mercury section received a few more observations in 2019 than it received in 2018 (Melillo, 2020). As in 2018, the author contributed the most observations with 6 lucky images, which were made in good sky conditions.

The six observers used telescopes ranging from 250 mm to 356 mm (10 in. to 14 in.) aperture. Their observations are all described and presented here. Note that the images and drawings are described using planetary east and west, which is opposite to the east and west directions on the celestial sphere.

Table 2. Observers of Mercury in 2019

Observer	Location	Instrument Aperture & Type*	Number & Type** of Observations	Apparitions Observed
Michel Doconinck	Aquarellia, France	250 mm DK	3 D	1, 3, 5
Howard Eskildsen	Ocala, Florida, USA	150 mm RFR 234 mm SCT	5 L	4, 6
Michel Legend	La Baule-Escoublac, France	410 mm Newt	2 D, 1 L	1
Simon Kidd	Cottered, England	356 mm SCT	3 L	1, 4
Frank J. Melillo	Holtsville, NY, USA	250 mm SCT	6 L	4, 6
Luigi Morrone	Angerola, Italy	356 mm SCT	1 L	2

* Telescope Types: RFR = Refractor; SCT = Schmidt Cassegrain, Newt = Newtonian, DK = Dall-Kirkham
** D = drawing, L = lucky imaging

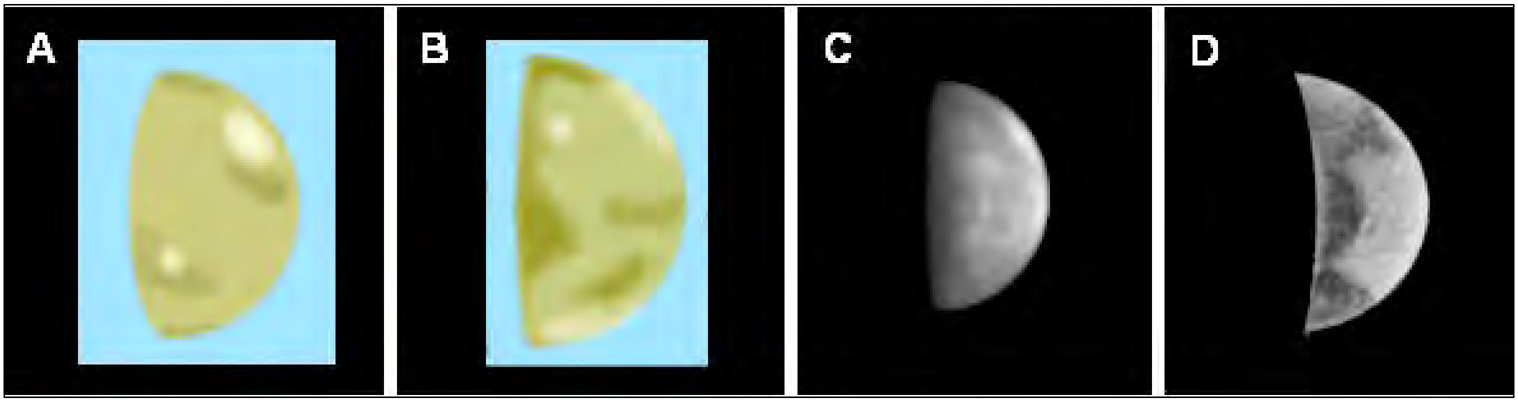


Figure 2. Drawings and an image of apparition 1. In this and all other figures in this article, north is up and planetary east is to the right.
A. Drawing by Michel Legend on 23 February 2019 at 15:00 UT, with CM = 255 degrees. Contrast enhanced by Melillo.
B. Drawing by Michel Legend on 25 February 2019 at 15:15 UT, with CM = 264 degrees. Contrast enhanced by Melillo.
C. Image by Simon Kidd on 25 February 2019 at 15:27 UT, with CM = 264 degrees.
D. Drawing by Michel Deconinck on 27 February 2019 at 16:58 UT, with CM = 275 degrees.

What We Look For

The MESSENGER global map (Applied Coherent Technology Corporation, 2016) is a good source of surface albedo information for all of our observations. The ALPO Mercury Observing Section has found that the ejecta deposits of impact craters ("rayed craters") are the most prominent features seen on the surface of Mercury. They appear bright against the background gray shade of the surface.

Also, some dark albedo features are seen next to the bright rayed craters, which make a nice contrast. Any bright area that one detects is most likely a rayed crater, but we do not see the crater itself. Rather, we see the bright area that was caused by an impact, similar to a low-power binocular view of the ejecta blankets of the craters Kepler and Copernicus on the Moon.

Apparition 1: Evening, 29 January to 14 March

Mercury became an evening object after superior conjunction with the Sun on 29 January. It was a favorable apparition as seen from Earth's Northern Hemisphere. Just four weeks later, on 27 February, Mercury reached its greatest elongation at 18.1 degrees east of the Sun and was shining at the magnitude of - 0.4. It was the brightest object in that part of the sky until the thin crescent Moon joined Mercury on 7 March.

Four observations by three observers were received during this evening apparition (**Figure 2**).

Michel Legend was first with his drawing of 23 February (CM = 255 degrees). He drew Mercury at a gibbous phase of 63 percent illumination (**Figure 2, panel A**). It showed a bright region on the northeast section of the disk, which appears to be the Caloris basin. Also, he drew a white spot just south of the center that might be the Amaral rayed crater, although that feature is associated with two other rayed systems arranged north to south that were not seen. Legend observed Mercury two days later on 25 February (CM = 264 degrees) and made an image. Aside from the planet's phase, the image didn't show detail on the disk. However, he also made a drawing that showed a bright spot north of the center that might be the Xiao Zhao rayed crater, one of the three that span that meridian, north to south. In addition, he depicted on the northern part of the limb a bright spot consistent with the Caloris Basin (**Figure 2, panel B**).

On the same day, Simon Kidd imaged Mercury and detected the three bright rayed craters Xiao Zhao, Enwonwu and Amaral arranged north to south. The Caloris Basin is likely the bright area on the northeast limb (**Figure 2, panel C**). The image matches very well the MESSENGER map.

Michel Deconinck of France observed Mercury on 27 February (CM = 275 degrees). He drew it as a fat crescent at 45 percent illumination, with dark markings along the terminator. He drew the limb as bright, and along its northern part the appearance is suggestive of the Caloris Basin still being visible (**Figure 2, panel D**).

Mercury remained an evening object until 14 March when it went through inferior conjunction with the Sun.

Apparition 2: Morning, 14 March to 21 May

Mercury became a morning object after 14 March. Again, four weeks later - on 11 April - it reached its greatest elongation of 27.7 degrees west of the Sun. Even though it was at nearly the maximum distance from the Sun as seen from Earth, it wasn't seen well from Earth's Northern Hemisphere due to the shallow angle between the ecliptic and the horizon. Also, it appeared less bright than it does at most greatest elongations, at magnitude of + 0.4.

The only observation of this apparition was the image made by Luigi Morrone on 25 April (CM = 249 degrees). See **Figure 3**. The image shows a gibbous planet with a few white patches that may be rayed craters. The most prominent feature lay in the northwest section of the disk. It is probably Nathair Facula, a bright rimless depression according to the MESSENGER map.

Mercury went through superior conjunction with the Sun on 21 May to end the morning apparition.

Apparition 3: Evening, 21 May to 20 July

Mercury entered the evening sky after 21 May. Although the greatest elongation was large at 25.2 degrees east of the Sun, Mercury was difficult to observe after

Figure 3. Image of apparition 2 by Luigi Morrone on 25 April 2019 at 8:31 UT, with CM = 249 degrees.

sundown due to the shallow angle between the ecliptic and the horizon.

Michel Deconinck made the lone observation of Mercury on 18 June (CM = 122 degrees). See **Figure 4**. His drawing at a half phase showed a dark region south of center near the terminator. This area is also seen in MESSENGER images, appearing as a nameless, relatively dark area between two bright regions.

Mercury ended the evening apparition on 20 July.

Figure 4. Drawing of apparition 3 by Michel Deconinck on 18 June 2019 at 18:10 UT, with CM = 122 degrees. Contrast enhanced by Melillo.

Apparition 4: Morning, 20 July to 3 September

After 20 July, Mercury became a morning object. The greatest elongation occurred on 9 August at only 19 degrees west of the Sun, but the favorable angle of the ecliptic with the morning horizon made it the best apparition of the year. The ALPO Mercury Observing Section received more observations than in any other apparition of 2019. The three observers who made images - Kidd, Eskildsen, and Melillo - were each successful in demonstrating features that are seen on the MESSENGER map (**Figure 5**).

Howard Eskildsen made his first image of the apparition on 5 August (CM = 52 degrees) and it revealed a narrow crescent at 25 percent illumination (**Figure 5, panel A**).

This author made his first observation of the year on 10 August (CM = 80 degrees), imaging in daylight under the best seeing conditions possible. Mercury showed a fat crescent at 42 percent illumination (**Figure 5, panel B**). A few white patches were visible on the disk. A rayed crater, Degas, can be seen faintly, just inside the limb diffraction arc in the north, as well as another faint rayed crater, Mena, located straight left from the center of the image. The dark feature on the limb to the southwest of Degas is evident in the MESSENGER images as an east-to-west dark area that has no name. The bright feature in the south is the ray system of crater Waters.

On 11 August (CM's of 83 to 85 degrees), three observers - Kidd, Eskildsen, and Melillo - imaged Mercury at 08:11 UT, 11:14 UT, and 14:17 UT, respectively. They all showed Mercury as a fat crescent at 46 percent illumination. The disk of Mercury in Eskildsen's image was small (**Figure 5, panel D**), but in Kidd's and Melillo's images it was higher in resolution and Mercury revealed rayed craters, including Degas and Waters (**Figure 5, panels C and E**).

Kidd followed this with another image on 17 August (CM = 112 degrees) that showed rayed craters Degas in the north and Waters in the south, both near the terminator, while Mena appeared small, southwest of the center about half way to the limb. The bright area around crater Bartok is prominent in the south (**Figure 5, panel F**).

Melillo made another image on 20 August (CM = 126 degrees). Again, it was taken in broad daylight when Mercury was high above the horizon. It revealed quite a few rayed craters (**Figure 5, panel G**). Degas and Waters were seen along the terminator. Mena was small but faintly visible just right of center, while the prominently visible feature below the center of the image is crater Bartok's surrounding bright area. The brightest area, near the limb and slightly north of the equator, is probably the rays of crater Nureyev, which was right on the limb in Kidd's image of three days before. Melillo's three images of this apparition, reviewed together, clearly show the rayed craters moving with the planet's rotation, progressively approaching the terminator.

Finally, Eskildsen took the last image of the apparition on 21 August (CM = 130 degrees). See **Figure 5, panel H**. The disk was small but it appears that the bright rayed crater Waters is visible, close to the terminator.

This excellent apparition came to a close on 3 September when Mercury went through superior conjunction with the Sun.

Apparition 5: Evening, 3 September - 11 November

In the autumn, Mercury entered the evening sky for its third time of 2019, but it was not so favorable as seen from Earth's Northern Hemisphere. It reached its greatest elongation on 20 October at 24.6 degrees east of the Sun. Although Mercury and Venus had close conjunctions with each other on 13 September and 30 October, it was difficult to see them as the ecliptic lay very near the horizon after sundown. Only one observation was received.

Michel Deconinck observed visually on 27 September (CM = 291 degrees). He drew a fat gibbous planet at 88 percent illumination (**Figure 6**). His drawing showed a dark terminator and large dark areas in the northwest and southeast sections of the disc. It is noted that the MESSENGER maps do not show albedo reliably in the far northern and southern regions, and the dark areas he depicted are beyond the latitude range of the 2001 Mercury map by Mario Frassati (Melillo, 2006). Consequently, we need further observations to enable us to ascertain what he saw.

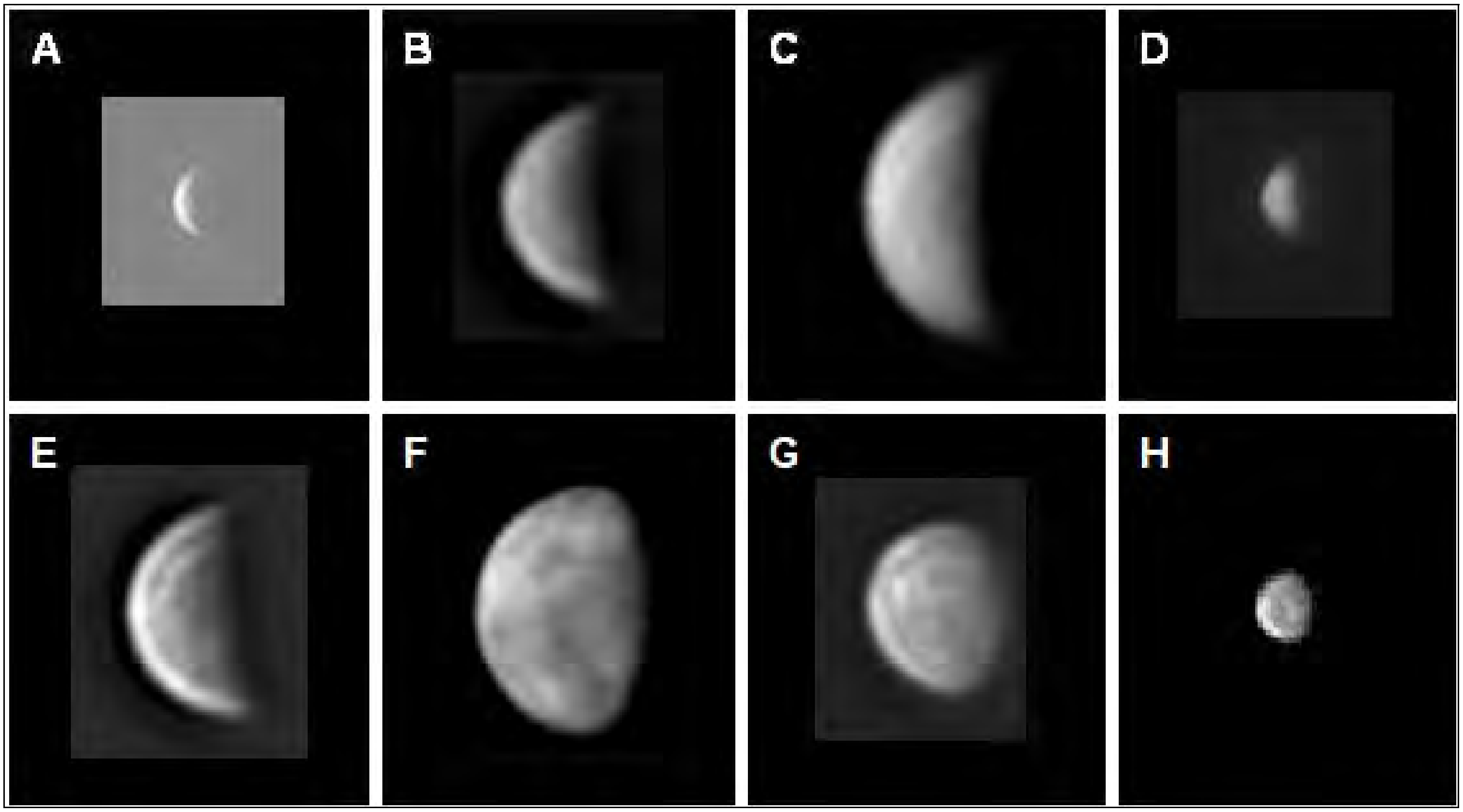


Figure 5. Eight images of apparition 4.
A. Image by Howard Eskildsen on 5 August 2019 at 11:20 UT, with CM = 52 degrees.
B. Image by Frank J. Melillo on 10 August 2019 at 14:30 UT, with CM = 80 degrees.
C. Image by Simon Kidd on 11 August 2019 at 08:11 UT, with CM = 83 degrees.
D. Image by Howard Eskildsen on 11 August 2019 at 11:14 UT, with CM = 84 degrees.
E. Image by Frank J. Melillo on 11 August 2019 at 14:17 UT, with CM = 85 degrees.
F. Image by Simon Kidd on 17 August 2019 at 6:48 UT, with CM = 112 degrees.
G. Image by Frank J. Melillo on 20 August 2019 at 14:20 UT, with CM = 126 degrees.
H. Image by Howard Eskildsen on 21 August 2019 at 11:30 UT, with CM = 130 degrees.

Mercury ended the evening appearance on 11 November.

Apparition 6: Morning, 11 November - 10 January 2020

On 11 November, Mercury was at inferior conjunction exactly between the Sun and the Earth while transiting the Sun. Also, this was the start of the most favorable morning apparition of the year as seen from Earth's Northern Hemisphere. Mercury became visible to naked eye quickly - by the third week of November. It reached its greatest elongation on 28 November at 20 degrees west of the Sun, shining brilliantly at magnitude of - 0.5.

This author made the first image on 23 November (CM = 261 degrees). It displayed a fat crescent at 42 percent illumination (**Figure 7, panel A**). Some details were visible such as the rayed craters and dark albedo regions. A prominent feature was the northernmost bright spot, a rimless depression called Nathair Facula. Just to the southwest of Nathair, there was a marginally detected dark feature, Rachmaninoff, a rimless crater with a dark floor. Straight south of Nathair, which appears to be in the 7 o'clock direction due to the curvature of longitude lines on the spherical surface, is the bright region Aparangi Planitia. It is a smooth plain, relatively bright as seen from this angle.

Howard Eskildsen imaged Mercury on 30 November (CM =298 degrees) and it showed a half phase (**Figure 7, panel B**).

Melillo made another image on 5 December (CM = 322 degrees), showing that the phase had become gibbous, and the two most prominent rayed craters Ellington, just south of the center of the image, and Debussy to its southwest, were clearly visible in the southern hemisphere (**Figure 7, panel C**).

Eskildsen imaged Mercury again on 6 December (CM = 327 degrees) and documented its slightly gibbous phase (**Figure 7, panel D**).

Melillo made another image the next day, 7 December (CM = 332 degrees), which showed the planet to be more broadly gibbous at 83 percent illumination (**Figure 7, panel E**). The two bright rayed craters, Ellington and Debussy, which were visible in the 5 December image, are seen to have rotated eastward toward the terminator.

Figure 6. Drawing of apparition 5 by Michel Deconinck on 27 September 2019 at 16:32 UT, with CM = 291 degrees. Contrast enhanced by Melillo.

Mercury ended this excellent morning apparition on 10 January 2020.

Conclusions

Observers are submitting fewer and fewer drawings of Mercury as the years go by. Nevertheless, known albedo features of Mercury were successfully identified by visual observers during 2019. Amateurs who observe by imaging are now aware that lucky imaging (i.e., webcam imaging) yields the best images, and all the images received by the Mercury Section in 2019 were made by that method. By using this technique, we have repeatedly documented the most prominent bright areas on the surface of Mercury and some dark areas as well.

Careful review of a number of the observations received in 2019 reveals that some albedo features that we are detecting cannot be clearly associated with surface features on the MESSENGER maps. We suspect that the MESSENGER maps, which are mosaics of multiple MESSENGER images after adjustments that make them all have comparable average brightness, do not reliably represent some albedo markings. For example, upon reviewing these maps, it is plain that some rayed craters are mapped without any greater brightness of the rays as compared to the surrounding surface. We conclude that our observations are gathering important data, documenting the true visibility of albedo features of the planet. Furthermore, we are doing so with techniques - notably, lucky imaging - that make our data more accurate than was ever possible in the past. We need many more such observations to document the entire surface as seen from Earth.

Mercury is the second-best planet for observing the surface, after Mars. With image stacking, software can bring out incredible details, some of which have never been reliably charted before. The use of a red filter brings out details of albedo features, especially the bright ejecta of craters, as we see in this report. Our observing details are now confirmable by comparing them to the MESSENGER images. But I must emphasize that not every observer can image Mercury, and a sketch or drawing will fill in the observation gap where imaging is not feasible. Mercury has the reputation of being the most difficult of the naked-eye planets to study, whether visually or with imaging, but it is revealing its secrets.

References

Applied Coherent Technology Corporation (2016). "Mercury MESSENGER MDIS Global Basemap (256ppd)." NASA Planetary Data System. Available online at: *https://astropedia.astrogeology.usgs.gov/download/Mercury/Messenger/Global/thumbs/Mercury_MESSENGER_MDIS_Basemap_BDR_Mosaic_Global_32ppd.jpg*

Boudreau, J. "Imaging Elusive Mercury." *Sky & Telescope,* 118(4), pp. 70-74 (2009). *http://ehis.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=889f13b5-9f13-46b6-9a29-32cbcb8f181b%40sessionmgr114&vid=2&hid=116*

Melillo, F. J. "Mercury in the Morning." *Sky & Telescope,* 108(3), pp. 78-80 (2004). *https://www.skyandtelescope.com/observing/celestial-objects-to-watch/mercury-in-the-morning-2/*

Melillo FJ (2006). "Scientific Interests in the Planet Mercury." *Journal of the Assn. of Lunar and Planetary Observers*, Vol. 48 No. 2, pp.14-17. Frassati's 2001 map and 3 historical maps of Mercury are reproduced in this article. Available at: *http://www.alpo-astronomy.org/gallery3/var/albums/Publications-Section/ALPO-Journals/DJALPO-2006/DJALPO48-2-Spring2006.pdf?m=1521160264*.

Melillo, F. J. (2010) "Mercury Observations During the Second and Third MESSENGER Flybys." *Journal of the Assn of Lunar & Planetary Observers,* 52(3), pp. 19-22. *http://alpo-astronomy.org/gallery3/index.php/Publications-Section/ALPO-Journals/DJALPO-2010/DJALPO52-3-Summer2010*

Melillo FJ (2020). "ALPO Observations of Mercury During the 2018 Apparitions." Journal of the Assn. of Lunar and Planetary Observers, Vol. 62 No. 2, pp. 28-32.

Murray, J. B., Smith, B. A. and Dollfus, A. "Cartography of the Surface Markings of Mercury." *Icarus* 17(Dec), pp. 576-584 (1972). *http://adsabs.harvard.edu/abs/1972Icar...17..576M*

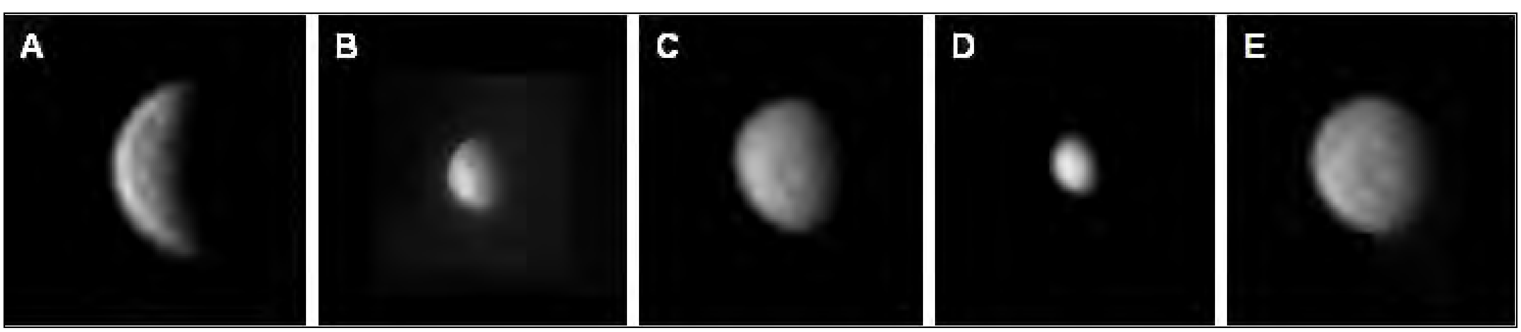


Figure 7. Five images of apparition 6.
A. Image by Frank J. Melillo on 23 November 2019 at 15:05 UT, with CM = 261 degrees.
B. Image by Howard Eskildsen on 30 November 2019 at 14:18 UT, with CM = 298 degrees.
C. Image by Frank J. Melillo on 5 December 2019 at 15:05 UT, with CM = 322 degrees.
D. Image by Howard Eskildsen on 6 December 2019 at 14:31 UT, with CM = 327 degrees.
E. Image by Frank J. Melillo on 7 December 2019 at 15:15 UT, with CM = 332 degrees.

Papers & Presentations

Lunar Domes in the Plana-Mason Region: Dome Mason1

By Raffaello Lena, coordinator
ALPO Lunar Domes Program,
raffaello.lena@alpo-astronomy.org
Jim Phillips, assistant coordinator
ALPO Lunar Domes Program,
thefamily90@gmail.com

Abstract

In this study we characterize a lunar dome using CCD terrestrial images, Lunar Reconnaissance Orbiter Wide Area Camera (LROC WAC) images, Clementine multispectral data, Chandrayaan-1 Moon Mineralogy Mapper (M^3) and the LROC WAC-based GLD100 Digital Terrain Map (DTM). The subject of this paper lies to the south of the crater Mason and has a base diameter of 8.0 km ± 0.3 km, a height of 190 m ± 20 m and average slope angle of 2.6° ± 0.2°. Spectral data indicate a basaltic composition. Based on the morphometric properties, we infer the physical conditions under which the dome was formed (lava viscosity, effusion rate, magma rise speed) as well as the geometries of the feeder dikes.

Introduction

In this paper we describe the results of a survey carried out on the Bürg-Plana-Mason region, north of Mare Serenitatis, in order to characterize lunar domes in this area. Mare Serenitatis is located in the northeastern quadrant of the Moon. It is situated on the site of an ancient and large basin formed by a major impact during pre-Nectarian time. This basin has been flooded by basaltic lavas whose ages range from 3.8 to 3.3 billion years (Head, 1979 and references therein). Mare Serenitatis spills into a smaller lava field named Lacus Somniorum, and then further north into the even smaller Lacus Mortis, located at 45° N and 27° E. This is an ancient lava flooded crater with several rilles; possible faults laid in the bedrock by the Serenitatis impact and later reactivated by stresses created by lava loading (Wilhelms, 1987).

The western rim of Lacus Mortis is sharp and very straight, but the eastern rim is squashed-in and is partially missing. The conspicuous crater Bürg is situated off-center: its walls contain deep clefts and its ejecta blanket can be seen thrown out into two main swaths heading north and south from the impact zone. Between these two swaths of material are two well-defined rilles that intersect to form a large T known as Rimae Bürg. The craters on the south shore of Lacus Mortis are Plana (46 km wide) on the west with a small central peak, and Mason (44 km wide) on the east. The current study describes a lunar dome, located at coordinates 40.90° N and 29.71° E, which we named Mason1 (Mas1).

In the revised catalogue of lunar domes by Kapral and Garfinkle (2005), a dome – described as "unverified" – is reported at same coordinates but with a diameter of 6.2 km and a height of 484 m. Our measurements indicate a base diameter of 8.0 km and its height is now determined to 190 m. This dome is not

Online Readers

Please send comments, questions, observing reports of your own, etc., to the authors by left-clicking your mouse on either of the e-mail addresses under the bylines on this page in blue text.

Also left-click on any hyperlinks in blue text within the text of this paper for additional information.

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

IAU directions are used in all instances.

Table of Observers and Number of Analyzed Images and Drawings

Observers	Images (drawing)	Telescope
R. Barzacchi (Italy)	1	Newton 477 mm
H. Eskildsen (USA)	2	Refractor 150 mm, Schmidt Cassegrain 235 mm
R. Garfinkle USA)	1 (drawing)	Schmidt Cassegrain 254 mm
G. Heinen (Luxembourg)	7	Schmidt Cassegrain 235 mm
R. Hill (USA)	7	Mak Cassegrain 200 mm
K.C. Pau (Hong Kong)	3	Newtonian 250 mm
J. Phillips (USA)	1	Maksutov 254 mm
F. Schenck (Germany)	5	Schmidt Cassegrain 355 mm

reported in the USGS I-705 map by Scott (1972).

Ground-Based Observations and LRO WAC Imagery

For this study we have analyzed 26 CCD images made by Barzacchi, Eskildsen, Heinen, Hill, Pau, Phillips and Schenck (**Table 1**). In addition, Garfinkle (2020) published a drawing of the dome near Mason which was observed on September 16, 2000 using a 254 mm Schmidt-Cassegrain (see Figure 14). The drawing is in his book *Luna Cognita*.

The image shown in **Figure 1** was taken by Schenck on June 19, 2018 at 02:01 UT using a Celestron C14 (14”; 355 mm aperture) Schmidt-Cassegrain telescope and a ZWO ASI 290MM monochrome CMOS imaging camera. In this image, the dome under study, Mas1, is well-displayed with some protuberances on the summit. **Figures 2 and 3** display the region around the craters Plana and Mason and the examined dome under different solar illumination angles and colongitudes. Moreover, we can see how different solar illumination angles may result in strong differences and appearance of the dome. Another

Lunar Dome Classification System

Effusive Domes

Class A domes are small and shallow and formed by high-TiO_2 lavas of low viscosity, erupting at high effusion rates over very short periods of time, resulting in edifices of low volume.

Class B domes consist of lavas of intermediate to high viscosity and moderate TiO_2 content, erupting at low to intermediate effusion rates. If the effusion process continues over a long period of time, steep flank slopes and high volumes may occur (class B_1), while short periods of effusion result in shallower edifices of lower volume (class B_2).

Class C domes are formed out of low-TiO_2 (class C_1) or high-TiO_2 (class C_2) lavas building up edifices of large diameter but shallow flank slope. These at shapes are due to low lava viscosities and high effusion rates.

Class D comprises the very complex, shallow but large and voluminous edifices Arago α and ß, which were most probably formed during several subsequent effusion stages, while classes A-E describe simple, likely monogenetic effusive domes.

Class E domes represent the smallest volcanic edifices formed by effusive mechanisms (diameter < 6 km). In analogy to class B, the class E domes are subdivided into subclasses E_1 and E_2, denoting the steep-sided flank slope larger than 2° and the shallow edifices of this class, respectively.

Class G comprises the highland domes, which have highland-like spectral signatures and high flank slopes of 5°–15°, represented by Gruithuisen and Maairan highland domes.

Class H is represented by the non-monogenetic Marius domes, subdivided into three different classes. Small domes of less than 5 km diameter belong to subclass H_1. The irregular shapes of domes of subclass H_2 with more than 5 km diameter and flank slopes below 5° indicate a formation during several effusive episodes. Domes of subclass H_3 have diameters comparable to those of monogenetic class B_1 domes, but their flank slopes are all steeper than 5° and reach values of up to 9°.

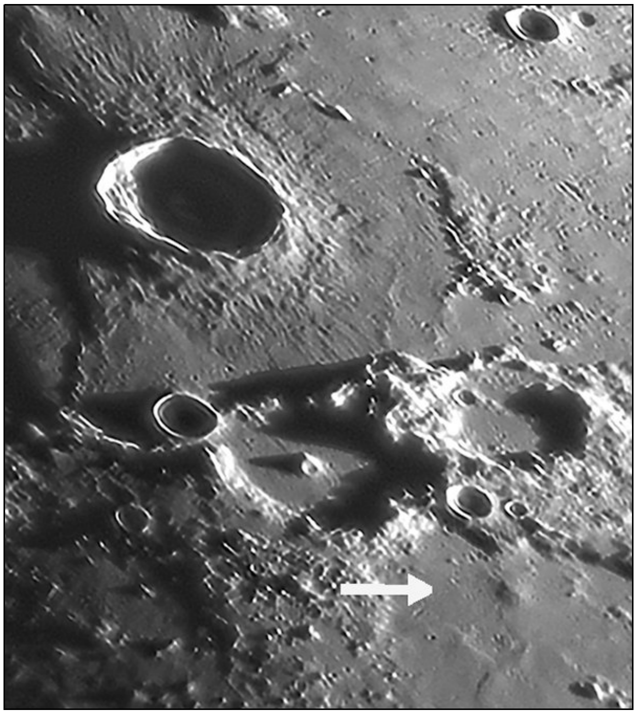
Putative Intrusive Domes

Lunar domes with very low flank slopes differ considerably from the more typical lunar effusive domes. Some of these domes are exceptionally large, and many of them are associated with faults or linear rilles of presumably tensional origin, while they do not show summit pits. A reliable discriminative criterion is the circularity of the dome outline: these domes are elongated and with low slopes (< 0.9°). The putative intrusive domes have circularity values below 0.8, while the circularity is always higher than 0.9 for the effusive domes having flank slopes below 0.9° and displaying effusive vents.

Class In1 comprises large domes with diameters above 25 km and flank slopes of 0.2°–0.6° and have linear o curvilinear rilles traversing the summit.

Class In2 is made up by smaller and slightly steeper domes with diameters of 10-15 km and flank slopes between 0.4° and 0.9°.

Class In3 comprises low domes with diameters of 13-20 km and flank slopes below 0.3°.



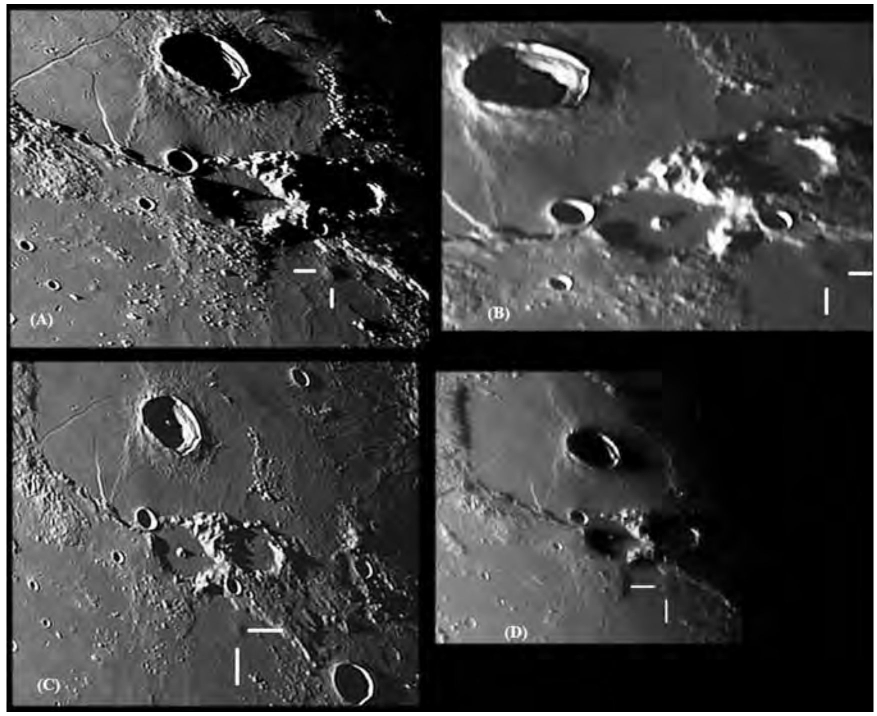


Figure 1 (above left). Image by Frank Schenck showing the lunar dome Mason1 (Mas1) marked by white arrow. Image made on June 19, 2018 at 02:01 UT using a 355 mm Schmidt Cassegrain.

Figure 2 (above right). Ground-based observations of Mas1. Selection of CCD images taken by (A) Pau, (B) Phillips, (C) Hill and (D) Eskildsen. All images have been cropped so that the Mason1 dome may be easily seen.

image, taken under high solar illumination angle, is shown in **Figure 4**. It was made by Barzacchi on March 19, 2016 at 22:18 UT using a Canopus 18" (477 mm aperture), a Baader 2X Barlow and a ZWO ASI 120MM monochrome camera. Compare these images to the drawing made by Garfinkle on September 16, 2000 (**Figure 14**).

Morphometric Properties

LOLA DEM and GLD100 Dataset

The new global topographic map of the Moon obtained by the Lunar Reconnaissance Orbiter (LRO) is the principal source of topographic information used in this study.

Associated topographic profiles were extracted from the LOLA DEM and the GLD100 dataset using the Quickmap LRO global basemap (*http://target.lroc.asu.edu/da/qmap.html*).

The morpometric data have been obtained using the Lunar Orbiter Laser Altimeter (LOLA) instrument on the LRO spacecraft with a grid size of 1/1,024 degrees (Smith et al., 2010) and the GLD100 dataset (Scholten et al., 2012). Based on the LOLA DEM data, the dome has a base diameter of 8.0 km ± 0.3 km. Its height, determined using the cross-sectional profile in the East-West (E-W) direction (**Figure 5**) reaches 190 m ± 20 m, while the average slope angle is 2.6° ± 0.2°. Its edifice volume was estimated, assuming a parabolic shape, to be 4.7 km^3 ± 1 km^3. The 3D reconstruction of Mas1 was obtained using WAC mosaic draped on top of the global WAC-derived elevation model GLD100 (**Figure 6**).

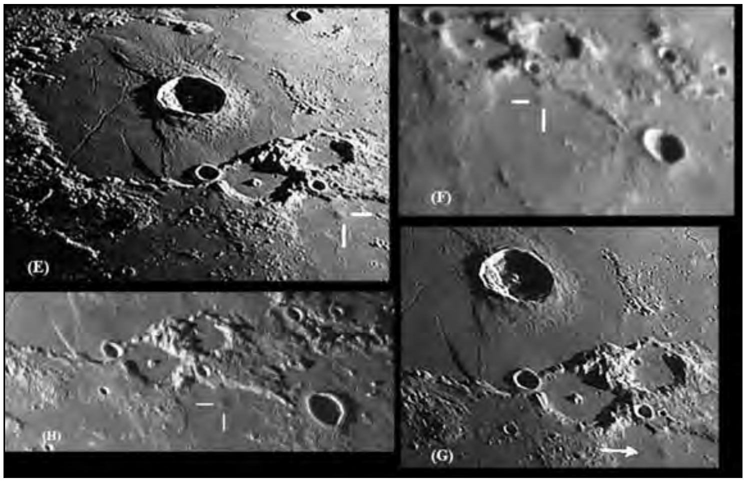
Digital Elevation Map Based on Telescopic CCD Imagery

To determine the morphometric properties of the dome, we also make use of an image-based 3D reconstruction approach which relies on a combination of photoclinometry and shape from shading techniques (Lena et al., 2013; Horn, 1989). This method takes into account the geometric configuration of camera, light source, and the surface normal, as well as the reflectance properties of the surface to be reconstructed, as described in an earlier article published in this journal (Lena and Phillips, 2018).

The height **h** of the dome was therefore obtained by measuring the altitude difference in the reconstructed 3D profile between the dome summit and the surrounding surface, taking into account the curvature of the lunar surface. The average flank slope was determined according to the equation:

Slope = arctan 2h/D

The 3D reconstruction (**Figure 7**) of Mas1 is produced using the CCD image shown in **Figure 1** taken by Schenck on June 19, 2018 at 02:01 UT. Based on the CCD image, the dome height is determined to be 195 m ± 20 m, yielding an average slope angle of 2.6°± 0.2°. We have also obtained the cross sectional profile (**Figure 8**) in E-W



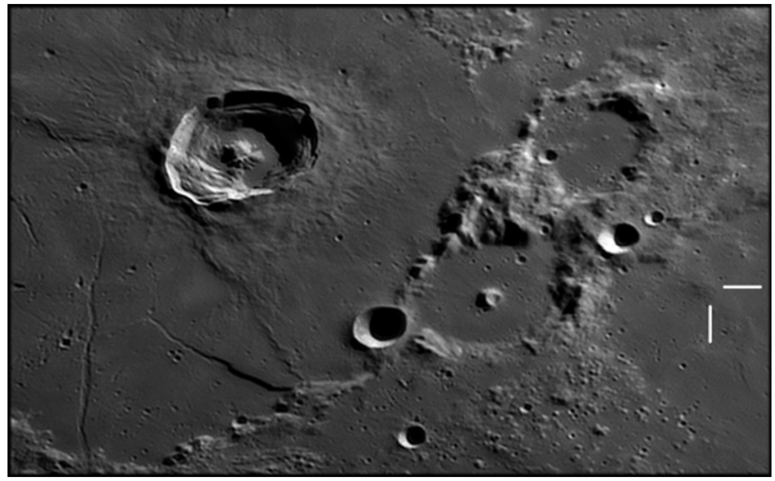


Figure 3 (above left). Ground-based observations of Mas1. Selection of CCD images taken by (E) Hill, (F) Heinen, (G) Schenck and (H) Heinen. All images have been cropped, so that the Mason dome may be easily seen.

Figure 4 (above right). Image by Barzacchi showing the dome Mason1 indicated by white marker lines. Image made under a high solar illumination angle on March 19, 2016 at 22:18 UT using a Canopus 18" (477 mm) telescope, a Baader Barlow 2x and a ZWO ASI 120MM camera.

direction of the dome based on the image made by Barzacchi on March 19, 2016 at 22:18 UT.

Shadow Length Method

The height of dome Mas1 was also computed from **Figure 2 (A)** made by Pau on January 25, 2019 at 19:49 UT using the shadow length method according to the equation:

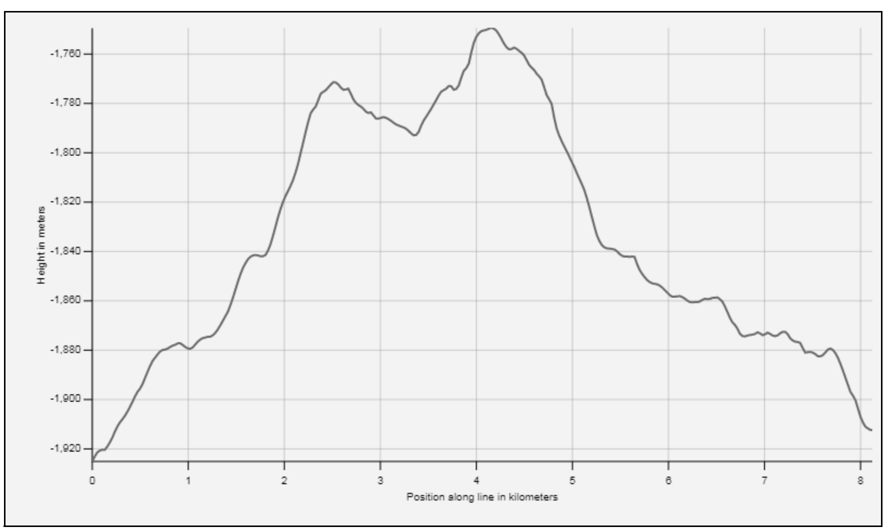
$$h = l \tan \alpha$$

where **l** is the shadow length corrected for foreshortening and measured in km, and tan **α** the tangent of the solar altitude. This measurement has been performed using the LTVT software package by Mosher and Bondo (2006). Accordingly, a height of 195 m ± 20 m was obtained, in accord with previous results.

Results and discussion

WAC Imagery

The Lunar Reconnaissance Orbiter WAC image (**Figure 9**) of dome Mas1 does not display the dome's relief as prominently as the telescopic CCD image shown in (**Figure 1**), which was taken under oblique solar illumination angle. An examination of the dome reveals a variety of features, including a shallow elongated depression measuring 40 m ± 5 m deep, with a base measuring approximately 1 x 2 km, located on the eastern flank (**Figure 10**).



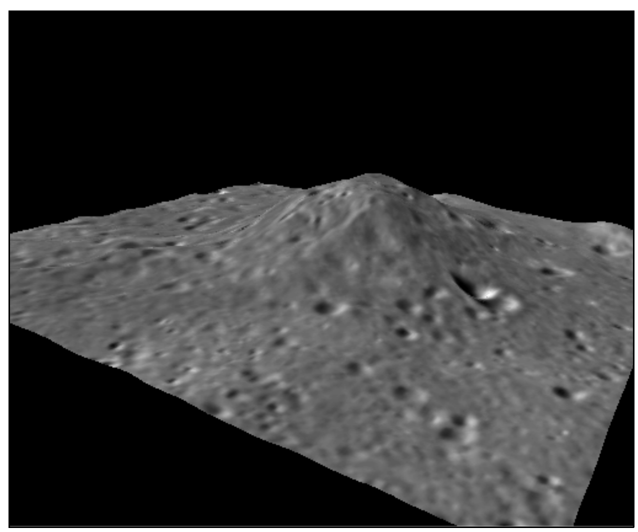
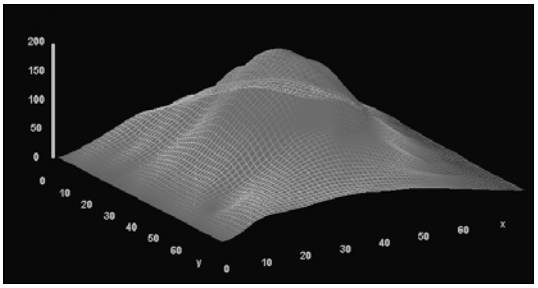


Figure 5 (above left). LOLA DEM. Cross-sectional profile in E-W direction of the dome Mas1.

Figure 6 (above right). WAC draped on top of the global LRO WAC-derived elevation model (GLD100). The height of the dome above the surrounding area is 190 m ± 20 m. The vertical axis is 7 times exaggerated.



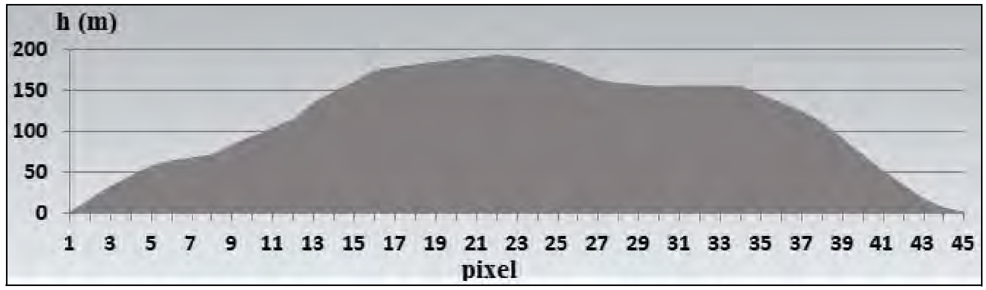
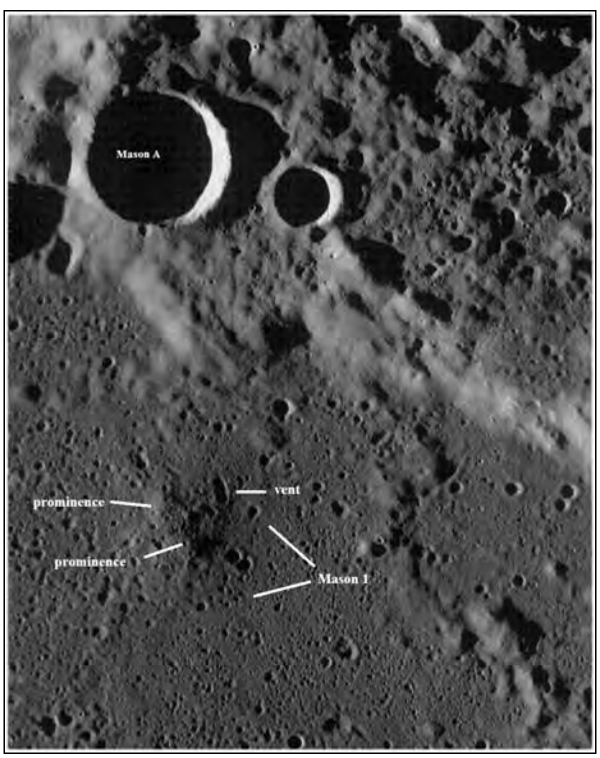


Figure 7 (above left). 3D reconstruction derived for the dome Mas1 based on shape from shading (SfS) approach using the CCD image taken by Schenck on June 19, 2018 at 02:01 UT. The vertical axis is 30 times exaggerated. The curvature of the lunar surface has been subtracted. The result is consistent with the measurements made using LOLA DEM and GLD100 dataset.

Figure 8 (above right). Cross-sectional profile of Mason1 in east-west direction derived by photoclinometry and shape from shading analysis using the CCD image taken by Barzacchi on March 19, 2016 at 22:18 UT. The vertical axis is 20 times exaggerated; the curvature of the lunar surface has been subtracted.

Summit eruptions are the consequence of the extrusion of magma from a central reservoir through the summit conduit. Note that a lateral eruption is a volcanic eruption which is directed sideways from a volcano rather than upwards from the summit. Lateral eruptions are caused by the outward expansion of flanks due to rising magma. Breaking occurs at the flanks of volcanoes making it easier for magma to flow outward.

Located on the northern margin of this vent, and superimposed to it, is a circular impact crater 0.3 km ± 0.1 km in diameter. The elongated depression is smoother in appearance than the circular crater suggesting it has been subject to surface erosion for a longer period of time and thus older than the circular impact crater (**Figure 10**). It is possible that this depression is a possible source vent for lavas, which could have erupted in several effusive events as lateral eruptions. Likely additional vents could be present, which look like subdued features in the LRO WAC images. Additionally on the summit of Mas1, some prominences are detectable in the WAC imagery which may be related to extrusion of material due to high lava viscosity forming the dome (e.g., a lava spine, which is magma in solid form rising from a lava dome or vent usually in a vertical shape). The prominences are visible in some terrestrial CCD images taken during our survey.



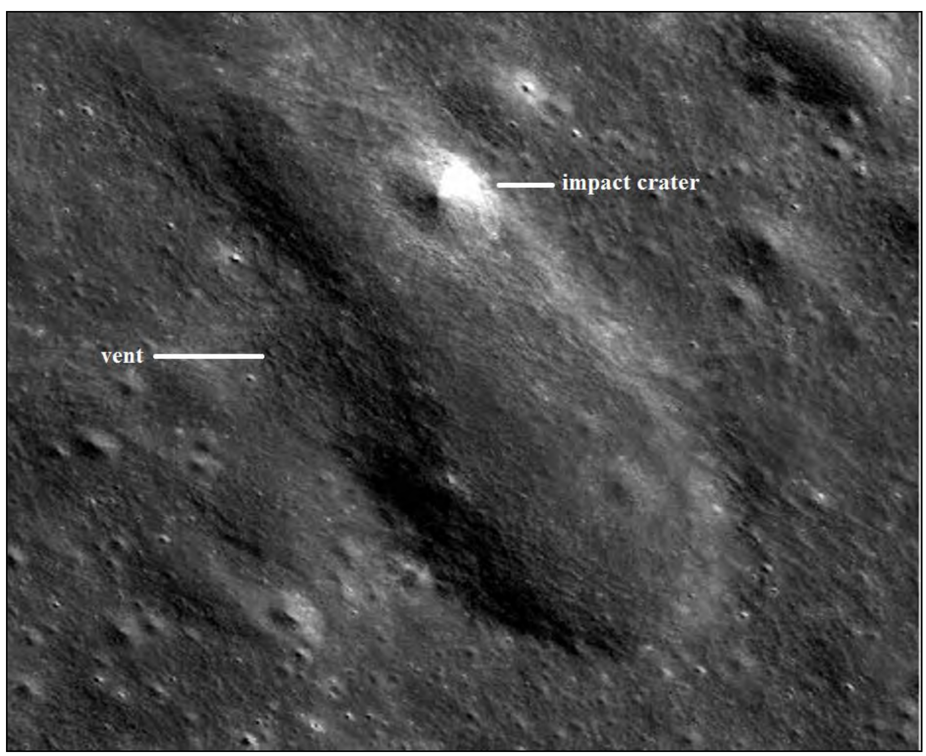
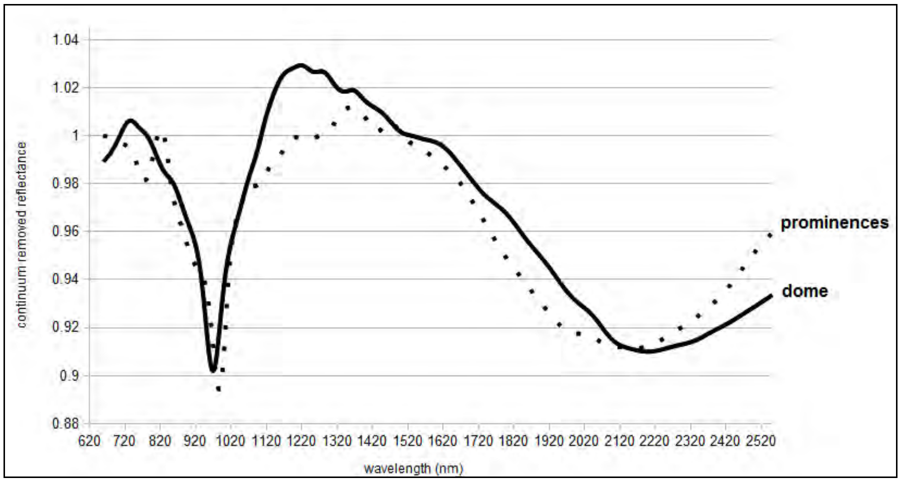


Figure 9 (above left). WAC image of Mas1 with vent and prominences marked. See text for details.

Figure 10 (above right). WAC imagery showing the vent.



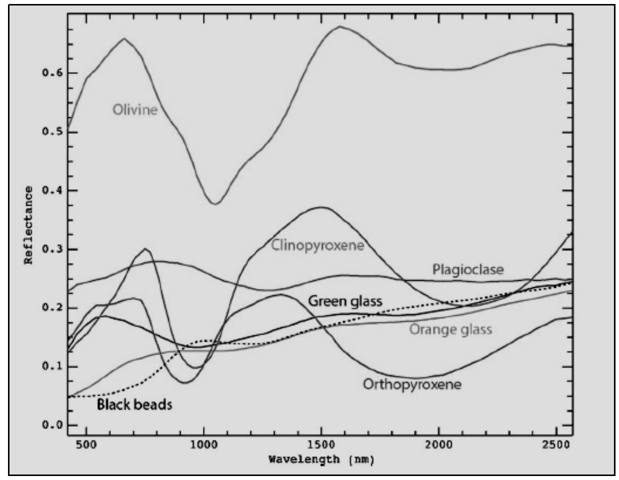


Figure 11 (above left). Spectral data of dome Mas1 from the Chandrayaan-1 Moon Mineralogy Mapper.

Figure 12 (above right). Spectral properties of major lunar minerals, including volcanic glasses.

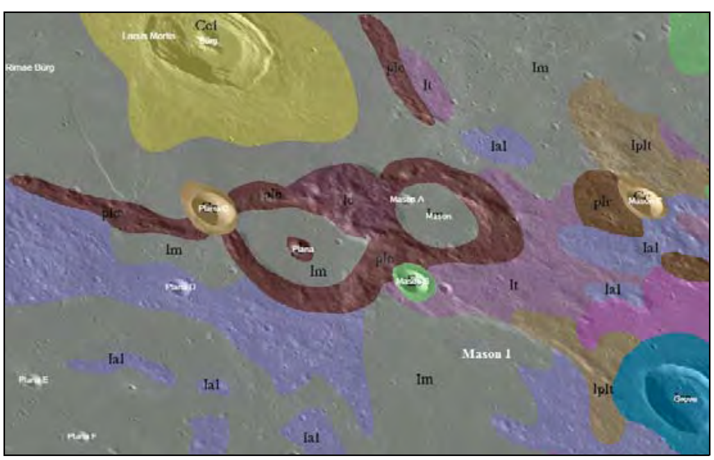
Spectral Data

The Christiansen Feature (CF) from the gridded data record (GDR) level 3 data product of the Diviner Lunar Radiometer Experiment/Lunar Reconnaissance Orbiter (DLRE/LRO) was used for further analysis.

Diviner produces thermal emissivity data, and can provide compositional information from three wavelengths centered on 8 µm which can be used to characterize the Christiansen Feature (CF), which is directly sensitive to silicate mineralogy and the bulk SiO_2 content. For the study area, CF values of 8 µm are towards longer wavelength (8.35 µm), indicating a less silicic composition and thus a basaltic composition (Greenhagen et al., 2010). Average CF value of 8.16 µm are consistent with a mixture of plagioclase and some pyroxene, while the average CF values of maria basalts range from 8.30-8.40 µm. The Clementine Ultraviolet-Visible (UVVIS) data reveal that Mas1 appears spectrally red with a color ratio of R_{415}/R_{750} = 0.57458, indicating a low to moderate TiO_2 content (Wöhler et al., 2011).

Furthermore, we have obtained the spectral data from Chandrayaan-1's Moon Mineralogy Mapper (M^3), an imaging reflectance spectrometer that can detect 85 channels between 460 and 3,000 nm. Data have been obtained through the M^3 calibration pipeline to produce reflectance with photometric and geometric corrections using an image set taken during the optical period OP2C1. The spectra of the dome (**Figure 11**) and the prominence display a narrow trough around 1,000 nm with a minimum wavelength at 980 nm and an absorption band at 2,200 nm, corresponding to a typical high-Ca pyroxene signature (Besse et al., 2014), indicating a basaltic composition.

During the spectral analysis, we have not found indications of spectral glass signatures and it is unlikely that pyroclastic deposits are present on the surface of Mas1. On the contrary, the 1,000 nm band center of lunar glass is shifted to longer wavelengths when compared to pyroxenes, and the 2,000 nm band center to shorter



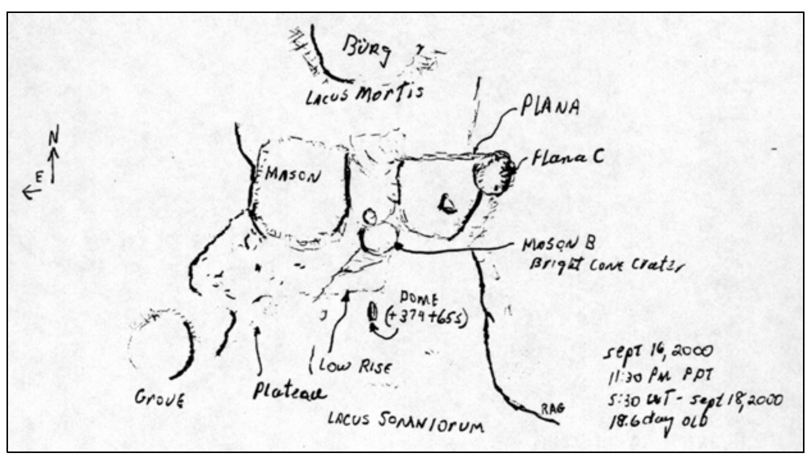


Figure 13 (above left). Wilhelms Geologic Map derived with the ACT-REACT Quick Map tool. Dome Mas1 lies in a geologic region described as the Im unit, which identifies Imbrian-age mare material.

Figure 14 (above right). Drawing by Garfinkle. This observation was made on September 16, 2000. Source: (Garfinkle, 2020) wavelengths. Thus, two 1,000 and 2,000 nm band center positions of lunar glasses will typically appear close together than those of pyroxenes. The spectral properties of major lunar minerals, including volcanic glasses, are shown in **Figure 12**. These minerals exhibit absorption bands that differ by their shape and position along the spectral domain. Pyroxenes (orthopyroxenes and clinopyroxenes) have two absorption bands, one centered near 1,000 nm and another near 2,000 nm.

Classification and Mode of Formation

Mas1 lies in a region mapped as *Im* unit (**Figure 13**), which denotes Imbrian mare material, in the rasterized version of the 2013 renovation of the I-0703 Wilhelms Geologic Map of the near side, mapped at a scale of 1:5,000,000 and ranging from -64 to 64 degrees latitude and -70 to 70 degrees longitude (Fortezzo and Hare, 2013). Based on morphometric and spectral data described above we identify Mas1 as an effusive lunar dome. The location of an elongated vent on a typical domical relief is furthermore suggestive of a volcanic origin (Head and Gifford, 1980). Thus Mas1 represents a mare dome likely of *Imbrian* age.

Wilson and Head (2003) provide a quantitative treatment of such dome-forming eruptions. This model estimates the yield strength, i.e., the pressure or stress that must be exceeded for the lava to flow, the plastic viscosity yielding a measure for the fluidity of the erupted lava, the effusion rate E (the lava volume erupted per second), and the duration T = V/E of the effusion process. This model relies on the morphometric dome properties and several physical constants such as the lava density, the acceleration due to gravity, and the thermal diffusivity of the lava. The rheologic model applied to Mas1 yields a low effusion rate of 88 $m^3\ s^{-1}$ and a high lava viscosity of 4.2 x 10^6 Pa·s (Pascal seconds). It formed over a period of time of about 1.8 years. The magma rise speed amounts to U = 6.4 x 10^{-6} m s^{-1} and the dike width and length to 80 m and 170 km, respectively.

According to the classification scheme for lunar domes (Lena et al., 2013) this steep dome belongs to class B_1. Class B domes consist of lavas of intermediate to high viscosity and low to moderate TiO_2 content, erupting at low to intermediate effusion rates. If the effusion process continues over a long period of time, steep flank slopes and high volumes may occur (class B_1), while short periods of effusion result in shallower edifices of lower volume (class B_2). If it is assumed that the vertical extension of a lunar dike is comparable to its length L (Jackson et al., 1997), the magma which formed Mas1 originated in the upper lunar mantle, well below the crust.

Three rheologic groups of effusive lunar mare domes differ from each other by their rheologic properties and associated dike dimensions, where the basic discriminative parameter is the lava viscosity (Lena e al., 2013). The first group R_1, is characterized by lava viscosities of 10^4 -10^6 Pa·s, magma rise speeds of 10^{-5}-10^{-3} m s^{-1}, dike widths around 10-30 m, and dike lengths between about 30 and 200 km.

Rheologic group R_2 is characterized by low lava viscosities between 10^2 and 10^4 Pa·s, fast magma ascent (U > 10^{-3} m s^{-1}), narrow (W = 1-4 m) and short (L = 7-20 km) feeder dikes.

The third group, R_3, is made up of domes which formed from highly viscous lavas of 10^6-10^8 Pa·s, ascending at very low speeds of 10^{-6} - 10^{-5} m s^{-1} through broad dikes of several tens to 200 m width and 100-200 km length. With its high lava viscosity the dome clearly belongs to rheologic group R_3.

Lunar mare domes that come close to the examined dome Mas1 are Archytas 2 (Lena et al., 2013) and the steep dome Condorcet 4 in Mare Undarum (Lena et al., 2008; Lena et al., 2013). Condorcet 4 has positive relief on the surface, like Mas1. Its effusion rate amounts to 102 $m^3\ s^{-1}$, similar to the value of 119 $m^3\ s^{-1}$ determined for Archytas 2. The estimated duration of the effusion time is of 3.4 and 4.2 years for Archytas 2 and Condorcet 4, respectively. We found that the feeder dike of Condorcet 4 has length of 178 km (170 km for Archytas 2), indicating an origin of the dome forming magma well below the lunar crust (Lena et al., 2008 and Lena et al., 2013).

The width of the dike estimated for Archytas 2 of 114 m is also comparable with the dike width of 90 m inferred for Condorcet 4 and 80 m inferred for Mas1. The viscosity of the lava that formed Archytas 2 of 4.4 x 10^6 Pa·s is also comparable to the values derived for other representative domes of class B_1 and rheologic group R_3, e.g., Mas1 and also Herodotus 1, but about a factor of three lower than the viscosities inferred for Hortensius 5 and 6 belonging to the same class B_1 (Lena et al., 2013). The diameter of Archytas 2 is 11 km, its height is 265 m, resulting in a flank slope of 2.7°. Herodotus 1 (also known as Herodotus omega) is another steep mare dome located to the south of Herodotus crater. Herodotus 1, with its slope of 2.4°, diameter of 14.4 km and height of 220 m belongs to class B_1 of the effusive lunar domes. The rheologic model indicates low effusion rate mainly due to high lava viscosity. Herodotus 1 was formed from a wide and long feeder dike, like the described domes and Mas1. The magma reservoir feeding the dome-forming eruption was located in the upper lunar mantle with inferred dike length of 188 km (Lena et. al, 2013).

Other domes of class B_1 are M23, M11 and M12 (Milichius π) in the Milichius region and the domes termed Hortensius 2-6. The dome Hortensius 5 is by far the steepest mare dome of class B_1 with flank slope of up to 5.3°. M11 has a diameter of 6 km, a height of 150 m resulting in an average flank slope of 2.6°. The well known Milichius π (M12) has a diameter of 9.7 km, a height of 230 m and an average flank slope of 2.72°. M23, recently reported by the authors (Lena and Phillips, 2020), has a smaller base diameter of 5.5 km and height of 230 m while the average slope angle corresponds to 4.7°.

Their rheologic parameters reported in previous studies (Lena et al., 2013; Wöhler, Lena and Phillips, 2007; Wöhler, Lena et al., 2006) are 1.4 x 10^6 and 5.6 x 10^6 Pa·s for the lava viscosity, E = 42 and 70 $m^3\ s^{-1}$ for the effusion rate, and T = 1.75 and 4.9 years for the duration of the effusion process for M11 and M12, respectively. A comparison of these domes with Mas1 reveals similar values with respect to the viscosity of the Milichius B1 class domes M11 and M12, while the effusion rate of Mas1 is somewhat higher. The rheologic model applied to dome M23 (Lena and Phillips, 2020) yields a lower effusion rate of 34 $m^3 s^{-1}$ and a higher lava viscosity of 1.0 x 10^7 Pa·s compared with Mas1, while the values inferred for the magma rise speed (U = 1.6 x 10^{-6} $m s^{-1}$), the dike width (130 m) and length (160 km) are comparable. We believe these differences were probably caused by a somewhat lower eruption temperature occurring for the dome M23 and thus a higher crystallinity of the lava.

References

Besse, S., J. M. Sunshine, and L. R. Gaddis (2014), "Volcanic glass signatures in spectroscopic survey of newly proposed lunar pyroclastic deposits." *Journal of Geophysical Research: Planets,* Vol. 119, doi:10.1002/2013JE004537. Abstract available at: *https://ui.adsabs.harvard.edu/abs/2014JGRE..119..355B/abstract*

Fortezzo, C. M. and Hare, T. M. (2013). "Completed Digital Renovation of the 1:5,000,000 Lunar Geologic Map Series." LPSC XLIV Abstract #2114. Available at: *https://astropedia.astrogeology.usgs.gov/download/Moon/Geology/Ancillary/LunarGeologic_Renovation_Fortezzo_LPSC2013.pdf*

Garfinkle, R.A., (2020). *Luna Cognita*, Springer, New York. In three volumes, pp. 1,680. Available at: *https://link.springer.com/book/10.1007/978-1-4939-1664-1*

Greenhagen, B.T., Lucey, P. G., Wyatt, M.B., Glotch, T. D., Allen,C.C., Arnold, J. A., Bandfield, J. L., Bowles, N. E., Donaldson Hanna, K. L., Hayne, P. O., Song, E., Thomas, I. R., Paige, D. A., (2010). "Global Silicate Mineralogy of the Moon from the Diviner Lunar Radiometer." *Science*, Vol. 329, pp. 1507-1509. doi: 10.1126/science.1192196. Abstract available at: *https://ui.adsabs.harvard.edu/abs/2010Sci...329.1507G/abstract*

Head, J. W., (1979). "Serenitatis multi ringed basin: regional geology and basin ring interpretation," *Moon and the Planets,* Vol. 21, pp. 439-462. Available at: *http://articles.adsabs.harvard.edu/full/1979M%26P....21..439H*

Head, J. W., Gifford, A., (1980). "Lunar Domes: Classification and Modes of Origin, Moon and Planets," Vol. 22, pp. 235-258. Available at: *http://articles.adsabs.harvard.edu//full/1980M%26P....22..235H/0000235.000.html*

Horn, B. K. P., (1989). "Height and Gradient from Shading." MIT technical report 1105A. *http://people.csail.mit.edu/people/bkph/AIM/AIM-1105A-TEX.pdf*

Jackson, P.A., Wilson, L., Head, J.W., (1997). "The use of magnetic signatures in identifying shallow intrusions on the Moon." *Lunar and Planetary Science Conference XXVIII, Abstract #1429*. Available at: *http://articles.adsabs.harvard.edu//full/1997LPI....28..649J/0000649.000.html*

Kapral, C., Garfinkle, R., 2005: GLR *Lunar Dome Catalog*. Available at: *http://digilander.libero.it/glrgroup/kapralcatalog.pdf*

Lena, R., and Phillips, J., (2018). "Lunar domes - The Marius Shield." *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 60, No. 4, pp. 52-67. Available at: *http://alpo-astronomy.org/gallery3/index.php/Publications-Section/ALPO-Journals/DJALPO-2017/JALPO59-4-Autumn-2017*

Lena, R., and Phillips, J., (2020). "Tobyas Mayer Region: Dome M23." *Journal of the Assn. of Lunar & Planetary Observers*, Vol. 62, No. 1, pp. 54-67. (Not yet available online.)

Lena, R., Wöhler, C., Bregante, M.T., Lazzarotti, P., Lammel, S., (2018). "Lunar domes in Mare Undarum: Spectral and morphometric properties, eruption conditions, and mode of emplacement." *Planetary and Space Science*, Vol. 56, Nos. 3-4, pp. 553-569. Abstract available at: *https://doi.org/10.1016/j.pss.2007.11.010*

Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. *Lunar Domes: Properties and Formation Processes*, Springer Praxis Books. https://www.springer.com/gp/book/9788847026360

Mosher, J., & Bondo, H., 2006. *Lunar Terminator Visualization Tool (LTVT)*. See: *https://github.com/fermigas/ltvt/wiki*

Scholten, F., Oberst, J., Matz, K.-D., Roatsch, T., Wählisch, M., Speyerer, E.J., Robinson, M.S., (2012). "GLD100: the near-global lunar 100 m raster DTM from LROC WAC stereo image data." *Journal of Geophysical Research: Planets*, Vol. 117(E00H17). Available at: *https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2011JE003926*

Schott, D., H., (1972). "Geologic map of the Eudoxus Quadrangle of the Moon" (USGS I-705, LAC-26). Available at: *https://www.lpi.usra.edu/resources/mapcatalog/usgs/I705/72dpi.jpg*

Smith et al. (2010). "The Lunar Orbiter Laser Altimeter Investigation on the Lunar Reconnaissance Orbiter Mission." *Space Science Reviews*, Vol. 150, pp. 209-241, doi:10.1007/s11214-009-9512-y. Abstract at: *https://lola.gsfc.nasa.gov/images/smith_lola_ssr09.pdf*

Wilhelms, D. E., (1987). "The geologic history of the Moon." USGS Professional Paper 1348, pp. 302. Available at: *https://doi.org/10.3133/pp1348*

Wilson, L., and Head, J. W., (2003). "Lunar Gruithuisen and Mairan domes: Rheology and mode of emplacement." *Journal of Geophysical Research*, 108 (E2), 5012, doi:10.1029/2002JE001909. Abstract available at: *https://ui.adsabs.harvard.edu/abs/1999nvm..conf...23H/abstract*

Wöhler, C., Lena, R., Lazzarotti, P., Phillips, J., Wirths, M., and Pujic, Z., (2006). "A combined spectrophotometric and morphometric study of the lunar mare dome fields near Cauchy, Arago, Hortensius and Milichius, *Icarus*, Vol. 183, pp. 237- 264. Abstract available at: *https://ui.adsabs.harvard.edu/abs/2006Icar..183..237W/abstract*

Wöhler, C., Lena, R., and Phillips, J., (2007). "Formation of lunar mare domes along crustal fractures: Rheologic conditions, dimensions of feeder dikes, and the role of magma evolution." *Icarus*, Vol. 189 No. 2, pp. 279-307. Abstract available at: *https://ui.adsabs.harvard.edu/abs/2007Icar..189..279W/abstract*

Wöhler, C., Berezhnoy, A., and Evans, R. (2011). "Estimation of elemental abundances of the lunar regolith using Clementine UVVIS+NIR data." *Planetary and Space Science*, Vol. 59, No. 1, pp. 92-110. Abstract available at: *https://ui.adsabs.harvard.edu/abs/2011P%26SS...59...92W/abstract*

Papers & Presentations

Timing Jupiter's Satellite Eclipses: The 2016-17 Apparition

By: John E. Westfall,
Program Coordinator,
Galilean Satellite Eclipses

EDITOR'S NOTE: This is the final report submitted by John before he passed away in July 2018. Questions or comments on this report should be directed to the ALPO Jupiter Section Coordinator Richard Schmude at: schmude@gordonstate.edu

Abstract

During the 2016/17 Jupiter apparition, three observers made 34 visual timings of the eclipses of three of Jupiter's four Galilean satellites - Io, Europa and Ganymede (Callistodid not experience eclipses during 2016/17). We compare the means of their observed eclipse disappearance and reappearance times with the predictions of the IMCCE (Institut de Méchanique Céleste et de Calcul des Éphémérides) E-5 ephemeris.

Introduction

The apparition covered here is the 39th observed by the ALPO Jupiter Section's Galilean Satellite Eclipse Timing Program, which conducts visual timings of the eclipses by Jupiter of the four Galilean satellites Io, Europa, Ganymede and Callisto.

Our observers timed the "last speck" visible when a satellite entered Jupiter's shadow (disappearance) and the "first speck" visible when it emerged from eclipse (reappearance). Each satellite's mean disappearance and reappearance timings were then averaged to determine if its position corresponded to its ephemeris. (Our 1998/99 Apparition report described in detail our method of reduction; see also our 2012-13 report [Westfall 2009, 201*.]) We have compared our reduced timings with the IMCCE predictions, using the INPOP13C planetary theory and Lieske E-5 satellite theory.

All Readers

Your comments, questions, etc., about this report are appreciated. Please send them to: the author's email address.

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).

Table 1 lists the pertinent dates and other circumstances of the 2016/17 Apparition.

This apparition saw the Sun and Earth move farther south of Jupiter's equator. Callisto's most recent eclipse series ended during the previous apparition, while Io, Europa and Ganymede entered and exited Jupiter's shadow at increasingly oblique angles relative to the shadow edge.

Observations and Observers

The 34 timings received for 2016/17 brought our 39-apparition total to 11,267 observations, showing a small increase from the 33 received for the 2015/16 Apparition. Table 2 gives descriptive statistics for the 2016/17 observations.

The number of timings made before and after opposition and of disappearances

Table 1. Circumstances of the 2016/17 Jupiter Apparition

Apparition		Observing Season	
Initial solar conjunction	2016 SEP 26, 06h	First eclipse timing§	2016 DEC 15 (+80d)
First maximum phase angle	2017 JAN 12, 09h (10.39°)	Last eclipse timing§	2017 AUG 13 (-74d)
Opposition to the Sun*	2017 APR 07, 22h (δ = -5.7°)	Duration	241d
Closest approach to Earth†	2017 APR 08, 21h (D = 44.2")	Solar elongation range	064°W – 058°E
Second maximum phase angle	2017 JUL 06, 04h (10.75°)	Sources: Meeus 2015; *Astronomical Almanac*, 2016 and 2017 editions; JPL *HORIZONS* website. Dates and times throughout this report are in Universal Time (UT).	
Final solar conjunction	2017 OCT 26, 18h		
Zenocentric latitude of Sun range	-2.57° to -3.46°	* δ = Jupiter's declination at opposition. † D = Jupiter's equatorial diameter in arc-seconds. § In parentheses are the number of days after initial solar conjunction (+) or before final solar conjunction (-).	
Zenocentric latitude of Earth range	-2.34° to -3.51°		

and reappearances were remarkably well balanced.

Table 3 lists the participants in our program during 2016/17, with their nationalities, instrument apertures and number of timings, both short-term and long-term.

The contributors used moderate-size telescopes in the aperture range 6-15 cm. The mean aperture, weighted by number of observations, was 12.8 cm.

Timings Analysis: Satellite Positions

The individual eclipse timings made by our participants in 2016/17 are listed in Table 5 at the end of this report. Table 4, below, summarizes the eclipse timings made in this period, with the means, standard errors of the means, and medians of the differences ("residuals") between our timings and the IMCCE E-5 ephemeris. The numbers of timings given in parentheses represent the number actually used in the analysis, after the removal of outliers. All the residuals were corrected for oblique contact with Jupiter's shadow at disappearance and reappearance, using the formula R' = R cos β', where R' is the corrected residual, R the original residual, and β' the zenographic latitude of the satellite relative to Jupiter's shadow.

This correction made a difference of 3-6 seconds for Io, 10-31 seconds for Europa and 141-195 seconds for Ganymede, the latter contacting the umbra at angles ranging from 48° to 54° from perpendicular.

In 2016/17, Europa and Ganymede did not differ significantly from the IMCCE E-5 ephemeris. However, at the 1-percent level of significance, Io's eclipses occurred an average of 7.8 seconds early compared to the ephemeris.

Table 2. Number of Eclipse Timings, 2016/17 Apparition

Number of Timings	34
Timings before Opposition	15 (44%)
Timings after Opposition	19 (56%)
Disappearance Timings	18 (53%)
Reappearance Timings	16 (47%)

Table 3. Participating Observers, 2016/17 Apparition

Observer and Telescope					ALPO Timing Program Total	
I.D. No.	Name	Nationality	Telescope Aper. (cm)	Number of Timings (Total)	Number of Apparitions	Number of Timings
1a	Büttner, D.	Germany	6	4	20	158
1b			10	7 (11)		
2	Hays, R.H., Jr.	USA (IL)	15	21	26	469
3	Westfall, J.	USA (CA)	12.7	2	36	626
Mean Number of Timings per Observer				11.3		

Table 4. Timing Residual Statistics, 2016/17 Apparition

Quantity	Satellite		
	Io	Europa	Ganymede
Disappearances: Number of Timings	9 (9)	4 (3)	5 (5)
Disappearances: Mean	+82.2±2.0s	+98.7±5.2s	+274.6±11.8s
Disappearances: Median	+81.0s	+94.0s	+282.0s
Reappearances: No. of Timings	6 (6)	5 (4)	5 (5)
Reappearances: Mean	-97.7±2.9s	-109.0±4.3s	-248.6±5.6s
Reappearances: Median	-99.0s	-108.5s	-253.0s
(Disap.+Reap.)/2: Means	-7.8±1.8s **	-5.2±3.4s	+13.0±6.5s
(Disap.+Reap.)/2: Medians	-9.0s	-7.2s	+14.5s

Conclusion

The analysis of our program's timings made during the 2016/17 Jupiter apparition showed that the times of eclipses by Jupiter of Europa and Ganymede did not differ significantly from the IMCCE E-5 ephemeris, although Io events averaged 7.8 seconds early at a 1-percent level of significance.

We thank the observers who contributed timings during 2016/17.

The present article is the final report of the ALPO Jupiter Section's Galilean Satellite Eclipse Timing Program. The predecessor of the program was a series of reports of visual timings of the eclipses by Jupiter of its Galilean satellites during the 1975/76 Apparition, published in *Sky & Telescope* magazine by Joseph Ashbrook.

Upon Dr. Ashbrook's death in 1980, the ALPO Jupiter Section continued the project as a subprogram directed by thjs assistant Jupiter recorder/coordinator. Over the four-decades of the program, over 500 observers took part, often coordinated by regional organizers; Brian Loader of the Royal Astronomical Society of New Zealand was particularly effective in recruiting and coordinating observers for many years.

Our visual timings were compared with the predictions of JPL's Jay Lieske's E-2 ephemeris for the 1975/76 through the 2000/01 apparitions and a database of the 10,308 timings made during that period is available on request. For 2001/02 through 2016/17 we have compared observations with the Lieske E-5 ephemeris.

However, for the past two decades the number of observers in our program has consistently declined until we have reached the point where the small sample size and limited number of independent observers has made it impossible to do meaningful statistical analyses for individual apparitions. Accordingly we are terminating the program with this concluding report. We wish here to take a final opportunity to thank the many regional organizers and observers who have made this program possible.

References

Meeus, Jean (2015). “Astronomical Tables of the Sun, Moon and Planets.” 3rd ed. Richmond, VA: Willmann-Bell. https://www.amazon.com/Astronomical-Table-Sun-Moon-Planets/dp/1942675038

United States Naval Observatory (2015). “The Astronomical Almanac for the Year 2016.” Washington: U.S. Government Printing Office. https://www.amazon.com/Astronomical-Almanac-2016-Stationery-Office/dp/0707741580

________ (2016). “The Astronomical Almanac for the Year 2017.” Washington: U.S. Government Printing Office. https://www.amazon.com/Astronomical-Almanac-Year-Companion-Online/dp/0707741661

Westfall, John E. (2009). “Galilean Satellite Eclipse Timings During the 1998/99 Apparition.” *Journal of the Assn of Lunar & Planetary Observers*, 51 (3): 38-48. http://alpo-astronomy.org/gallery3/index.php/Publications-Section/ALPO-Journals/DJALPO-2009/DJALPO51-3-Summer2009

________ (2019). "Timing Jupiter's satellite eclipses: The 2012/13 Apparition." *Journal of the Assn of Lunar & Planetary Observers*, 61 (4): 60-63. http://alpo-astronomy.org/gallery3/index.php/Publications-Section/ALPO-Journals/DJALPO-Volume-61-2019/JALPO61-4-Autumn-2019

________ (2020). "Timing Jupiter's Satellite Eclipses: The 2013/14 Apparition." *Journal of the Assn of Lunar & Planetary Observers*, 62 (1): 79-81.

________ (2020). "Timing Jupiter's Satellite Eclipses: The 2014/15 Apparition." *Journal of the Assn of Lunar & Planetary Observers*, 62 (2): 69-72.

________ (2020). "Timing Jupiter's Satellite Eclipses: The 2015/16 Apparition." *Journal of the Assn of Lunar & Planetary Observers*, 62 (3): 71-73.

Table 5. Galilean Satellite Eclipse Timings, 2016/17 Apparition

UT	LD	Lat	ObN	STB	Dif
Io Disappearances					
61229	18	-17	2	100	+80
70130	19	-17	2	000	+97
70206	19	-17	2	000	+91
70213	18	-17	2	000	+93
70215	18	-17	2	200	+79
			1a	001	+85
70222	17	-17	2	010	+83
70303	14	-18	2	000	+85
70308	13	-18	2	000	+82
Io Reappearances					
70425	8	-18	2	101	-100
70511	14	-18	3	101	-107
70521	17	-19	1b	001	-112
70612	20	-19	2	100	-109
70619	20	-19	2	100	-98
70813	15	-19	2	100	-92

UT	LD	Lat	ObN	STB	Dif
Europa Disappearances					
61215	25	-30	2	000	+72
70203	30	-31	2	000	+109
70217	27	-31	2	000	+128
70401	5	-33	1b	002	+110
Europa Reappearances					
70503	16	-34	2	000	-132
70528	27	-35	2	100	-121
70604	28	-35	3	001	-172
			2	000	-132
70614	30	-36	1b	001	-147

UT	LD	Lat	ObN	STB	Dif
Ganymede Disappearances					
70227	37	-48	2	000	+446
70328	12	-50	1b	001	+456
70517	8	-52	2	010	+383
70614	21	-54	1a	000	+442
			1b	000	+477
Ganymede Reappearances					
70502	24	-52	1b	010	-412
			1a	010	-372
0614	47	-54	1b	100	-442
			1a	100	-407
70622	47	-54	2	000	-430

Column headings: UT = Universal Time, expressed as ymmdd, where y is the last digit of the year; LD = distance of satellite from Jupiter’s limb in arc seconds; Lat = zenographic latitude of satellite on Jupiter’s shadow cone in degrees; ObN = observer number as in Table 3; STB = observing conditions, where S = seeing, T = transparency and B = field brightness, all expressed in terms of 0 = condition not perceptible, 1 = condition perceptible but does not affect accuracy and 2 = condition perceptible and does affect accuracy; and Dif = (observed – calculated) eclipse time in seconds. Underlined timings were excluded during analysis due to unusually large differences from the other observations, usually due to unfavorable observing conditions. Note that these “raw” residual values have not been corrected for oblique contact with Jupiter’s shadow.

ALPO Resources

People, publications, etc., to help our members

Board of Directors

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

- Executive Director; Julius L. Benton, Jr., Associates in Astronomy, P.O. Box 30545, Wilmington Island, Savannah, GA 31410; *jlbaina@msn.com* (preferred) and *jbenton55@comcast.net*
- Associate Executive Director; Carl Hergenrother, 4101 North Sunnywood Place, Tuscon, AZ 85749; *chergen@lpl.arizona.edu*
- 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*
- Member of the Board; Timothy J. Robertson, 195 Tierra Rejada Rd., #148, Simi Valley, CA 93065; *cometman@cometman.net*
- Member of the Board; Richard W. Schmude, Jr., 109 Tyus St., Barnesville, GA 30204; *schmude@gordonstate.edu*
- Member of the Board, Secretary/ Treasurer; Matthew Will, P.O. Box 13456, Springfield, IL 62791-3456; *matt.will@alpo-astronomy.org*

Publications Section

http://alpo-astronomy.org/gallery3/index.php/Publications-Section

- Coordinator; Ken Poshedly (ALPO-Member-Discussion e-mail group moderator & *The Strolling Astronomer* production); 1741 Bruckner Ct, Snellville, GA 30078-2784; *ken.poshedly@alpo-astronomy.org*
- Assistant Coordinator; (Editor, *The Strolling Astronomer)*; Shawn Dilles, 9517 Center St., Vienna, VA 22181; *shawn.dilles@alpo-astronomy.org*
- Assistant Coordinator (Book reviews, *The Strolling Astronomer*); Robert A. Garfinkle, FRAS, 32924 Monrovia St., Union City, CA 94587-5433; *ragarf@earthlink.net*
- Assistant Coordinator (Indexer, *The Strolling Astronomer*); Michael Mattei, 11 Coughlin Rd., Littleton, MA 01460-2108; *micmatt@hughes.net*

Interest Sections

Outreach Section

Lunar & Planetary Training Program

http://www.alpo-astronomy/training

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

Podcasts

https://soundcloud.com/observersnotebook

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

Youth Activities Program

http://www.cometman.net/youth/

- Acting Coordinator; Pam Shivak, 4225 NW 32nd St., Cape Coral, FL 33993; *pamelashivak@yahoo.com*

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, 1475 Holly Lake Circle; Snellville, GA 30078; *sdsiedentop@gmail.com*
- Acting Assistant Coordinator; Jim Tomney, 404 Dixie Dr., Towson, MD 21204; *jim@tomney.com*

Observing Sections

Eclipse Section

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

- Coordinator; Keith Spring, 2173 John Hart Circle, Orange Park, FL 32073; *star.man13@hotmail.com*

Mercury/Venus Transit Section

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

- Coordinator; Keith Spring, 2173 John Hart Circle, Orange Park, FL 32073; *star.man13@hotmail.com*

Meteors Section

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

- Coordinator; Robert D. Lunsford, 14884 Quail Valley Way, El Cajon, CA 92021-2227; *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*

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*

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*
- Assistant Coordinator; Pam Shivak, 4225 NW 32nd St., Cape Coral, FL 33993; *pamelashivak@yahoo.com*
- Acting Assistant Coordinator (new observers and ALPO Solar Section Online Image Archive contact; primary moderator ALPO Solar Section Yahoo email list); Kim Hay, 76 Colebrook Rd., RR #1, Yarker, Ontario, K0K 3N0 Canada; *cdnspooky@gmail.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*

ALPO Resources

People, publications, etc., to help our members

Lunar Section

Lunar Topographical Studies Program

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

Lunar Selected Areas Program

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

Lunar Banded Craters Program

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

- Coordinator; David Teske, 2162 Enon Rd., Louisville, MS 9501; drteske@yahoo.com
- Assistant Coordinator; Wayne Bailey, 14120 S. Mica Place, Tucson, AZ 85736; wayne.bailey@alpo-astronomy.org
- Assistant Coordinator; William Dembowski, 219 Old Bedford Pike, Windber, PA 15963; dembowski@zone-vx.com
- Acting Assistant Coordinator; Alberto Anunziato, Boulevard Racedo 773, 3100-Parana-Entre Rios, Argentina albertoanunziato@yahoo.com.ar

Lunar Domes Studies Program

- Coordinator; Raffaello Lena, Cartesio 144 D, 00137 Rome, Italy; raffaello.lena@alpo-astronomy.org
- Assistant Coordinator; Jim Phillips, 101 Bull St., Charleston, SC 29401-1712; thefamily90@gmail.com

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 Program

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 (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; harrisaw@att.net
- 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

- Section Coordinator - Open
- Assistant Coordinator, Apparition Reports; Richard W. Schmude Jr., 109 Tyus St., Barnesville, GA 30204; schmude@gordonstate.edu
- Assistant Coordinator, John McAnally, 2124 Wooded Acres, Waco, TX 76710; CPAJohnM@aol.com
- Assistant Coordinator, Jupiter Section Yahoo email list; 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

Exoplanets Section

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

- Acting Coordinator; Jerry Hubbell, 406 Yorktown Blvd, Locust Grove, VA 22508; jerry.hubbell@alpo-astronomy.org

****

ALPO Publications

The Monograph Series

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

Publications too lengthy for publication in *The Strolling Astronome*r. All are available ONLY 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. File size approx. 2.6 mb.
- **Monograph No. *5.*** *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878.*

ALPO Resources

People, publications, etc., to help our members

By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. 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. 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. 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. 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. File size approx. 2.6 mb.
- **Monograph No. 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
- **Monograph No. 12.** *Solar Activity from 2014 through 2016* (subtitled *An unorthodox analysis of solar activity during three years, on the way to solar minimum*) by Theo Ramakers. Documents the research done to evaluate the relationship between the Wolf number indicator used to identify solar activity in many amateur solar reports and the size of the areas which Active Regions occupy during times of high solar energy.”
- **Monograph No. 13.** *A Manual for Observing the Moon: The ALPO Lunar Selected Areas Program* by Dr. Julius Benton. Second update to original 1994 edition. Intended for serious enthusiasts who want to seriously contribute to lunar science through participation in the specialized efforts of the ALPO Lunar Selected Areas Program (which now includes the Dark Haloed Craters Program (DHCP) and the Bright and Banded Craters Program (BBCP). The handbook includes fundamental methods and techniques for conducting systematic observations of specific types of lunar features, including remarks on the lasting value of current lunar visual observations by amateur astronomers with Earth-based telescopes.
- **Monograph No. 14.** *Theory and Methods for Visual Observations of Saturn* by Dr. Julius Benton. Intended for the individual who seeks to gain an understanding of the observational theory and methodology involved in pursuing a worthwhile program of observing Saturn, its ring system, and accompanying satellites. The methods and techniques presented will hopefully be instructive and helpful to the observer who wishes to produce the most useful and reliable data possible for analysis, whether one is conducting a purely visual program or utilizing digital imagers to capture images of Saturn at various wavelengths.
- **Monograph No. 15.** *A Guide for Visual Observations of the Planet Venus* by Dr. Julius Benton. Update to the original 2016 edition. Intended for the individual who seeks to gain an understanding of the observational theory and methodology involved in pursuing a worthwhile program of observing the planet Venus. This small (65-page) handbook has been written for the amateur astronomer who wants to pursue an organized program of systematic visual observations of this planet, a beautiful but exceedingly difficult object to observe.

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

ALPO Resources

People, publications, etc., to help our members

send SASE to: Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080.

- **Venus (Benton):** Introductory information for observing Venus, the comprehensive *ALPO Venus Handbook*, as well as all observing forms and ephemerides, can be conveniently downloaded as pdf files at no cost to ALPO members and individuals interested in observing Venus as part of our regular programs at *http://www.alpo-astronomy.org/venus*.

- **Mars:** Free resources are on the ALPO website at *www.alpo-astronomy.org* . Click on "Mars Section" in the left column; then on the resulting webpage, look for links to resources in the right column including "Mars Observing Form", and "Mars Links". Under "Mars Links", click on "Mars Observers Cafe", and follow those links to The New "Internet Mars Observer's Handbook."

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

- **Jupiter:** *(1) Jupiter Observer's Handbook*, from the Astronomical League Sales, temporarily out of stock. (*2*) *ALPO_Jupiter*, the ALPO Jupiter Section e-mail network; to join, send a blank e-mail to *ALPO_Jupiter-subscribe@yahoogroups.com* (3) *Jupiter Observer's Startup Kit*, $3 from Richard Schmude, Jupiter Section Coordinator.

- **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 (postage & handling); check/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, 14884 Quail Valley Way, El Cajon, CA 92021-2227.

Back Issues of The Strolling Astronomer

Online Issues

All issues of this Journal are available for downloading via the ALPO website through Vole 61(2019).
All indexes have been posted except for volume 61 (2019) and volume 62 (2020). The missing items will be posted as soon as possible.

To download online Journals:

1. Go to alpo-astronomy.org, then click on the "ALPO Section Galleries" link near the top of the right corner.
2. Next, click on the Publications Section icon, then click on the ALPO Journals icon.
3. Choose either the folder of indexes or the desired volume of Journals according to year.
4. Finally, click on the desired Journal to view or download.

Note that the newest four issues are available for downloading only by ALPO members.

Hard-Copy Issues

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 to order 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
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, 2, 3 and 4
Vol. 60 (2018) Nos. 1, 2, 3 and 4
Vol. 61 (2019) Nos. 1, 2, 3 and 4
Vol. 62 (2020) Nos. 1, 2, 3 and 4

$5: Vol. 63 (2021) No. 1 (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* (known also as *The Strolling Astronomer*). Membership dues include a subscription to our Journal. Two versions of our Journal are distributed — a hardcopy (paper) version and an online (digital) version in portable document format (pdf) at considerably reduced cost.

Membership rates and terms are listed below (effective January 1, 2019).

- ..*$US18 – 4 issues of the digital Journal only; all countries, e-mail address required
- ..*$US32 – 8 issues of the digital Journal only; all countries, e-mail address required
- ..*$US45 – 4 issues of the paper Journal only; US, Mexico and Canada
- ..*$US84 – 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
- ..*$US75 – Sustaining Membership level, 4 issues of the digital and paper Journal, all countries
- ..*$US150 – Sponsoring Membership level, 4 issues of the digital and paper Journal, all countries
- ..*$US250 – Patron Membership level, 4 issues of the digital and paper Journal, all countries
- ..*$US500 – Benefactor Membership level, 4 issues of the digital and paper Journal, all countries
- ..*$US1,000 – Provider Membership level, 4 issues of the digital and paper Journal, all countries
- ..*$US2,500 – Funder Membership level, 4 issues of the digital and paper Journal, all countries
- ..*$US10,000 – Universal Membersship level, lifetime 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 link:
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 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)