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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 51, Number 4, Autumn 2009

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Founded in 1947

Inside this issue . . .

- ***ALPO board meeting report***
- ***Update on the LCROSS mission and observing alert for ALPO observers***
- ***A look back at Apollo 11***
- ***Apparition report: Jupiter in 2005-2006***

. . . plus reports about your ALPO section activities and much, much more

“Bird Strike” impact in Jupiter’s South Polar Region (SP) as imaged by Anthony Wesley, Murrumbateman, Australia, July 19, 2009, 13:30 UT CMI = 200°, CMII = 210° and CMIII = 301°. Equipment: homemade Newtonian on Losmandy Titan GEM; 14.5", f/5 Royce conical primary mirror, 1/30 wave Antares Optics secondary mirror, Televue 5x powermate working at 7.7x; Point Grey Research Dragonfly2 mono camera, ICX424al; Astrodon I-Series RGB filters; Capture details, 60 seconds in each filter @ 47fps; Capture software, Coriander; Operating System: Linux (Fedora 10 x86); Processing software, Ninox for crop and presort, Registax for alignment and stacking, Astra Image for deconvolution and RGB align, The Gimp for cleanup and captioning; Seeing conditions not available in ALPO scale but described as initially “reasonable”, but then deteriorating as time passed. (source: http://jupiter.samba.org/)

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Paula York, Founder
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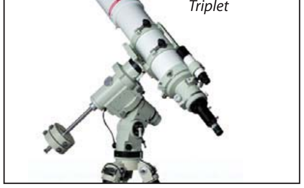

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Journal of the Association of Lunar & Planetary Observers

The Strolling Astronomer

Volume 51, No. 4, Autumn 2009
This issue published in October 2009 for distribution in both portable document format (pdf) and also hardcopy format.

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

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

For membership or general information about the ALPO, contact:

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

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Feature Stories

ALPO Resources

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Inside the ALPO
Member, section and activity news

Point of View
ALPO 2009

By Matthew L. Will, ALPO membership secretary

It's not very often that I get to talk about the ALPO membership and how the ALPO is surviving as an organization in the pages in the *Journal*. Last summer's convention was the first one in 16 years that I couldn't attend for personal reasons. So this gives me a chance to speak to all the membership and not just those who made it to the convention.

The good news is that the ALPO seems to be remarkably stable in terms of finances and size in membership despite the past recession. With the release of last summer's issue of the *Journal* (JALPO51-3), we topped out at 446 members. In some areas, we have experienced actual growth. For example, the number of international members has actually increased, making up 19.3% of our membership. This is close to the 1-to-5 ratio in international members that we had in the 1980s. I encourage our readers to review the minutes of our August ALPO Board meeting in this issue of your Journal.

But the ALPO is not stagnating on the business and administrative end. Thanks to our editor Ken Poshedly, a new printer for the ALPO has been found that produces the hard copy of our *Journal* in a more economical manner with the same quality. And Larry Owens, our webmaster, has improved the ALPO website to include blogs for various sections. This secretary is now getting help with the many responsibilities of managing the business end of the ALPO.

There are plans to expand of the ALPO's outreach with amateur astronomers, astronomy clubs, and educational institutions. Many of our ALPO staff members are already doing talks at various public venues with positive responses for which our Secretary is grateful. Of course, the organization is only as alive as its membership. Please feel free to play up the ALPO among your astronomy friends and colleagues. Download the newly revised PowerPoint presentation about the ALPO from the ALPO Web Site (*www.alpo-astronomy.org/main/ALPOintroduction.ppt*) and give the presentation at your next astronomy club meeting or museum/planetarium get-together.

In case you don't know it, all members have been drafted into the ALPO Army! There will be no "cattle call" (medical exam) and the only cheeks that you will have to spread will be the ones on your face (a warm smile). As far as I am concerned, you all have a draft number of 1; because you're all number 1 to me. Without you, there is no ALPO. So let's spread our fascination with the Solar System and our goodwill to others outside the ALPO. Hopefully, we can open a new vista in amateur astronomy to our fellow amateurs and newcomers to astronomy alike, that aren't currently ALPO members, but could be in the future.

Let us know.

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News of General Interest

E-mail address update

Ordinarily, we leave it to our readers to check for new e-mail addresses in the *ALPO Resources* section of this publication.

However, this one is most important and needs to be pointed out.

Please note that the e-mail address for our own ALPO founder and director emeritus Walter Haas has changed. The new e-mail address is haasw@agavue.com

ALPO Board announces staff membership news

Effective immediately, staff members who have not answered a third notice for membership renewal within one month of reception of that renewal notice will be subject to removal from the ALPO Staff by the ALPO Board. As the ALPO Staff Guidelines have stated, membership is a requirement for serving on the staff of the ALPO. More than simply needing the money to support production of the Journal ALPO, staff should endorse and encourage others interested in the ALPO to become members by example. The vast majority of staff members do renew on the first or second renewal notice and this is greatly appreciated. The ALPO Board thanks everyone for their faithful interest and support of the ALPO.

Join/ renew your ALPO membership online

Save yourself the postage and either join or renew your ALPO membership at either of two online locations:

Telescopes by Galileo, www.galileosplace.com/ALPO/

The Astronomical League, (online readers click here); hard copy readers, go to http://www.astroleague.org, then left-click on "Login for AL Store" in the left panel, then left-click on ALPO in the list of categories page, then left-click on the ALPO membership choice.

The ALPO thanks both *Telescopes by Galileo* and *The Astronomical League* for providing this valuable online service.

ALPO Interest Section Reports

Web Services

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

Visit the ALPO home page online at www.alpo-astronomy.org

Computing Section

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

Important links:

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

Lunar & Planetary Training Program

Tim Robertson,
section coordinator
cometman@cometman.net

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

ALPO Observing Section Reports

Eclipse Section

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

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

Comets Section

Gary Kronk,
acting section coordinator
kronk@cometography.com

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

Meteors Section

Report by Bob Lundsford,
section coordinator
lunro.imo.usa@cox.net

In April, this writer travelled to the Mojave Desert to view the Lyrid meteor shower for three nights. The first morning of observations was on Monday April 20, when I watched for the last two hours before dawn. No Lyrid activity was detected but a dozen sporadic meteors

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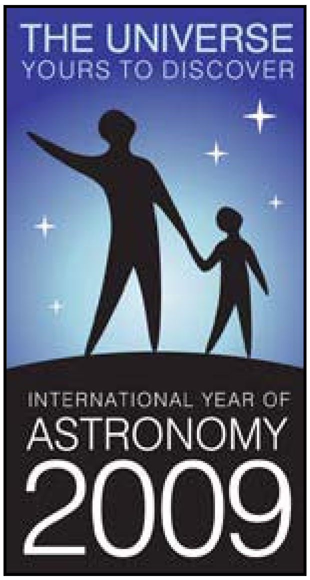
Galilean Nights: Global Astronomy Event Invites the World to Discover Our Universe

Sep 17, 2009, Paris



Wind the clock back 400 years and follow in the footsteps of a giant — experience now just what first amazed Galileo in 1609! The latest Cornerstone project of the International Year of Astronomy 2009 (IYA2009), *Galilean Nights*, will see thousands of public observing events around the world replicating Galileo's observations and bringing what he saw 400 years ago to the public of today. From 22 to 24 October, amateur and professional astronomers, science centers, schools and all interested groups are invited to be part of the *Galilean Nights* project and to register their events on the project website *www.galileannights.org*. We can all make this a worldwide success.

The *Galilean Nights* builds on the unprecedented success of April's *100 Hours of Astronomy*, another IYA2009 Cornerstone project. Over three nights amateur and professional astronomers, and enthusiasts, will share their knowledge and enthusiasm for the Universe by encouraging as many people as possible to look through a telescope at our neighboring planets. The focus for the *Galilean Nights* is on the observations made by the Italian astronomer Galileo 400 years ago, including those of Jupiter and the Moon, which will be well-positioned in the night sky for observing during the event. For many members of the public, it will be their first look through a telescope, when they can see such breathtaking sights such as the cloud bands of the gas giant Jupiter, and intricate details on our cratered Moon. It will be an unforgettable experience.

Anyone from any background and with any level of experience is encouraged to organize events, from one person sharing the night sky through a telescope with a small group of neighbors and friends, to large astronomical groups holding major observing sessions in public areas. To keep track of developments, assist with promotion and to help people to find local Galilean Nights activities, all events should be registered on the project website: *www.galileannights.org*. Hundreds of events all over the world have already been registered and the number is increasing every day.

IYA2009 Executive Committee Chair Catherine Cesarsky says, "Amateur observations have always played an important role in astronomy, a fact highlighted by one of the most exciting events of this year when it was an amateur astronomer who noticed that Jupiter had suffered a massive impact by an asteroid or comet. So it is fitting that *Galilean Nights* continues this tradition as thousands of amateur astronomers and the public will turn their attention to Jupiter and other objects that Galileo observed 400 years ago."

Stunning images of distant objects in the Universe are well-known around the world and do more to bring astronomy to the wider public and to inspire future astronomers than words ever could. The public has been set the challenge of capturing the inspirational nature of our local solar neighborhood in the worldwide *Galilean Nights* photography competition. Run in partnership with Europlanet, the *Galilean Nights* competition encourages anybody with an enthusiasm for astronomy to try a different approach to their observations and create their own inspirational photographs of our planetary neighbors. The contest is being officially launched today during Europlanet's European Planetary Science Congress, held this year in Potsdam, Germany.

Four-hundred years since Galileo's telescopic observations revolutionized our view of the Universe, the public will once again be turning their attention to the heavens. People all around the world are encouraged to take part in the *Galilean Nights Cornerstone* project and experience for themselves the same sense of awe and wonder that Galileo must have felt.

Links
- Galilean Nights website: *www.galileannights.org*
- IYA2009 website: *www.astronomy2009.org*
- European Planetary Science Congress website: *http://meetings.copernicus.org/epsc2009/*

Notes
The vision of the IYA2009 is to help the citizens of the world rediscover their place in the Universe through the day and night-time skies the impact of astronomy and basic sciences on our daily lives, and understand better how scientific knowledge can contribute to a more equitable and peaceful society.

The aim of the IYA2009 is to stimulate worldwide interest, especially among young people, in astronomy and science under the central theme,"The Universe, Yours to Discover". IYA2009 events and activities will promote a greater appreciation of the inspirational aspects of astronomy that embody an invaluable shared resource for all countries.

The IYA 2009 United States node home page is at *www.astronomy2009.us/*

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Reminder: Address changes

Unlike regular mail, electronic mail is not forwarded when you change e-mail addresses unless you make special arrangements.

More and more, e-mail notifications to members are bounced back because we are not notified of address changes. Efforts to locate errant members via online search tools have not been successful.

So once again, if you move or change Internet Service Providers and are assigned a new e-mail address, please notify Matt Will at matt.will@alpo-astronomy.org as soon as possible.

kept me awake. Unfortunately the next night was completely overcast so no observations were possible on that night. After a partly cloudy day, the night of the Lyrid maximum cleared completely. As the skies cleared the wind also picked up, blowing dust and sand at times. The wind delayed the start of observations until 3 a.m. (10:00 UT). I was then able to view the meteor activity for an hour and 45 minutes. During that span I counted a total of 36 meteors with 13 of them belonging to the Lyrid shower. While there were no fireballs, there were still many bright meteors which were enjoyable to watch.

The observing session was cut short to view the lunar occultation of Venus. I had never seen one in dark skies and was eager to view and photograph the event. It was an impressive sight as the two bright objects approached each other. Being used to stellar occultations by the Moon, it seemed to take forever for the lunar crescent to cover the bright planet. The reappearance of Venus occurred near sunrise and was even more spectacular as a lunar mountain sliced the crescent of Venus in two before it fully emerged from behind the lunar disk. It was the perfect ending to a most enjoyable trip!

Visit the ALPO Meteors Section online at www.alpo-astronomy.org/meteor.

Meteorites Section

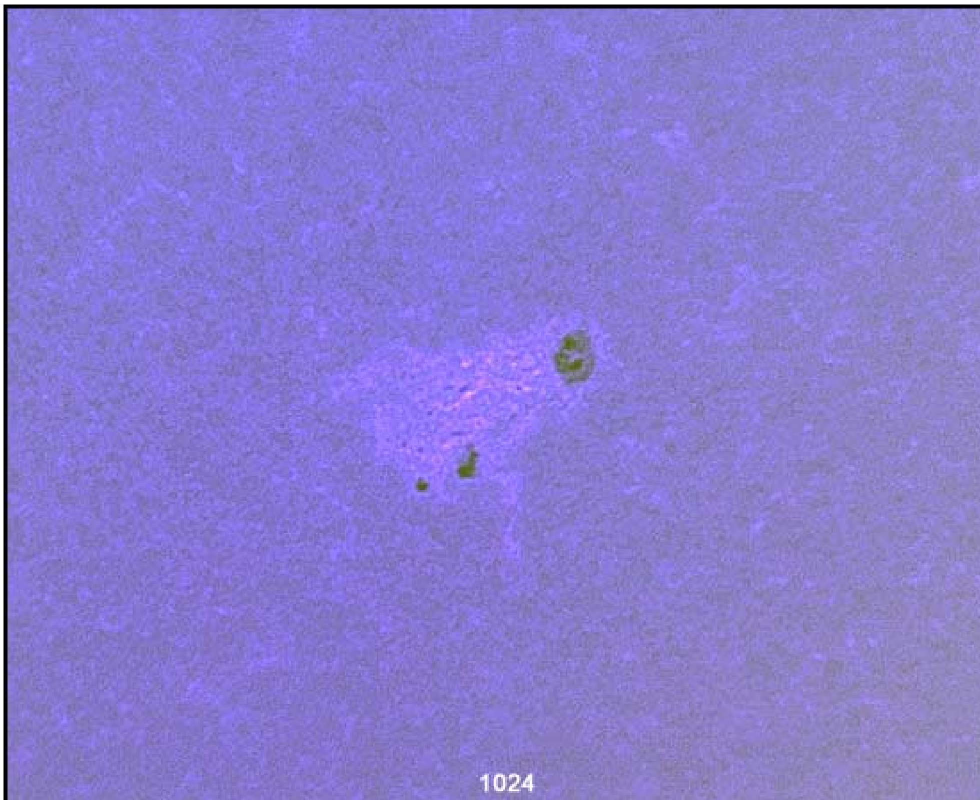
Dolores Hill, section coordinator
dhill@lpl.arizona.edu

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

Solar Section

Kim Hay, section coordinator,
kim@starlightcascade.ca

Over the last few months, the Sun has been spotless, but on July 4, 2009 solar observers observed Sunspot Number AR11024 which appeared during Carrington Rotation CR2085. See http://www.solar.ifa.hawaii.edu/ARMaps/Archive/2009/20090704.1632_armap.png and the NASA SOHO website http://sohowww.nascom.nasa.gov/sunspots/ .



Ca-K
Carrington Rotation Number: 2085, 2009 July 4, 13:31 UT
Altitude: 30°, Seeing: 3", Sky Condition: Clear, Wind: Calm
Telescope: Orion 80 ED Refractor, Equatorial Mount, Electric Drive
Aperture: 80mm, FL 600 mm, F/7.5, Solar Filter: Lunt B600 Calcium K-Line
Photo System: Orion StarShoot II Solar System Imager, 2X Barlow
Howard Eskildsen P.O. Box 830415, Ocala, FL 34483, Photo File # 090704CaKb
HowardEskildsen@msn.com
N E + W S

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This particular spot was from Solar Cycle 24 in which there were several class B flares detected by SOHO.

Several of our Solar Observers have submitted images of AR11024 in white light, h-alpha and the Calcium K line. Solar Observers around the world observed this active group for several days until its disappearance on July 12. During its presence, the highest Relative Sunspot Number in which this writer observed was 25. It may have been higher, but due to high clouds and haze, smaller spots may not have been viewed.

The July full count should now be available on the www.aavso.org/solarbulletin page and the Solar Influences Data Analysis Centre SIDC) http://www.sidc.be/products/ri_hemispheric/

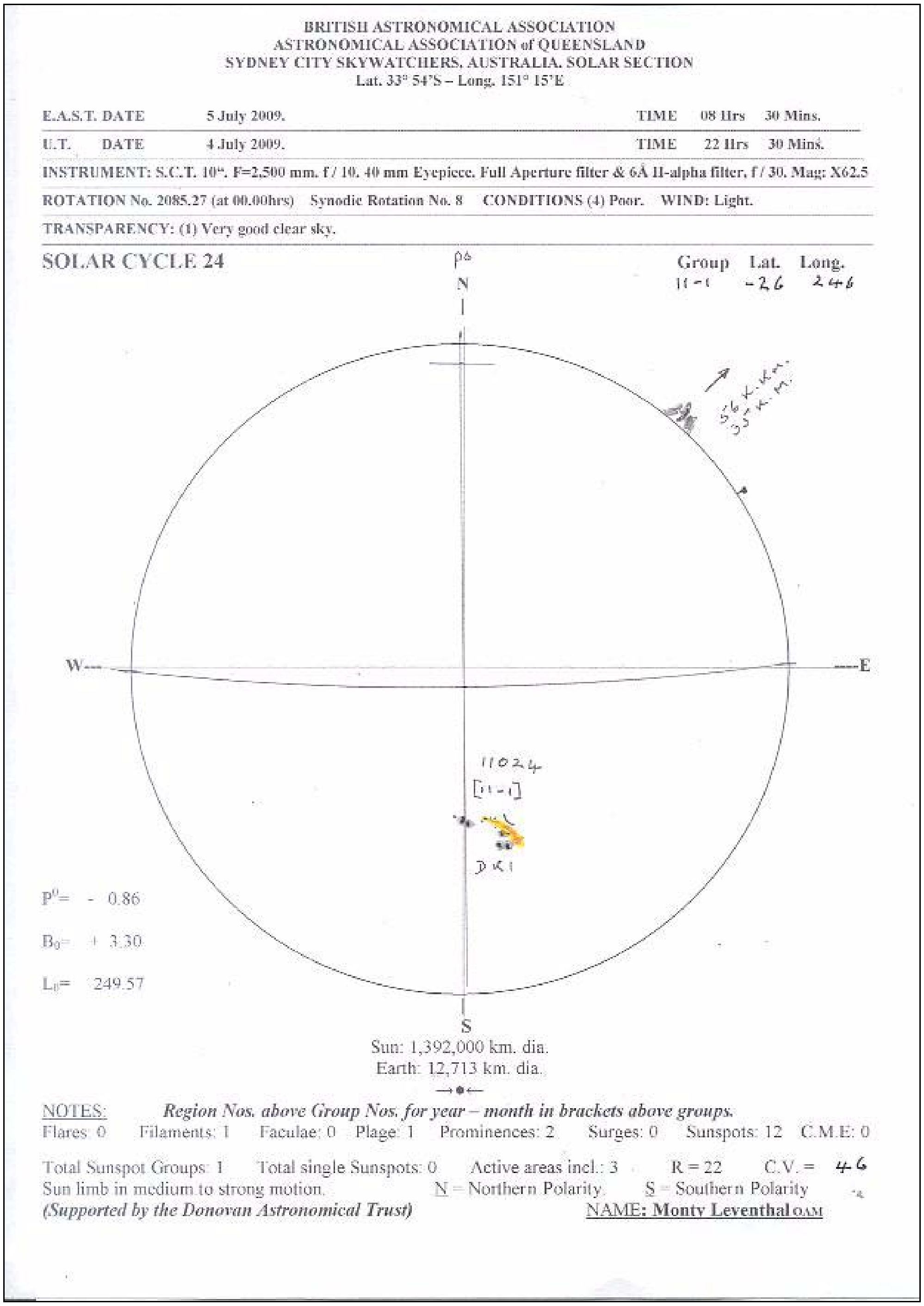
NOAA had stated that the Sun came out of the Cycle 23 in December 2008, but has not exhibited any real increase in sunspot activity. There have been some transition spots between old Cycle 23 and the new Cycle 24, but the activity still has remained low. NOAA has predicted Solar Cycle 24 will peak in May 2013 with a lower averaged sunspot number of 90. To read the full story of this item, see

http://www.spaceweather.com/headlines/y2009/08may_noaaprediction.php?PHPSESSID=617egek26qnhb30e6dico1gvj7

There are a few theories as to why the Sun may be void of spots. For instance, in "The Mystery of the Missing Sunspots" (at http://spaceweather.com), the story is that there may be a deep jet stream inside the Sun which may be hampering the production of sunspots.

Over the July 23-25 time period, there was some excitement as aurora activity appeared over Canada and the upper mid-western United States. This aurora was not predicted, but came from a k6 flare. There is a new area in the South Hemisphere that has shown up with magnetics of Cycle 24 activity, but to date, no sunspots have formed.

Over the next few months the ALPO Solar Section page will be undergoing some changes. Since the new webmaster (Larry Owens) has implemented the *Word Press* program feature, this coordinator will be implementing changes to bring this section up to speed on interaction with members and up-to-date information. We also have the Yahoo ALPO Solar e-mail


BRITISH ASTRONOMICAL ASSOCIATION
ASTRONOMICAL ASSOCIATION of QUEENSLAND
SYDNEY CITY SKYWATCHERS, AUSTRALIA. SOLAR SECTION
Lat. 33° 54'S – Long. 151° 15'E

E.A.S.T. DATE 5 July 2009. TIME 08 Hrs 30 Mins.
U.T. DATE 4 July 2009. TIME 22 Hrs 30 Mins.
INSTRUMENT: S.C.T. 10". F=2,500 mm. f / 10. 40 mm Eyepiece. Full Aperture filter & 6Å H-alpha filter, f / 30. Mag: X62.5
ROTATION No. 2085.27 (at 00.00hrs) Synodic Rotation No. 8 CONDITIONS (4) Poor. WIND: Light.
TRANSPARENCY: (1) Very good clear sky.

SOLAR CYCLE 24

Group	Lat.	Long.
11-1	-26	246

P⁰= - 0.86
B₀= + 3.30
L₀= 249.57

Sun: 1,392,000 km. dia.
Earth: 12,713 km. dia.

NOTES: *Region Nos. above Group Nos. for year – month in brackets above groups.*
Flares: 0 Filaments: 1 Faculae: 0 Plage: 1 Prominences: 2 Surges: 0 Sunspots: 12 C.M.E: 0

Total Sunspot Groups: 1 Total single Sunspots: 0 Active areas incl.: 3 R = 22 C.V. = 46
Sun limb in medium to strong motion. N = Northern Polarity S = Southern Polarity
(Supported by the Donovan Astronomical Trust) NAME: Monty Leventhal OAM

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list for day-to-day conversations and alerts.

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

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

Venus Section

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

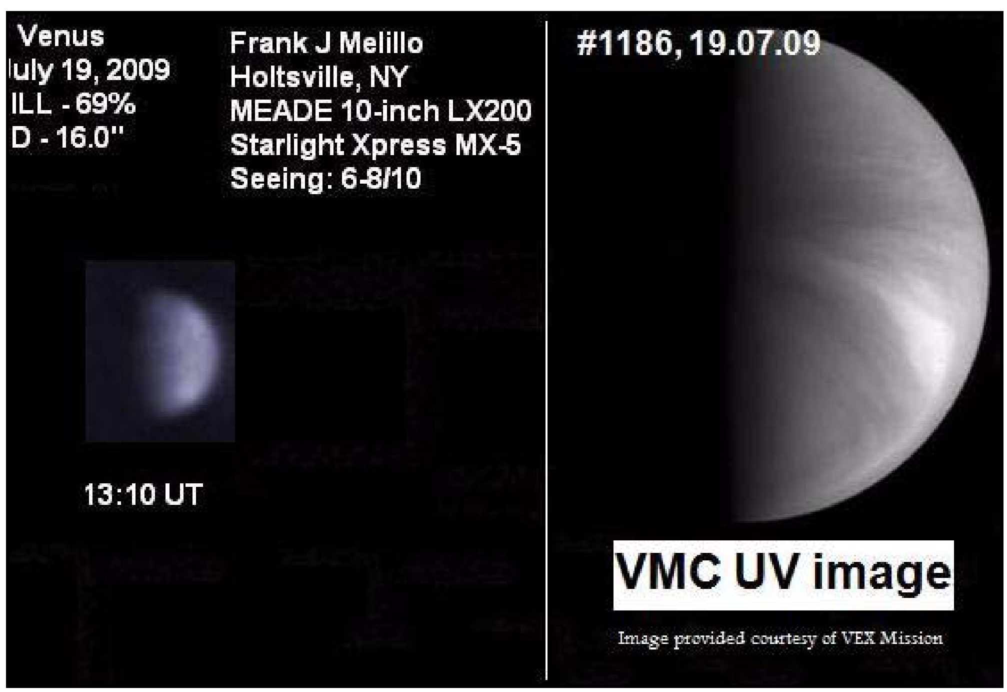
Venus remains visible in the Eastern sky before sunrise. During the current 2009-10 Western (Morning) Apparition, the planet passes through its waxing phases (a progression from crescent through gibbous phases). At the time of this report, the gibbous disk of Venus is about 14.9" across and 61.9% illuminated. Venus reached Greatest Illuminated Extent (greatest brilliancy) on May 2nd at visual magnitude -4.7, and attained Greatest Elongation West on June 5th, and theoretical dichotomy (half phase) on June 6th. During the 2009-10 Western (Morning) Apparition observers are seeing the trailing hemisphere of Venus at the time of sunrise on Earth. The accompanying table of Geocentric Phenomena in Universal Time (UT) is presented for observational planning purposes.

The Venus Express (VEX) mission started systematically monitoring Venus at UV, visible (IL) and IR wavelengths back in late May 2006, and as part of an organized Professional-Amateur (Pro-Am) effort, and a few ALPO Venus observers submitted high quality digital images of the planet taken in the near-UV and near-IR, as well as other wavelengths through polarizing filters.

Geocentric Phenomena of the 2009-10 Western (Morning) Apparition of Venus in Universal Time (UT)

Inferior Conjunction	2009	Mar 27 (angular diameter = 59.7 arc-seconds)
Greatest Brilliancy	2009	May 2 (m_V = – 4.7)
Greatest Elongation West	2009	Jun 05 (46º west of the Sun)
Predicted Dichotomy	2009	Jun 06.61 (exactly half-phase)
Superior Conjunction	2010	Jan 11 (angular diameter = 9.8 arc-seconds)

On July 19, 2009, Frank J. Melillo submitted a near-UV image of Venus taken at 13:10 UT showing a bright white feature near the planet's SE limb. An alert was sent to Sanjay Limaye on the VEX mission team, and it turned out that the VEX mission also imaged the same feature on July 19, confirming the images taken by Frank Melillo. At the time of the report, other observations of this feature have been arriving, and more details will be provided in the forthcoming apparition report for the 2009-10 Western (Morning) Apparition of Venus. In the meantime, while this near-simultaneous confirmation of a bright feature on Venus is a superb example of Pro-Am cooperation, such features are not considered rare. The ALPO Venus Section archives contain numerous images of similar white features on Venus exclusive of the cusp regions, but this is one of the first times that almost



Digital image of Venus by Frank Melillo of Holtsville, NY, taken July 19, 2009 at 13:10 UT, using a 25.4 cm (10.0 in.) SCT, UV and IR blocking filters. Image shows a bright white feature near the planet's SE limb, also confirmed by the VEX mission. S = 7, Tr = twilight sky. Apparent diameter of Venus is 16.1", phase (k) 0.674 or 67.4% illuminated, and visual magnitude -4.1. South is at top of image. VEX image of the same feature is also shown beside Melillo's image, courtesy of VEX Mission.

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simultaneous imaging by both amateur and professional astronomers has occurred. Observations of such features at various wavelengths, as well as any other atmospheric phenomena on Venus, should continue to be submitted in JPEG format to the ALPO Venus Section as well as to the VEX website at:

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

Routine observations of Venus are needed throughout the period that VEX is observing the planet, which continues in 2009-10 and a year or so afterwards. Since Venus has a high surface brightness, it is potentially observable anytime it is far enough from the Sun to be safely observed.

Key observational endeavors:

- Visual observations and drawings in dark, twilight, and daylight skies to look for atmospheric phenomena including dusky shadings and features associated with the cusps of Venus
- Visual photometry and colorimetry of atmospheric features and phenomena
- Monitoring the dark hemisphere for Ashen Light
- Observation of terminator geometry (monitoring any irregularities)
- Studies of Schröter's phase phenomenon near date of predicted dichotomy (A curious difference between the observed percentage of illumination and the actual geometric percentage when the planet is near greatest elongation from the Sun.)
- Routine digital imaging of Venus at visual, UV, and IR wavelengths
- Special efforts to accomplish simultaneous observations (observers are always encouraged to try to view and image Venus simultaneously; that is, as close to the same time and date as circumstances allow, which improves confidence in results and reduces subjectivity.
- Contribution of observation data and images to the Venus Express mission is encouraged

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

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Lunar Calendar, October thru December 2009 (all times U.T.)

Oct. 02	22:00	Moon 5.0 degrees NNW of Uranus
Oct. 04	06:11	Full Moon
Oct. 11	08:56	Last Quarter
Oct. 12	01:00	Moon 1.1 degrees SSW of Mars
Oct. 13	12:29	Moon at Perigee (369,067 km - 229,328 miles)
Oct. 16	07:00	Moon 6.4 degrees SSW of Saturn
Oct. 16	14:00	Moon 6.1 degrees SSW of Venus
Oct. 17	05:00	Moon 6.8 degrees SSW of Mercury
Oct. 18	05:32	New Moon (Start of Lunation 1074)
Oct. 25	23:19	Moon at Apogee (404,166 km - 251,137 miles)
Oct. 26	00:41	First Quarter
Oct. 27	06:00	Moon 3.0 degrees NNW of Jupiter
Oct. 27	19:00	Moon 2.9 degrees NNW of Neptune
Oct. 30	04:00	Moon 5.1 degrees NNW of Uranus
Nov. 02	19:14	Full Moon
Nov. 07	07:31	Moon at Perigee (368,899 km - 229,223miles)
Nov. 09	04:00	Moon 3.2 degrees SSW of Mars
Nov. 09	15:57	Last Quarter
Nov. 12	20:00	Moon 6.8 degrees SSW of Saturn
Nov. 15	16:00	Moon 6.1 degrees SSW of Venus
Nov. 16	19:13	New Moon (Start of Lunation 1075)
Nov. 17	10:00	Moon 2.8 degrees S of Mercury
Nov. 22	20:08	Moon at Apogee (404,734 km - 251,490 miles)
Nov. 23	19:00	Moon 3.4 degrees NNW of Jupiter
Nov. 24	03:00	Moon 3.1 degrees NNW of Neptune
Nov. 24	21:38	First Quarter
Nov. 26	13:00	Moon 5.2 degrees NNW of Uranus
Dec. 02	07:31	Full Moon
Dec. 04	14:13	Moon at Perigee (363,478 km - 225,855 miles)
Dec. 06	23:00	Moon 5.1 degrees SSW of Mars
Dec. 09	00:15	Last Quarter
Dec. 10	05:00	Moon 7.1 degrees SSW of Saturn
Dec. 15	23:00	Moon 3.1 degrees S of Venus
Dec. 16	12:02	New Moon (Start of Lunation 1076)
Dec. 18	07:00	Moon 1.4 degrees NNW of Mercury
Dec. 20	14:55	Moon at Apogee (405,730 km - 252,109 miles)
Dec. 21	12:00	Moon 3.8 degrees NNW of Jupiter
Dec. 21	12:00	Moon 3.3 degrees NNW of Neptune
Dec. 23	21:00	Moon 5.4 degrees NNW of Uranus
Dec. 24	17:35	First Quarter
Dec. 31	12:00	Full Moon (Partial Lunar Eclipse)

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

Lunar Section:

Lunar Topographical Studies / Selected Areas Program

Report by Wayne Bailey, acting program coordinator
wayne.bailey@alpo-astronomy.org

A report on the LCROSS mission to search for water on the Moon and a report on the Apollo 11 mission to the Moon both appear later in this issue of The Strolling Astronomer.

The NASA LRO/LCROSS (Lunar Reconnaissance Orbiter/Lunar CRater Observation and Sensing Satellite) was launched on June 26, 2009 and is now in lunar orbit. LCROSS is nominally scheduled to impact in the vicinity of the lunar south pole at 11:30 UT October 9, 2009. The impact time is optimized for observation from the western U.S. to Hawaii. Initial pictures from LRO have been posted, including images of the Apollo landing sites. The orbit is still being reduced towards the final operational orbit altitude of 50 km (31 miles) so the resolution will be even better in the future. LRO allows anyone to propose imaging targets, in addition to those scheduled by the mission science team. The public targets will be imaged when possible, probably towards the end of the mission. For more information see the June through August issues of The Lunar Observer or visit the following websites:

- LRO home page: *http://lro.gsfc.nasa.gov*
- Images, public target proposal & ephemeris *http://lroc.sesc.asu.edu* Images, (includes images, public target proposal & ephemeris)

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- http://lcross.arc.nasa.gov/observation.htm (LCROSS operations)
- http://www.nasa.gov/lcross (LCROSS mission page)

The Lunar Observer series on drawing techniques was well-received. In addition to numerous comments, sketches have been received from two new observers. "Focus On" articles on Mare Fecunditatis and the Triesnecker to Ariadaeus area were published in *The Lunar Observer*. Deslandre, Menelaus, and Atlas-Hercules were announced as the next topics for emphasis by observers.

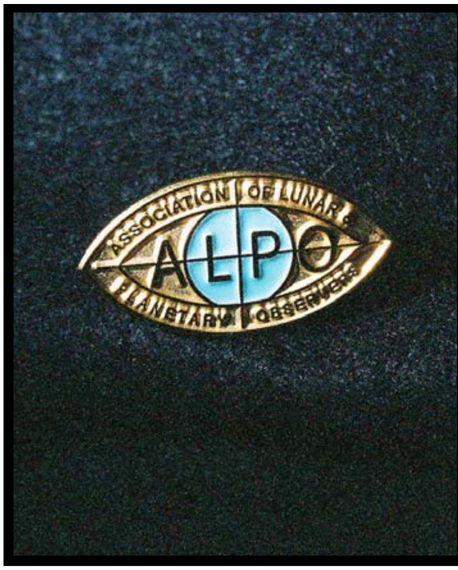
Visit the following online web sites for more info:

- The Moon-Wiki: http://the-moon.wikispaces.com/Introduction
- ALPO Lunar Topographical Studies Section http://moon.scopesandscapes.com/alpo-topo
- ALPO Lunar Selected Areas Program http://moon.scopesandscapes.com/alpo-sap.html
- ALPO Lunar Topographical Studies Smart-Impact WebPage http://moon.scopesandscapes.com/alpo-smartimpact
- The Lunar Observer (current issue) http://moon.scopesandscapes.com/tlo.pdf
- The Lunar Observer (back issues) http://moon.scopesandscapes.com/tlo_back.html
- Banded Craters Program http://moon.scopesandscapes.com/alpo-bcp.html

Lunar Domes Survey

Marvin Huddleston, FRAS, program coordinator
kc5lei@sbcglobal.net

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



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We ask all who are considering an online purchase of Orion astronomical merchandise to do so via this online method to support the ALPO.

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Lunar Transient Phenomena

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

Since the last ALPO-LTP program report, eight new LTPs have come to light. I am including weights on a scale of 1 (only a slight chance this was a LTP) to 5 (scientifically proven LTP) to show the relative merit of each report:

- 2009 Mar 31, 19:26-19:50 UT; Marie Cook (UK) observed Proclus to be bright in red (with some variations) and dull in blue (Weight=3).
- 2009 Apr 02, 20:00-20:30 UT; Clive Brook (UK) observed that Mare Crisium crossing rays of Proclus were brighter in red than in blue light. To a lesser extent a similar effect was seen south of the mare (Weight=2).
- 2009 Apr 04, 20:30-20:45 UT; Clive Brook (UK) observed a slight pinkish mottling on the floor of Plato that faded (Weight=3).
- 2009 Apr 04, 21:40 UT; Marie Cook (UK) observed that the floor patches in Plato looked slightly darker than normal in blue light than in red (Weight=2)
- 2009 Apr 05, 01:03-01:31, 01:44 and 02:30 UT; Jay Albert (FL, USA) noted a tiny point on the SE rim of Plato, adjacent to the east wall shadow – it was fainter in a blue than in red light. Due to observing conditions, though, and limits of detection, he did not regard this as a true LTP, but I mention this just in case any one else was observing.
- 2009 Apr 12, 00:00 UT; Clive Brook (UK) found that the rays of Proclus were more clearly seen through a rose/purple filter than through blue (Weight=1).
- 2009 May 03/04, 23:20-00:11 UT; Paul Abel (UK) found the NE wall of Tycho was slightly brighter and more blurred than expected; furthermore, it had a strong orange-brown color. Later part of the inner NW floor had a dull brown color (Weight=2).
- 2009 Jun 11,01:00-01:15 UT; Clive Brook (UK) observed fluctuations in the Brightness of Aristarchus (Weight=1).
- 2009 Jun 16, 03:20-03:40 UT; Phil Morgan (UK) observed a diffuse ashen light like effect over the shadow filled floor of Plato, the effect was lighter towards the south – no shadow spires seen (Weight=1).

Although not an LTP, on 2009 Jul 16 09:54 UT, Bob O'Connell (FL, USA) imaged a very bright spot beyond the terminator, near Lambert. Although spectacular, it was eventually realized that this was just a tall mountain with Sun-facing slope.

Further details about these reports, and general articles on LTP, can be found in *The Lunar Observer* newsletter published by the ALPO Lunar Section.

Visit the ALPO Lunar Transient Phenomena program online at

- *www.alpo-astronomy.org/lunar/ltp.html*
- *www.ltpresearch.org/*

Lunar Meteoritic Impact Search

Report by Brian Cudnik,
program coordinator
cudnik@sbcglobal.net

Those who are interested in making observations of the LCROSS impact are encouraged to contact me at *cudnik@sbcglobal.net* or visit the LMIS website at *http://www.alpo-astronomy.org*.

The impact is scheduled to occur at 11:30UT on October 9, 2009.

The LRO/LCROSS mission is described on this website:

http://www.nasa.gov/mission_pages/LCROSS/main/index.html

The projected date that the book *Lunar Meteoroid Impacts and How to Observe Them* (ISBN: 978-1-4419-0323-5) will be available is September 2009. The following website has more information on this book:

http://www.springer.com/astronomy/book/978-1-4419-0323-5

This book not only discusses possible lunar meteors, but also includes information about lunar craters and how to observe them. Crater information includes crater morphology versus size, morphology versus age, and other aspects to look for when observing lunar craters. Craters elsewhere in the solar system are also discussed. Finally the book gives practical guidelines for observing the phenomena with both visual and video means.

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

Mars Section

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

Mars is back! It's still small, in the eastern sky before dawn, but observers are already studying it eagerly. There have been two dust storms in the first week of August! One was at southern latitudes, extending from Argyre to Hellas, while the other was at equatorial latitudes, in Chryse and Xanthe. Figures 1 and 2 accompanying this report show what our observers have detected. Due to the incomplete coverage by observers, we are not sure where or on what day they started, and as of this writing, we are not sure whether they are continuing. We need *your* observations, too, to monitor such storms! Both of these storms were

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documented by the Mars Reconnaissance Orbiter's Color Imager camera, which is usually called MARCI. You can see the weekly MARCI movie at http://www.msss.com/msss_images/latest_weather.html .

Don't forget that we are particularly excited about ascertaining the visibility of the North Polar Cap through the thinning North Polar Hood in September and October. This was discussed in the article, "First Detections of the North Polar Cap of Mars in 2007: a Continuing Conundrum" (p. 29, JALPO 50-4, Autumn 2008). Can you see irregularities in brightness in the NPH or NPC? We expect to see clouds from time to time at all Martian latitudes for the rest of 2009. Also, we'll be measuring the North Polar Cap as it shrinks, from October 2009 to April 2010. This will be done by measuring images -- as far as we know, nobody is using a micrometer any longer.

Join us online in the Yahoo discussion group at http://tech.groups.yahoo.com/group/marsobservers . There you can discuss what your see or image, ask for advice, and upload your images and drawings for others to see.

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

Minor Planets Section

Report by Frederick Pilcher, section coordinator
pilcher@ic.edu

John Reed's ephemeris program for all Sun-orbiting objects, with the Minor Planet Center's catalog of minor planet orbits and other related programs, is now available for download and off-line computation. The direct link for the download of the 80 megabyte zipped file is http://www.alpo-astronomy.org/minor/eph/Eph.zip and for the documentation, http://www.alpo-astronomy.org/minor/eph_doc.html.

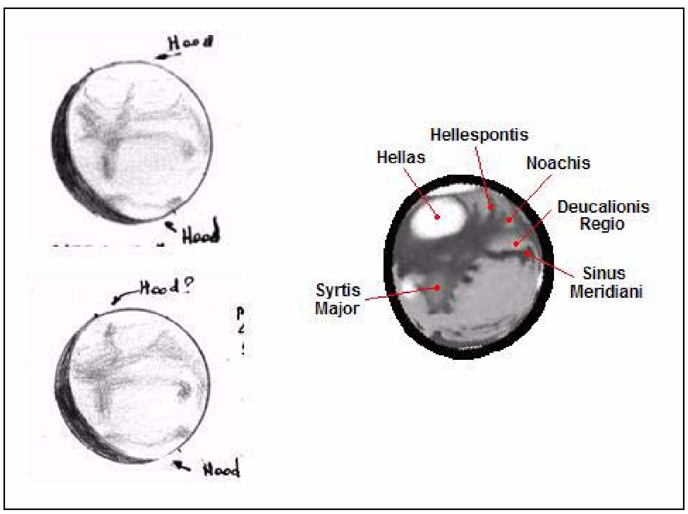

Figure 1. Mars drawings made by Stanislaw Maksymowicz of Ecquevilly, France, on August 6, 2009. Mars was only 5.4 arc seconds in apparent diameter at the time. On the right is a simulation with labels indicating the main features identified. He found Hellas to be bright, which is its usual appearance, but Hellespontis and Noachis were as bright as Hellas, which is not normal and suggests that these areas are covered with bright dust. He also found Deucalionis to be bright, though he drew Noachis at its normal medium intensity. This suggests that there is dust in Deucalionis but that it has settled out of Noachis. The southwest (upper right) limb is bright, and he described it as white. There may be clouds, frost or a mixture of clouds and dust there. Note that both polar hoods are seen. Image details: both were made with a 15 cm (6 in.) Cassegrain telescope at 357x magnifications, the top one with a Wratten 11 (pale yellow-green) filter at 02:55 UT, with seeing 5 to 7 on the ALPO scale; and the bottom with a Wratten 80A (pale blue) filter one at 03:20 UT, with seeing 5 to 6. The CM in the top image is 301°, in the bottom image it is 308°, and in the simulation it is 304°.

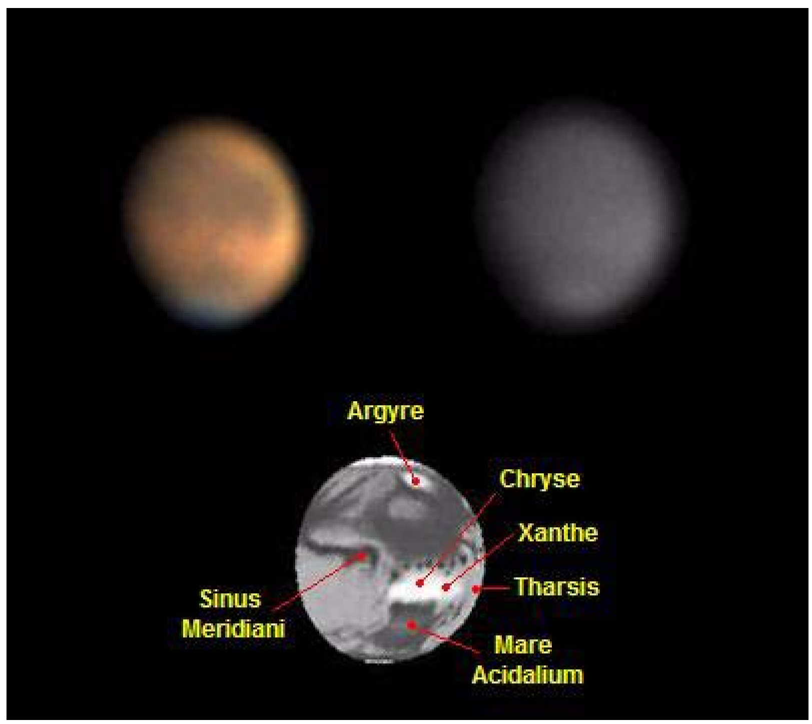

Figure 2. Mars images made by Rolf Meier of Ottawa, Canada, on August 8, 2009, at 9:07 UT, with Mars at an apparent diameter of 5.4 arc seconds. South is up and planetary east is to the left. The upper-left image is a composite of three monochromatic images in red, green, and blue; the upper-right image is his blue image. Argyre and its surroundings are always somewhat bright, but they appear brighter here than usual, suggesting residual dust in that region. Chryse and Xanthe are covered with a bright dust storm, and this dust obscures the southwest (upper right) tip of Mare Acidalium, an area called Niliacus Lacus and Nilokeras. It extends westward perhaps to Tharsis on the limb. Image details: 14 in. (35.5 cm) Schmidt Cassegrain telescope at *f*/37, with Astronomic RGB filters; SkyNyx 2.0M camera; central meridian 13 degrees.

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We congratulate Brian D. Warner, interim editor of the Minor Planet Bulletin and himself a back yard astronomer, as being the first author of “The Asteroid lightcurve database” in *Icarus*, the International Journal of the Solar System, Vol. 202, pp. 134-146, July 2009.

Minor Planet Bulletin Volume 36, No. 3, 2009 July-September, publishes the following highlights. Occultations of stars in 2008 by three asteroids produced more than 20 chords each and show somewhat irregular outlines with maximum and minimum dimensions: 9 Metis 176x161 km, 19 Fortuna 230x194 km, and 135 Hertha 101x59 km. A lightcurve was also made of 135 Hertha showing the phase of the lightcurve at the time of occultation.

Hungaria-type asteroids 3309 Brorfelde and 5905 Johnson were both observed to be binaries at a second opposition which further refined the physical parameters of the system. For 3309 Brorfelde the primary rotation period is 2.5046 hours, orbit period 18.45 hours, ratio of secondary to primary diameters Ds/Dp = 0.26, with the secondary apparently tidally locked in its orbit. For 5905 Johnson the primary rotation period is 3.7824 hours, orbital period 21.78 hours, Ds/Dp = 0.40.

New lightcurves and rotation periods have been published for 124 other asteroids. Some of these are new determinations, with some secure and others still provisional, some are improvements on previous determinations, and some are of objects with secure periods to aid the determination of spin/shape models. The asteroids for which these data have been obtained are 29, 40, 91, 100, 107, 120, 129, 131, 157, 174, 232, 261, 271, 291,343, 358, 359, 402, 494, 497,506, 556, 566, 618, 624, 654, 657, 660, 691, 718, 731, 734, 779, 802, 823, 908, 946, 1015, 1032, 1041, 1111, 1125, 1129, 1188, 1235, 1254, 1376, 1406, 1428, 1518, 1595, 1600, 1620, 1655, 1656, 1666, 1732, 1792, 2000, 2294, 2320, 2358, 2509, 2617, 2660, 2678, 2679, 2735, 2785, 2829, 2857, 3169, 3416, 3453, 3854, 3928, 3940, 4058, 4440, 4606, 4758, 4935, 4959, 5385, 5558, 5587, 5747, 5855, 6247, 6352, 6517, 6685, 6801, 7131, 7818, 8356, 9000, 11304, 16528, 16556, 16773, 17010, 17079, 22195, 22600, 23255, 26383, 29780, 31017, 45878, 45898, 53430, 58605, 68181, 76800, 76929, 87343, 92498, 192692, 194386, 207398, 2006 VV2, 2008 BT18, 2008 EV5. Hungaria-type asteroid 1235 Schorria has one of the slowest rotations known, 1265 +/- 80 hours.

We remind all users and inquirers that the *Minor Planet Bulletin* is a refereed publication and that it is available on line at *www.minorplanetobserver.com/mpb/default.htm*.

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

Jupiter Section

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

A report on the Jupiter apparition of 2005-2006 appears later in this issue of The Strolling Astronomer.

Anthony Wesley has discovered a dark spot in Jupiter’s southern hemisphere. From July 19 images, I computed a latitude of (56.5 ± 0.5)° S and a system II longitude of 217° W for this feature. At least one professional astronomer reports that a large amount of heat was associated with this spot. This is consistent with this dark area being the remnant of an impact. John Rogers, coordinator of the British Astronomical Association Jupiter Section, reports that the dark spot was not on Rich Jakiel’s July 19 image taken at 7:40 UT. At that time, the CM was 271°, and the impact spot position was 54 degrees past the CM. Anthony Wesley reports that it was first seen on July 19 at 13:30 UT. Therefore the impact took place sometime on July 19. The impacting object was either a comet or an asteroid. It may have been about a half of a mile across. People are encouraged to continue observing Jupiter.

On another note, I am nearly finished with a book about comets. Once I send this book off, I will again concentrate on the ALPO Jupiter and Remote Planets sections. Please keep sending me your images and observations.

Again, I would like to remind everyone that John McAnally's book, *Jupiter and How to Observe It* is available from Springer. Just go to the Springer website to order this book.

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

Galilean Satellite Eclipse Timing Program

John Westfall, assistant Jupiter section coordinator
johnwestfall@comcast.net

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

Contact John Westfall via regular mail at P.O. Box 2447, Antioch, CA 94531-2447 USA or e-mail to *johnwestfall@comcast.net* to obtain an observer’s kit.

Saturn Section

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

Saturn passed opposition back on March 8, 2009, and is now situated in the constellation of Leo rapidly approaching edgewise orientation of the rings on September 4th when the rings will be 0° to our line of sight from Earth, followed by conjunction with the Sun on September 17th. Unfortunately, the planet will be too close to the Sun for observations of the actual edgewise ring presentations. As of

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this writing, over 500 observations and images have been contributed, and quite a number of observers have imaged small white spots in the SEBZ and EZn, dusky features along the SEB, along with transits of Saturn's brighter satellites that lie close to the ring plane. Geocentric phenomena for 2008-09 are presented below for the convenience of observers:

Geocentric Phenomena for the 2008-2009 Apparition of Saturn in Universal Time (UT)	
Conjunction	2008 Sep 04^d UT
Opposition	2009 Mar 08^d
Sun passes thru the Ring Plane S --> N	2009 Aug 10^d (edgewise to Sun)
Earth passes thru the Ring Plane S --> N	2009 Sep 04^d (edgewise to Earth)
Conjunction	2009 Sep 17^d
Opposition Data:	
Equatorial Diameter Globe	19.8 arc-seconds
Polar Diameter Globe	17.9 arc-seconds
Major Axis of Rings	44.9 arc-seconds
Minor Axis of Rings	2.0 arc-seconds
Visual Magnitude (m_v)	0.5 m_v (in Leo)
B =	–2.5°

Geocentric Phenomena for the 2009-2010 Apparition of Saturn in Universal Time (UT)	
Conjunction	2009 Sep 17^d
Opposition	2010 Mar 21^d
Conjunction	2010 Oct 01^d
Opposition Data:	
Equatorial Diameter Globe	15.7 arc-seconds
Polar Diameter Globe	14.0 arc-seconds
Major Axis of Rings	35.6 arc-seconds
Minor Axis of Rings	4.2 arc-seconds
Visual Magnitude (m_v)	0.9 m_v (in Leo)
B =	+6.4°

Since the last edge-on orientation of the rings back in 1995, the southern hemisphere and south face of the rings have been inclined toward Earth, but once the Sun and Earth pass through the ring plane headed northward (August and September 2009, respectively), the northern hemisphere and north face of the rings will become increasingly visible for over a decade.

The next apparition of Saturn begins with the planet emerging from the solar glare in early October, for which the following geocentric phenomena for 2009-10 are offered for planning upcoming observations:

At edgewise presentations, equal portions of the southern and northern hemisphere are visible, separated by the ring plane. Since the ring passages this year of the Earth and Sun through Saturn's ring plane occurs so close to conjunction of the planet with the Sun, observations with be highly unfavorable. Nevertheless, at times of edgewise orientation of Saturn's rings, observers will want to see how close to the theoretical edge-on positions the rings can be seen or imaged with different apertures.

For the 2008-09, as well as the 2009-10 observing season, small inclinations of the plane of the rings allow observers to witness transits, shadow transits, occultations, and eclipses of satellites lying near Saturn's equatorial plane. Apertures under about 20.3 cm (8.0 in.) are usually unable to produce the best views of these events, except perhaps in the case of Titan. It will be interesting to see what imaging with various instruments produces, since controversy exists as to whether shadow transits of any of the satellites other than Titan are visible from Earth with large instruments.

Nearly all of the satellites are presumed to be too small to cast umbral shadows onto the globe of the planet Saturn. Those individuals who can image and obtain precise timings (in UT) to the nearest second of ingress, CM passage, and egress of a satellite or its shadow across the globe of the planet at or near edgewise presentations of the rings should send their data to the ALPO Saturn Section as quickly as possible.

Notes should be made of the belt or zone on the planet crossed by the shadow or satellite, and visual numerical relative intensity estimates of the satellite, its shadow, and the belt or zone it is in front of is important, as well as drawings of the immediate area at a given time during the event.

In addition to observing and imaging phenomena specific to edge-on ring presentations, the following are important activities for ALPO Saturn observers and include Pro-Am opportunities in support of the ongoing Cassini mission:

- Visual numerical relative intensity estimates of belts, zones, and ring components.

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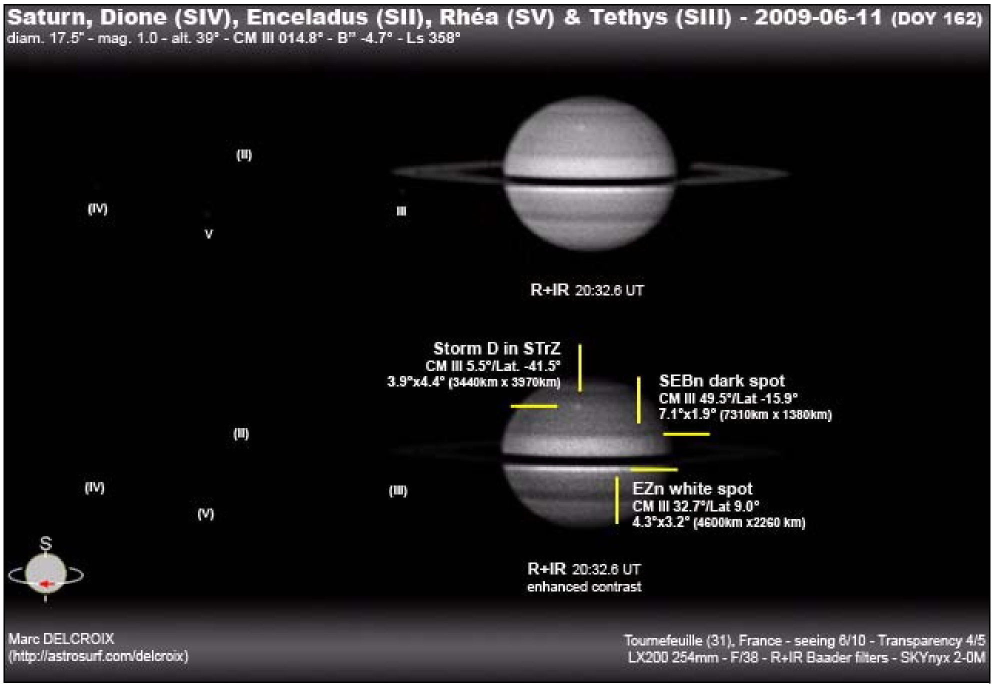
- Full-disc drawings of the globe and rings using standard ALPO observing forms.
- Central meridian (CM) transit timings of details in belts and zones on Saturn's globe.
- Latitude estimates or filar micrometer measurements of belts and zones on Saturn.
- Colorimetry and absolute color estimates of globe and ring features.
- Observation of “intensity minima” in the rings plus studies of Cassini's, Encke's, and Keeler's divisions.
- Systematic color filter observations of the bicolored aspect of the rings and azimuthal brightness asymmetries around the circumference of Ring A.
- Observations of stellar occultations by Saturn's globe and rings.
- Visual observations and magnitude estimates of Saturn's satellites.
- Multi-color photometry and spectroscopy of Titan at 940nm - 1000nm.
- Imaging Saturn using a 890nm narrow band methane (CH4) filter with apertures of 31.8 cm (12.5 in.) or larger to alert the Cassini team of interesting large-scale targets and suspected changes in belt and zone reflectivity.
- Regular digital imaging of Saturn and its satellites.

Observers are urged to carry out digital imaging of Saturn at the same time that others are imaging or visually watching Saturn (i.e., simultaneous observations). All observers should compare what can be seen visually with what is apparent on their images, without overlooking opportunities to make visual numerical intensity estimates using techniques as described in the author's new book, *Saturn and How to Observe It* (available from Springer, Amazon.com, etc.). Although regular imaging of Saturn is extremely important and encouraged, far too many experienced observers have neglected making intensity estimates, which are badly needed for a continuing comparative analysis of belt, zone, and ring component brightness variations over time, so this type of visual work is strongly encouraged before or after imaging the planet.



Images of Saturn taken on June 11, 2009 at 20:32 UT by Marc Delcroix of Tournefeuille, France, showing multiple features on Saturn at R + IR wavelengths, as well as several satellites, using a 25.4cm (10.0in) SCT. S is at the top of the image. Ring tilt is -4.7º. CMI = 215.3°, CMII = 280.4°, CMIII = 14.8°. Seeing = 6, Transparency = 4.

The ALPO Saturn Section appreciates the work of so many dedicated observers. The ALPO Saturn Section is grateful for the hard work of so many dedicated observers who faithfully submit observations and images, prompting more and more professional astronomers to request drawings, digital images, and supporting data from amateur observers around the globe.

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@gdn.edu

The planet Neptune is very close to Jupiter. Interestingly it was also close to Jupiter nearly 400 years ago. Galileo was the first person to observe Neptune through the telescope, but did not recognize Neptune as a new planet.

Uranus and Neptune will reach opposition in August and September respectively, and will be well-placed in the sky in September. I ask for all of you to continue to reporting brightness estimates of these planets and their brighter moons. We now have several years of brightness measurements of Uranus' moons Titania, Oberon, Ariel and Umbriel. Please keep up the good work.

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

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

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Orion® StarShoot™ Planetary Imager & AutoGuider

The Orion StarShoot Planetary Imager & Autoguider is the first dual-purpose camera of its kind from Orion! Powered by a 1/3" format Aptina MT9V032 Color CMOS chip, with a 752x480 pixel layout, the "SSPIAG" boasts an incredibly fast frame rate (up to 50 frames per second), allowing you to catch those split-second windows of atmospheric clarity during your planetary imaging sessions. In fact, raw image frames are processed so quickly it's like watching a video feed! The imager's progressive scan readout delivers every pixel of every exposure. Due to its amazing speed, the SSPIAG is ideal for imaging time-sensitive celestial events such as Moon occultations, solar and lunar eclipses, Space Station flybys and more.

The StarShoot Planetary Imager comes with intuitive PHD Planetary software, to give you full control over image capture, stacking, basic processing and file export. In addition, the camera's internal processing features allow you to boost dynamic range and gain, apply noise reduction and more. The camera's 1.25" removable nosepiece has been threaded for use with Orion filters.

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Mars Globe from Sky & Telescope

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Feature Story:
ALPO Board Meeting Minutes, August 7, 2009 Long Island, New York

Minutes provided by Matt Will, ALPO Secretary / Treasurer

(All photos courtesy of Mike Mattei and Beth and John Westfall as indicated)

On August 7, 2009, at 2:40 p.m. EDT (Eastern Daylight Time), ALPO Executive Director and Board Chairman, Michael D. Reynolds called the ALPO Board to order at Hofstra University in Hempstead, New York, located on New York's Long Island.

Present Board Members

This Board meeting was an historic first for the ALPO. The only Board members present at this year's ALCon were Mike Reynolds (Chairman), Richard Schmude, and John Westfall. In an effort to meet our own requirement for having a quorum composed of a majority of Board members at our required annual business meeting, Matt Will arranged with AT&T for a teleconference line for Board members to participate in the business meeting who could not be at the ALCon in person. ALPO Board members on the call included, Julius Benton in Savannah, Georgia, Walter Haas in Las Cruces, New Mexico, Don Parker in Coral Gables, Florida, Ken Poshedly in Atlanta, Georgia, and Matt Will in Springfield, Illinois. Board member Sanjay Limaye could not make the call.

Figure 1. ALPO Mercury Section Coordinator Frank Melillo and John Boudreau discuss Mercury imaging. (Photo by Mike Mattei).

Issue One: Approval of the Board Meeting Minutes of 2008 (Introduced by Matthew Will)

Board meeting minutes for our 2008 ALPO Board meeting were approved by all the present Board members.

Issue Two: Location for the ALPO to Convene in 2010 (Introduced by Mike Reynolds)

Executive Director Mike Reynolds lead the discussion concerning the next year's convention and its location. The Astronomical League has abandoned meeting in Denver, Colorado, next year and decided to meet in Tucson, Arizona, in 2010. The meeting dates for this ALCon may conflict with a total solar eclipse two Board members and other ALPO members may attend on July 11, 2010. Mike Reynolds suggested that he could certainly host an ALPO convention in his hometown of Jacksonville next year. In this instance, the ALPO would be meeting by themselves without any other organizations involved. The ALPO does occasionally hold its own conventions to focus on Solar System topics solely, without the distraction of other ongoing paper sessions about other astronomical topics and other presentations and events. What used to be a rarity (ALPO-only conventions) have been held every three or four years since the 1990s. Having done the past three conventions jointly with other groups, we're just about due again to have an ALPO-only convention. It was the Board's consensus that Jacksonville was the obvious choice. The formal motion for the selection wasn't made until the end of the meeting, by Richard Schmude with Ken Poshedly seconding. The vote was 8 to 0 in favor of Jacksonville. John Westfall had suggested a meeting with the Division of Planetary Sciences of the American Astronomical Society, which might be a great opportunity to network with the pros. Unfortunately, this group meets at a time of year when it would be difficult for most members to break away. Meetings with the DPS/AAS generally occur annually in October. John Westfall also said that the Solar Eclipse Mail List (SEML) group might be conducting a meeting on their own in 2011 in lieu of observing a total solar eclipse since none are to occur that year. This would be an occasion to make ourselves known to another group. No action was taken on the selection for a 2011 convention site.

Issue Three: Membership and Finances (Introduced by Matthew Will)

ALPO Secretary and Treasurer Matthew Will, reported to the ALPO Board the ALPO's finances for the preceding year in the annual report submitted to the Board last February. An interim report concerning this year's activities was issued last month. The ALPO has $3,505.22 in the Springfield account and $3,060.15 in the Las Cruces account, as of June 30, 2009. The current value of the ALPO Endowment is $24,670.61 as of June 30, 2009.

The ALPO membership has maintained a remarkably stable membership count of 446 members with the release of this summer's issue of the Journal. The online payment options are being utilized at the same level of activity as in the past. The ALPO is still getting a steady stream of new members as in the past year. For the

Figure 2. The ALPO exhibit, provided by Matthew Will and set up by Frank Melillo. (Photo by John Westfall)

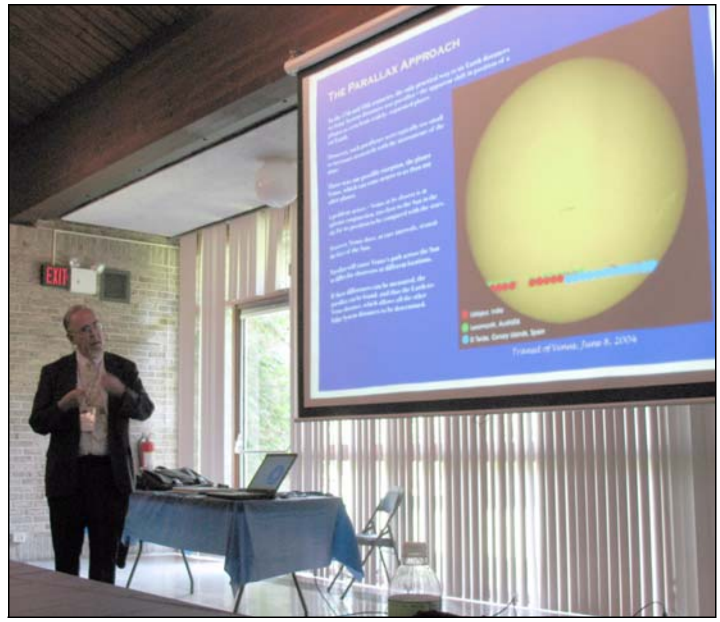

Figure 3. John Westfall, coordinator of the ALPO Mercury/Venus Transit Section, speaking on errors involved in timing the limb contacts during the 2004 transit of Venus. (Photo by Beth Westfall)

most part, the finances are currently stable. The new printer for the Journal, Sheridan Press, has helped in maintaining the cost of printing and mailing the hard copy version of the Journal at reasonable levels. So far, the ALPO has fared better than anticipated in these challenging economic times.

For the first time, more members are now receiving the digital version of the Journal than the hard copy version. This is particularly true with more longtime members switching to the digital version of the Journal as well.

Issue Four: Staff Changes (General Board Discussion)

Recently, Matthew Will has sought help in regard to his work as Secretary and Treasurer of the ALPO. Matt has conducted some interviews with ALPO members interested in providing assistance to the ALPO involving matters in promoting the ALPO or support in other areas where the member's expertise would be of some value. These conversations have proven productive. Matt will be following up with these individuals to help with certain "overflow" work that Matt has little time for, yet needs to be done.

The ALPO Board reviewed acting staff appointments for possible promotion to permanent status. The Board voted to promote the following staff from acting to permanent status.

- Larry Owens, webmaster
- Jim Melka, assistant coordinator, Mars Section

Don Parker made a motion to approve the appointments and Julius Benton seconded. The Board approved the appointments 6 to 0, with John Westfall and Richard Schmude not present at the time.

Larry Owens will remain as an acting coordinator for the Computing Section. No new staff positions or sections were provisionally created during this meeting.

Some concern was raised regarding staff that have not renewed their memberships. As the ALPO Staff Guidelines have stated, membership is a requirement for staff. More than simply needing the money to pay for production of the Journal, staff should endorse and encourage others interested in the ALPO to become members by example. After some discussion, Ken Poshedly made a motion to place an announcement in the next issue of the Journal addressing this issue. The announcement reads as follows:

Effective immediately, staff members that do not answered a third renewal notice for membership renewal within one month of reception of that renewal notice will be subject to removal from the ALPO Staff by the ALPO Board. As the ALPO Staff Guidelines have stated, membership is a requirement for serving on the staff of the ALPO. More than simply needing the money to support production of the Journal ALPO, staff should endorse and encourage others interested in the ALPO to become members by example. The vast majority of staff members do renew on the first or second renewal notice and this is greatly appreciated. The ALPO Board thanks everyone for their faithful interest and support of the ALPO.

The motion was seconded by Matt Will and the motion carried 6 to 0. John Westfall and Richard Schmude were not on the call at the time.

Issue Five: Board Meeting Attendance (Introduced by John Westfall)

John Westfall discussed problems with Board attendance at the last few conventions. At this convention, only

Figure 4. Group photograph of some convention attendees. From left to right: Sean Walker, John Boudreau, David Levy (red shirt), John Westfall, Stewart Parker, Roger Venable, Richard Schmude, (Thomas Jefferson statue), Beth Westfall, Mike Reynolds, Wayne Bailey, Frank Melillo, and Mike Mattei. Many thanks to Frank Melillo for organizing the ALPO portion of the conference. (Photo by John Westfall)

three board members could attend. John said that if older Board members could not attend the business meetings with some regularity that they might consider giving up their Board seats to someone younger that could. John said that Board members should consider possible replacements in the future because we are all getting older and may in the future consider travel to these conventions as not being practical for personal reasons.

Issue Six: PATS Invitation (Introduced by Mike Reynolds)

PATS, the Pacific Astronomy and Telescope Show, is an international conference/exhibition/convention/ workshop for amateur astronomers. RMTC, Inc., the conference organizer, will be bringing together dozens of exhibitors, clubs, and presenters together at the Convention Center in Pasadena, California. The ALPO has been invited to give a talk at this event. Mike Reynolds has agreed to represent the ALPO at the PATS conference by giving a talk about our organization. Matt Will has agreed to provide some extra materials for distribution at PATS for Mike prior to his talk.

In further discussions concerning membership applications and renewal forms, Ken Poshedly requested that Matt Will review membership application and renewal forms to encourage members to write about themselves, their interest, professional and personal background, and their possible interest in helping out the ALPO. Matt said that the renewal forms invite members to talk about themselves more and that the online membership application probably should be reviewed to welcome members to include this information too.

Issue Seven: New Officers (Introduced by John Westfall)

In accordance with a long-standing agreement with the Board members the rotation for the positions of Executive Director and Associate Executive Director continue. Richard Schmude will become our new Executive Director for the next two years and Julius Benton will be the new Associate Executive Director. Matthew Will continues on as both Secretary and Treasurer. John Westfall made a motion to affirm the approval of these proposed officers serving for the next two years and Walter Haas seconded the motion. The vote was affirmative, 8 to 0.

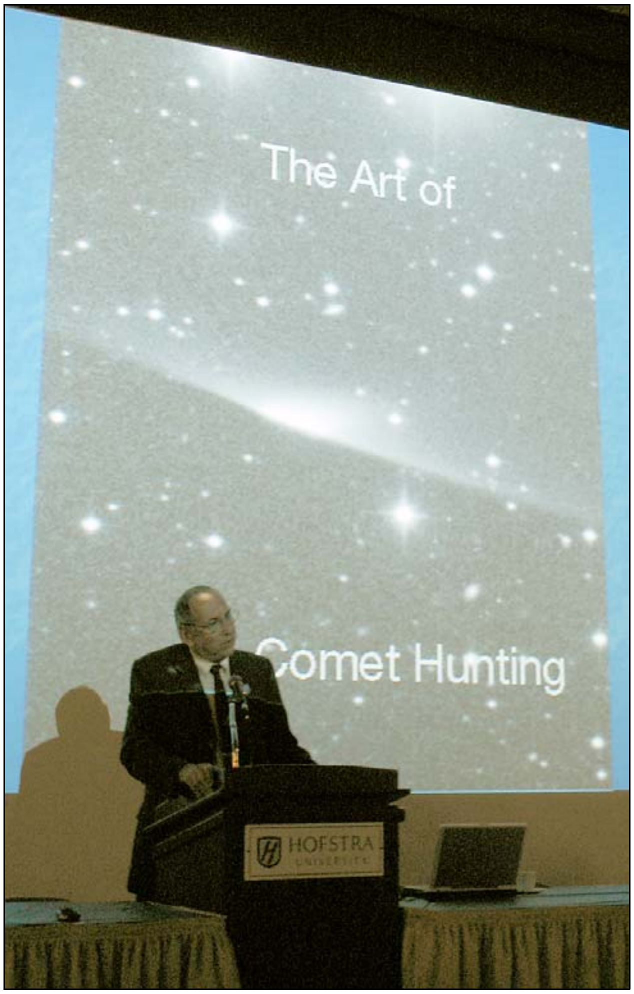

Figure 5. Author and long-term comet hunter David H. Levy delivering the banquet address. Behind him is an image of Comet Shoemaker-Levy 9, on its way to impact Jupiter in 1994. *(Photo by John Westfall)*

Issue Eight: Other New Business (Introduced by Mike Reynolds)

ALPO Journal (Introduced by Mike Reynolds)

Mike Reynolds complemented Ken Poshedly for the outstanding job that Ken has performed in editing the Journal. Likewise, other Board members chimed in on their appreciation for Ken's work. Ken thanked the Board and said that it was his intent to continue keeping the Journal primarily as an "observers" journal. He also wants the staff coordinators to continue their focus on supplying the Journal with a steady diet of interim reports and apparition/section reports without which, there would be no Journal.

ALPO Web Site (Introduced by Matt Will)

Matthew Will discussed some continual problems with the ALPO section web pages. Matt noted that while some section pages do an outstanding job of providing valuable content and keeping up-to-date, other section sites needed to be cleaned up and to have erroneous or outdated information removed. This includes names and addresses of past staff no longer working for the sections, outdated material, and dead links. Both Matt Will and Ken Poshedly will work with Larry Owens, the web site coordinator, to correct what can be easily corrected, and then work with the coordinators whose sites are privately managed as a link to the main server, to make corrections as well.

Office Space at Yerkes Science Center (Introduced by Matthew Will)

At last year's business meeting, Matt Will opened a discussion regarding the ALPO's possible participation in the proposed Yerkes Science Center, to be developed in place of the soon to be abandoned Yerkes Observatory. Yerkes Observatory and its surrounding grounds are being relinquished by its current owner and property manager, the University of Chicago. While the land around the observatory for the most part is being sold to a real estate developer, the actual offices and observatory are being considered for redevelopment as principally, an educational science center. It was agreed that some attempt should be made to contact the persons involved in managing the proposed science center. Unfortunately, initial attempts have failed and the status of Yerkes is presently unknown. The web site for the Yerkes Study Group (the commission with the responsibility for developing the concept of a science center) has not announced any developments since they issued their last report on the matter in December 2007. The ALPO would be interested in the possibility of obtaining storage space at Yerkes for its observational and educational collections with possible expansion into operational offices in the future. Many educational organizations are planning to have a presence there, so this poses a unique opportunity for the ALPO to not only have an established storage/future office site, but to coexist with other educational organizations on the same site that share a common interest. Don Parker has agreed to talk to his contacts in the Great Lakes region to find out if anything has changed with the science center concept or if this project has been terminated.

(Special Note: Since the Board meeting, it has been learned that surrounding land around Yerkes Observatory will not be developed as a residential community. Yerkes and the real estate neighboring the observatory will continue to be maintained by the University of Chicago. Plans for the proposed science center have been shelved.)

With no new business to conduct John Westfall made a motion to adjourn the Board meeting. Don Parker seconded. The motion passed 8 to 0, and the Board meeting adjourning at 4:20 p.m. EDT on August 7, 2009.

Figure 6. Acting Coordinator of the ALPO Lunar Topographical Studies Program Wayne Bailey during his presentation on banded craters on the Moon. (Photo by Mike Mattei)

Feature Story:
Lunar CRater Observation and Sensing Satellite (LCROSS) Searches for Lunar Water

By Wayne Bailey,
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Online Features

Left-click your mouse on the author’s e-mail addresses in blue text to contact the author of this article.

(Editor’s Note: Due to the tardy release date of this issue of the JALPO, the request for observers in this article is obviously outdated; the background information included here remains invaluable.)

Introduction

NASA's combined missions, the **L**unar **R**econnaissance **O**rbiter (LRO) and the **L**unar **CR**ater **O**bservation and Sensing Satellite (LCROSS), were launched by the same Atlas/Centaur rocket on June 18, 2009 and are now operating in orbit within the Earth/Moon system. Flight operations for LCROSS will end on October 9, 2009, while the LRO mission will continue. What is LCROSS expected to accomplish in this short time, how will it do it, and is any of it observable by amateurs?

Science Objectives

The primary goal of LCROSS is to test whether or not water ice deposits exist on the Moon (Table 1). There are both practical and scientific reasons for wanting to know whether water exists on the Moon.

On the practical side, when humans return to the Moon there are two options for obtaining the water that will be required: Carry it with them, or use water that is already there. Since it costs around $US 100,000 per gallon to transport water to the Moon, an in-situ supply would be advantageous.

From the scientific perspective, despite the Moon's proximity to Earth, more is known about Mars than about most of the surface of the Moon. Water has been delivered to the Moon by comet and meteoroid impacts for billions of years, but we don't know whether any remains.

Water exposed on the sunlit surface would evaporate into the vacuum because of the lack of atmospheric pressure and the fact that the daytime temperature can reach 120° C (248° F). Due to the low surface gravity, water vapor will escape from the Moon. However, the lunar rotation axis is inclined only 1.5° from the perpendicular to the ecliptic plane, so the Sun never rises more than a few degrees above the horizon near either of the lunar poles. Within craters in those regions, the depressed floors and raised rims can combine to produce apparent horizons several degrees above the true horizon, completely blocking sunlight from polar crater floors. The surface temperature in this perpetual darkness is estimated to be about –200° C (–328° F). Any water vapor that drifts into one of these “cold traps” could be perpetually frozen. Over the lunar lifetime, significant amounts of ice could accumulate.

Table 1: LCROSS Science Goals

Confirm the presence or absence of water ice in a permanently shadowed region on the Moon
Identify the cause of the hydrogen signatures detected at the lunar poles
Determine the amount of water, if present, in the lunar regolith
Determine the composition of the regolith in one of the Moon's permanently shadowed craters

There are competing processes, however, that could evaporate exposed water, even in areas permanently shaded from the Sun. The dark areas are still exposed to the solar wind and plasma from the magnetosphere. They are also exposed to earthshine, radiation reflected from sunlit terrain in the vicinity, ultraviolet starlight, and scattered zodiacal ultraviolet light. Meteoritic impacts vaporize volatiles, which may either escape or recondense in a cold trap. But impacts also spread debris, thereby burying, and protecting, other exposed volatiles. The orientation of the lunar rotation axis and orbit also slowly change due to gravitational perturbations by the Earth, Sun, and even the other planets, which changes the geometry of polar illumination. There may have been either more or fewer permanently-shadowed areas in the past, so the available time to

Table 2: Impact Characteristics

	Centaur	Shepherding Spacecraft
Impactor mass	2249-2366 kg (4958-5216 lb)	621-866 kg (1369-1909 lb)
Impactor velocity	2.5 km/sec (1.55 miles/sec)	2.5 km/sec (1.55 miles/sec)
Angle from horizontal	60-70 degrees	60-70 degrees
Impact Energy	~1.5 tons TNT ($6x10^9$ Joules)	~0.5 tons TNT ($2x10^9$ Joules)
Plume height	10 km (6.2 miles)	
Crater: Diameter	~20 m (66 feet)	~14 m (46 feet)
Depth	~4 m (13 feet)	~2 m (6 feet)
Mass excavated	~$3.5x10^5$ kg (385 tons)	~$1.5x10^5$ kg (165 tons)

For Comparison	
Energy of 10-kg (22-lb) meteoroid impact	~2 tons TNT ($8x10^9$ Joules)
Density of 20-m (66-ft) diameter craters	30-100 craters per square km

accumulate frozen volatiles may be considerably shorter than the lunar lifetime. The relative importance of these processes is not known.

In the 1990s, two missions, Clementine and Lunar Prospector, found evidence of hydrogen concentrations at the poles, which could be due to H_2O. LCROSS intends to determine whether the hydrogen at the poles is in the form of water ice. If so, it will also measure the concentration (ice to dust ratio), as well as determine the regolith composition in the floor of a permanently-shadowed crater.

Technique

LCROSS will use imaging, spectrometry, and photometry to analyze a sample of the surface within the 98-km far-southern crater Cabeus, much of whose floor is permanently shadowed.

The surface sample will be obtained by impacting the surface, creating a small crater and a debris plume (Table 2). The debris plume will be analyzed by remote sensing to determine its composition and structure. The resulting crater, along with the plume morphology and dynamics, will also provide data about crater formation mechanisms and the lunar surface structure.

Now separated from LRO, LCROSS includes two components: the Centaur Upper Stage, which propelled the combination of LRO and LCROSS to the Moon and which also serves as the impactor, and the Shepherding Satellite, which guides the Centaur to its target and carries the instrumentation. The Shepherding Satellite will also become a second, smaller, impactor after transmitting its data to Earth. The impacts and debris plumes will also be observed from ground-based and orbital facilities. LRO may be able to observe the impacts from lunar orbit.

In order to create a debris plume that rises vertically above the surface (and therefore be visible above the crater rim) and to create the most debris, the Centaur must impact at a high velocity and at a high angle to the surface. Previous lunar orbiters, such as Lunar Prospector, impacted at shallow angles. LCROSS would also have hit the Moon's polar area at a shallow angle on its initial approach, but instead it used the lunar gravity during its initial pass above the lunar south pole in order to change direction into a high-inclination Earth orbit about the same size as the Moon's orbit. This temporary orbit serves four purposes:

- It provides time to activate and check the instruments, refine the targeting, and to allow outgassing of any residual hydrazine fuel or water from the Centaur prior to impact;
- It can be adjusted to satisfy impact date and time constraints;
- It provides time for science data collection on the polar craters;
- Most importantly, since the orbit is Earth-centered and near-polar, it provides a steep, high-velocity, approach to the lunar south pole. The amount of material excavated

Figure 1. LCROSS Shepherding Spacecraft being lowered onto lower adapter ring, which connects it to the Centaur Upper Stage. (Photo credit: NASA, courtesy of Northrop Grumman)

Figure 2. Shepherding Spacecraft instrument package. The instrument viewing apertures are visible within the sunshade. (Photo credit: NASA Ames Research Center/Dominic Hart)

Table 3: LCROSS Instrumentation

Instrument	Wavelength Region	Purpose
Visible Camera	3-color visible	Context, ejecta cloud morphology, visible grain properties
Near Infrared Cameras (2)	900-1700 nm (nanometers)	Context, ejecta cloud morphology, NIR grain properties, water concentration maps
Mid Infrared Cameras (2)	6.0-13.5 micrometers	MIR thermal image, context, ejecta cloud morphology, MIR grain properties, remnant crater imagery
Visible Spectrometer	263-650 nm	Vapor plume and ejecta cloud emission and reflectance spectrometry, grain properties, water vapor dissociation products (OH^- and H_2O^+)
Near Infrared Spectrometers (2)	1200-2400 nm	Vapor plume and ejecta cloud emission and reflectance spectrometry, grain properties, ice, water vapor
Total Luminance Photometer	425-1000 nm	Impact flash total luminance and luminance decay curve

and its maximum plume height above the lunar surface depend on the impact energy, which in turn depends on the mass and velocity of the impactor. Since the mass of Centaur is pre-determined, a higher velocity produces higher energy.

Adjustments to this orbit will cause LCROSS to impact Cabeus on the third orbital circuit, the next close approach after the initial flyby. The lunar position of this target crater is 35.5° W/84.9° S. The exact time of impact is chosen to provide satisfactory solar illumination of the target crater and plume (lunar phase), as well as libration and timing to permit visibility from the participating terrestrial observatories and satellites. At the predicted moment of impact, the Sun will be 5.8° and the Earth 8.0° above the horizon at the center of Cabeus.

Another requirement is the elimination of residual water and fuel from the Centaur, which is important for two reasons. First, any residue would be incorporated in the impact's debris plume where it would be indistinguishable from lunar material; (fortunately, this actually is a manageable problem since the amount of water would be small compared to the amount expected from the lunar surface). Second, water that sublimates from the surface of the Centaur after its release can change its trajectory, possibly missing the intended impact point by hundreds of meters.

Spacecraft

LCROSS was launched on an ATLAS V rocket, along with LRO. The LCROSS Shepherding Spacecraft (Figure 1) was designed and built by Northrop Grumman. The science payload (Figure 2) was designed and built by NASA's Ames Research Center. The Centaur Upper Stage that propelled LCROSS and LRO to the

Figure 3. Impactor/Shepherding Spacecraft Separation. The Shepherding Spacecraft will trail the Impactor by several minutes to observe the impact and debris plume before it also impacts the Moon. (Note that the Moon's phase shown here is not the same as at the now-scheduled time of impact.) (Credit: NASA/Ames Research Center)

Moon and that also serves as the impactor for LCROSS will remain attached to the Shepherding Spacecraft until approximately 9 hours and 40 minutes before impact. The impactor is simply an inert mass used to impart energy to the lunar surface. The guidance, observation, and communication capabilities are on the Shepherding Spacecraft. Its instrumentation consists of three spectrometers, five cameras, and a high-speed photometer (Table 3).

The cameras are intended to monitor the morphological evolution of the debris plume, its thermal evolution, and to determine grain properties from visible through mid-infrared wavelengths. The spectrometers cover the ultraviolet, visible and near-infrared regions for chemical analysis of the plume. The near-infrared portion of the spectrum includes water ice and water vapor bands, and the ultraviolet-visible region includes bands of water dissociation products (OH^- and H_2O^+). The high-speed photometer will measure the total visible luminance of the impact flash and its decay, which are sensitive to volatile content, regolith depth and target strength.

Science Operations

The first two months after arrival in orbit are being used to check instrument operation, alignment, and calibration. During its first flyby of the Moon (June 23), the instruments were turned on and scanned the craters Mendeleev, Goddard C and Giordano Bruno, selected because they offer a variety of terrain, composition and illumination conditions for calibration. The lunar limb was also scanned to verify instrument alignment. On August 1, an Earth-view calibration was performed by scanning north-south and east-west across the Earth to check instrument alignment.

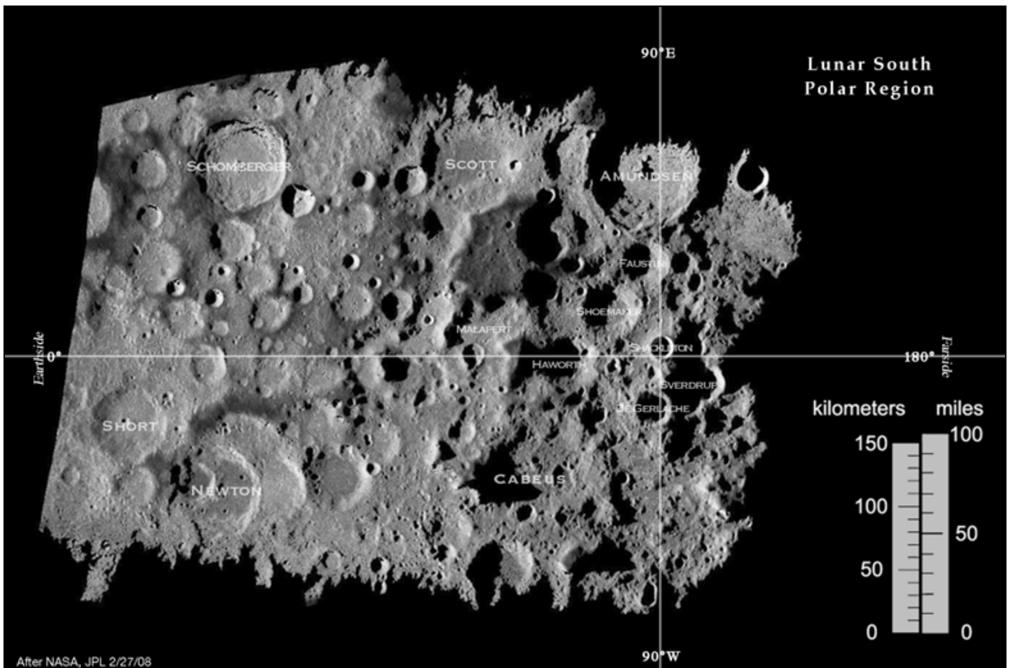
However, on August 22, a significant anomaly occurred in the inertial reference unit on the Shepherding Spacecraft. The rotation rate sensors had a problem that caused the attitude control system to use the star trackers to measure rotation rate. Star trackers are good for determining direction, but they are not as good for measuring how fast that direction is changing. As a result the attitude control thrusters fired excessively. Communication between the ground and spacecraft is only scheduled intermittently, so the problem wasn't discovered until the next scheduled communication opportunity. By then, most of the reserve thruster fuel had been used. The problem was quickly ameliorated, and seems to have been solved, although it's still being studied. The anomaly used 140 kg (309 lb) of fuel, which leaves a reserve of only 9 - 18 kg (20 - 40 lb). Fortunately, LCROSS still has sufficient fuel to complete its mission, but essentially has no reserve to accommodate future anomalies or to perform optional activities.

The final month before impact will include science observations of lunar polar craters. On its final orbit, the Shepherding Spacecraft will separate (Figure 3) and slow 50 m/s so that at impact it will trail the Centaur by 10 minutes. This allows the Shepherding Satellite 4 minutes of observations and data transmission before it also impacts within either the same or an adjacent crater. The targeting accuracy is specified as within a 10-km (6.2 mi) radius, but the expected accuracy is about 1.2 km (0.75 mi). The crater resulting from Centaur impact will be similar in size to Apollo 11 landing site's East crater (Table 2).

Impact will occur on October 9, 2009 at about 11h 30m UT, with an uncertainty of 5 minutes at the time of this writing.

Observing Conditions for the Impacts

The impact time was chosen to allow good observation conditions at the terrestrial observatories in the southwestern U.S and Hawaii, as shown in Figure 6. Observers in western North America, particularly the U.S. Pacific and Mountain States, and the Eastern Pacific will have the best observing conditions. The Moon is also near its northernmost declination (+26.05°) at impact time, which favors northern-hemisphere observers. Libration has the lunar south pole tilted 3.76° towards the Earth, which increases the visibility of the target crater. The Sun angle is always low within the Moon's polar areas, but fortunately, the solar selenocentric latitude will be 1.51° south, raising the Sun a little higher above the local horizon. (The detailed conditions at the predicted impact time are: colongitude = 158.15°, solar latitude = -1.51°, geocentric librations 2.82° W/3.76°S; calculated by the JPL "HORIZONS" website.) Visibility of the actual impact from the Earth depends on its location inside Cabeus, since the entire floor is not visible even with favorable libration, due to blocking by the crater's northern rim.



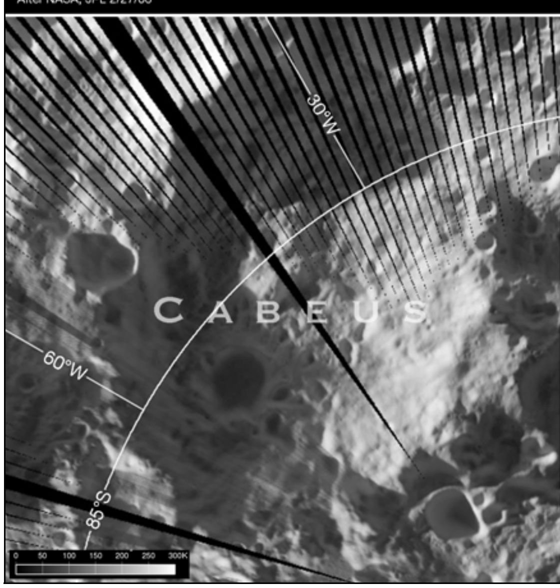


Figure 4. Images showing the LCROSS target crater, Cabeus. (Above) Earth-based radar view of the Moon's south polar region, with Cabeus below center. The direction of Earth and of the source of "illumination" is to the left. The features "lit" by this earth-based radar image are visible from Earth at favorable libration, but much of the radar-visible area does not receive sunlight because the Earth strays farther from the Moon's equator than does the Sun. (Left) A large-scale thermal infrared image of Cabeus taken by the Diviner camera of the Lunar Reconnaissance Orbiter (LRO), showing the temperatures within those areas that are neither sunlit nor visible from Earth. A temperature scale (in Kelvins) is in the lower left. The black bars represent missing data.

Impact will occur in daylight for observers in easternmost North America and all of South America, and during morning twilight for most of the central United States and Canada, as well as eastern Mexico. The Moon will be below the horizon in daylight for most of Europe, Asia, Africa, and the Mid-East. Eastern Asia and Australia will be in darkness, but the Moon will be below the horizon except in eastern Siberia and northeastern Japan.

The impact flash duration is only tens of milliseconds. Its brightness depends on the structure of the impact site, but probably won't be visible in amateur telescopes, even if the crater rim does not obscure it. Where conditions are favorable, the plume may be visible in 25-30 cm (10-12 in.) telescopes. It should appear a few seconds after impact, peak in brightness about 30-100 seconds after impact and extend a maximum of 4-5 arc seconds above the lunar limb as viewed from the Earth. For those interested in attempting observations, Figure 5 is a Pic du Midi Observatory photograph of the south polar region, under conditions of lighting and libration very similar to those at the predicted time of impact.

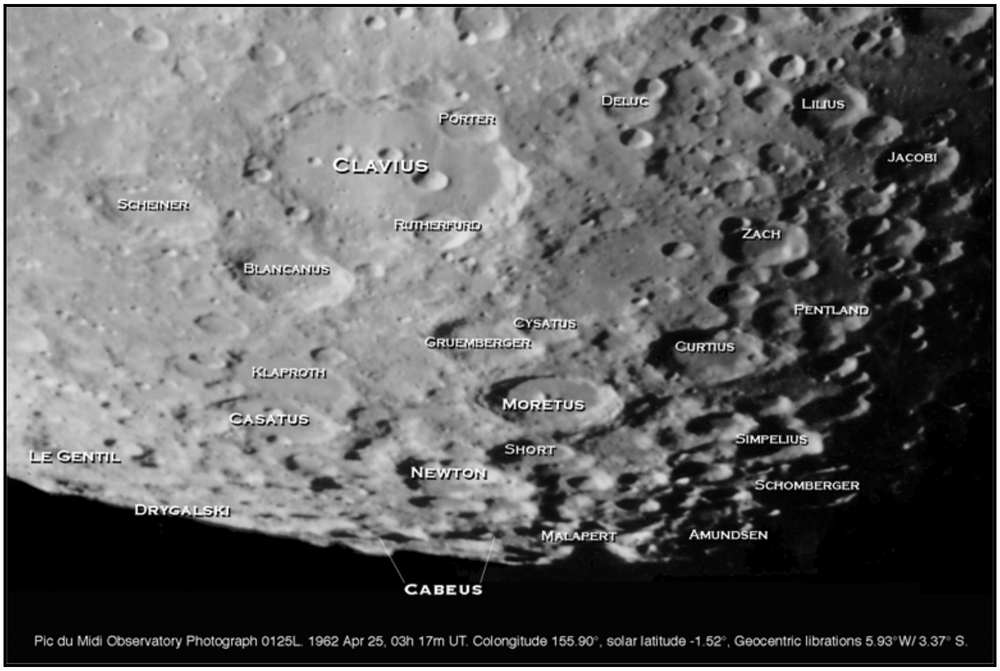


Figure 5. Lunar South Polar region (north at top), showing the location of Cabeus, the target for the LCROSS impact. The lighting and libration conditions, calculated by the JPL "HORIZONS" website, are quite similar to those at the scheduled time of impact, October 9, 2009, 11h 30m UT.

Observing Opportunities

The LCROSS mission provides amateur observers with several possibilities:

- *Public Outreach*. The impacts will undoubtedly attract public interest, making LCROSS an opportunity to advance public awareness of astronomy and the space program by means of public viewing of the impact events. Given their likely minutes-long duration, direct viewing of the impact plumes through-the-eyepiece might be possible for small groups, taking turns with a medium-size telescope. For larger groups, probably the best form of real-time viewing would be with a video camera, the resulting images displayed on one or multiple video screens. This would also allow the events to be recorded for repeated later viewing.

  Undoubtedly, there will be webcam broadcasts, making the events visible worldwide. This public-outreach method has been proven many times with lunar and solar eclipses and the transits of the planets Mercury and Venus.

- *Major observing challenge*. Many amateurs are not motivated or equipped to emulate the work of professional astronomers; instead they observe for the gratification of themselves and their associates and justifiably make no apologies for a rewarding activity that is supported solely by their own time and money. It is clear that seeing or imaging the impact flashes and ejecta plumes may be challenging, but this is just what many amateurs delight in.

- *Scientific contributions.* However, specialized observations by advanced amateurs may be able to help the scientific community understand the physics of the flashes, the ejecta plumes and even the possible gas clouds caused by the two impacts, along with the composition of the lunar regolith at the impact points.

Assuming that amateurs will observe in the visible and NIR (near-infrared) bands, their most useful contribution would concern the morphology of the impact plumes. NIR observations would also be useful for the detection of water ice, and could even help in the areas of target properties, mineralogy, thermal evolution of the ejecta, and particle size. Observations in the visible band only might still help in the detection of water ice, and determining target properties and particle size.

A feasible goal for amateurs will be size and altitude measurement, along with photometry, of the impact plumes, followed by imaging of the possible gas clouds. This might be done with digital video at a high frame rate (e.g., 15-30 fps) to capture the brightness and duration of the impact flashes (if not obscured by lunar terrain), but video would also be useful (perhaps at a slower frame rate) to monitor the impact plumes. Non-video CCD images are unlikely to capture the brief flashes, but they would allow longer exposure times and more accurate photometry of the plumes and gas clouds.

A photometry program will be more useful if it includes calibration using a star near the Moon, applying to both video and still images. CCD images should be flat- and dark-fielded. Also, the image scale should be determined, most conveniently using the distances between well-defined lunar features. Having found the image scale, it might be possible to monitor ejecta cloud height by means of measuring the length of its shadow, provided that the shadow is cast on lunar terrain and not simply into shadow or space; this is a method long used to measure lunar relief.

If they are to be analyzed, observations need complete documentation – atmospheric conditions; telescope type, aperture and focal ratio; information about related equipment such as filters,

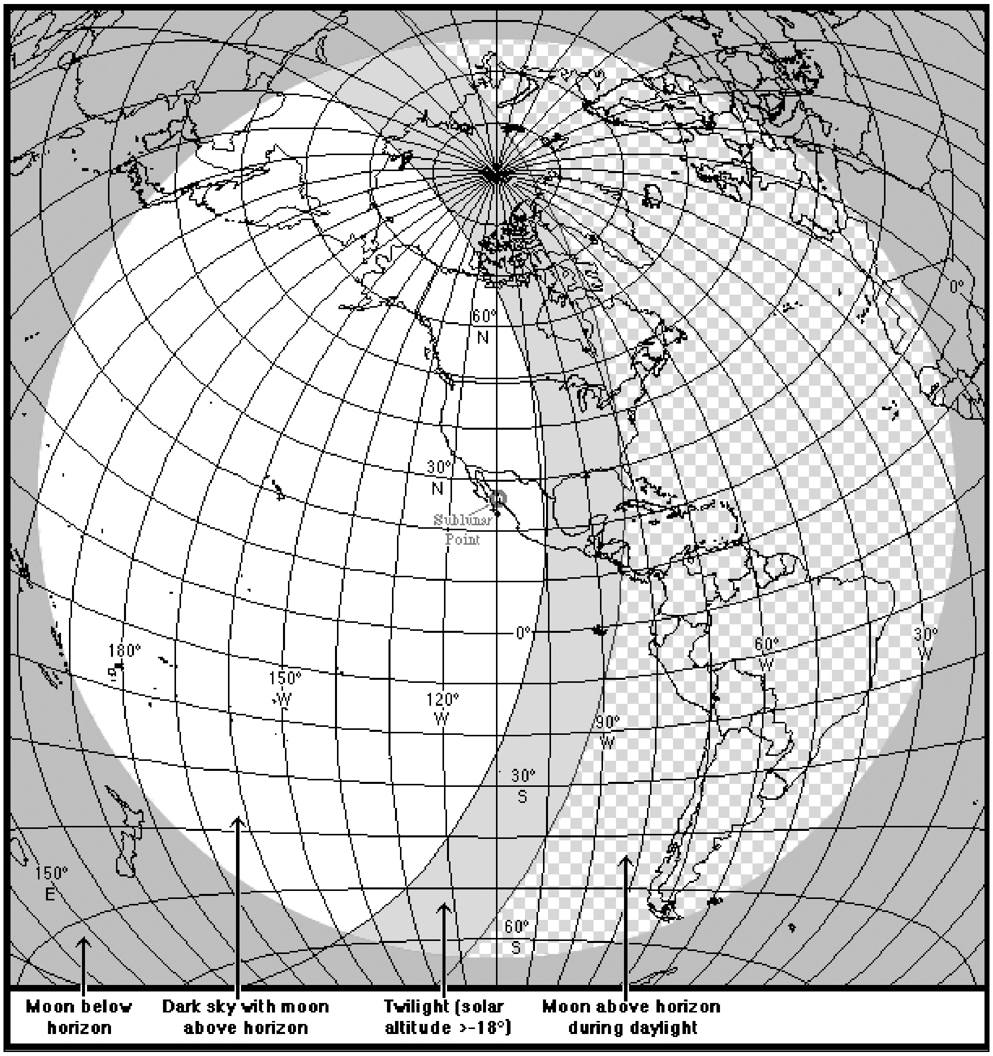


Figure 6. Lunar visibility conditions at the scheduled time of LCROSS impact, October 9, 2009, 11h 30m UT. This equal-distance projection is centered on the "Sublunar Point," where the Moon will be overhead. Viewers within the light-toned circle centered on that point will have the Moon above their horizon, but with its altitude decreasing with distance from that location.

eyepieces, enlarging lenses, and so forth; and of course accurate exposure durations and UTC. For both video and still imaging, accurate times are essential. For video this is best achieved by WWV or GPS time inserters. If one's video camera or recorder has an audio channel, WWV or other shortwave signals can be recorded along with the video images.

Besides time accuracy, which is essential, high time resolution is very useful and is necessary for the impact flashes. If the camera has no cutoff filter (and IR-cutoffs are common on commercial cameras) the near-UV and near-IR may be available as well as the visible band. Admittedly, with small instruments an observer will not want to use filters because they reduce light. (Note, however, that color video automatically records in three bands – R, G and B.) Those with larger amateur instruments should be willing to use at least broadband filters (e.g., U, B, V, R, I). And, if one owns or has access to a larger telescope, especially 61 cm (24 inches) aperture or more, they should at least consider narrow-band filters. Promising wavelengths include the 308-nm OH emission line (if possible), 380-nm CN line, and the 619-nm water line.

The professionals will archive their LCROSS observations with the Planetary Data System, and amateurs should plan to do this as well if they intend to make their observations as useful as possible to the scientific community. The requirements to do this are too lengthy to specify here, and those unfamiliar with them should consult the PDS Geosciences Node website (*http://pds-geosciences.wustl.edu*) and PDS staff as well.

Thus, observations by advanced amateurs will be valuable, as long as they are aggressive in gaining access to medium-size or large telescopes, or simply maximize the capabilities of their own instruments by means of coordinating imaging at different time resolutions, different exposures, and in different spectral bands. Given the vagaries of weather, there is some point in redundancy, but not carried to the point of, say, dozens of observers recording the impact flashes with unfiltered cameras and nobody focusing on specific bands or wavelengths. Coordinated amateur observers have a good chance to contribute meaningful science to the LCROSS Mission.

Amateur observations are being organized through a Google group at *http://groups.google.com/group/lcross_observation* and any observations should also be submitted to the following:

- The ALPO Lunar Transient Phenomena program (Dr. Anthony Cook, *atc@aber.ac.uk*)
- The ALPO Lunar Meteoritic Impacts program (Brian Cudnick, *cudnik@sbcglobal.net*)
- The ALPO Topographical Studies/ Selected Areas programs (Dr. Wayne Bailey, *wayne.bailey@alpo-astronomy.org*)

The impacts will also be broadcast on NASA TV and *http://www.nasa.gov*. Science centers and planetariums are also expected to plan public events to view the impacts. Additional information about the spacecraft, mission, and science, as well as the current status of the mission can be found at the mission and payload websites, *http://www.nasa.gov/lcross*, and *http://lcross.arc.nasa.gov/*. There are Twitter and Facebook links on these pages, as well as news sections and blogs for the latest information.

NOTE: When this article went to press the precise impact time and location within Cabeus were undecided, making it essential for observers to monitor the web sites listed above.

Feature Story:
Apollo 11 in Brief

By Wayne Bailey
acting coordinator, ALPO Lunar Topographical Studies Section
wayne.bailey@alpo-astronomy.org

Online Features

Left-click your mouse on the author's e-mail addresses in blue text to contact the author of this article.

Introduction

Forty years ago, in July 1969, the era of human exploration of the Moon began with the flight of Apollo 11. It continued for three and a half years, through Apollo 17. In recognition of the fortieth anniversary, I'd like to briefly review what was involved in achieving the first manned landing on the Moon, and summarize the scientific accomplishments of the mission.

Ground-based observations and the preceding Ranger, Surveyor, Gemini, Orbiter and Apollo flights provided the engineering and scientific basis for the manned Apollo flights, whose primary purpose was to land humans on the Moon and return them safely to Earth. Science was a strong justification for the trip, but the primary goal was the trip itself. Within those constraints, a lot of science was accomplished prior to the first landing while looking for safe landing sites. Science also provided much of the justification for continuing the flights after the first couple of landings accomplished the primary goal.

From an engineering viewpoint, several capabilities had to be demonstrated prior to a human landing: the capability to accurately reach the Moon (Ranger); to achieve a soft landing (Surveyor); to rendezvous and dock spacecraft (Gemini); to enter lunar orbit (Orbiter); to return to Earth and land safely (Apollo 8). The result was the successful lunar landing and return of astronauts on Apollo 11.

Apollo 11 Statistics

Lunar Module	Eagle
Commander	Neil Armstrong
Lunar Module Pilot	Edwin "Buzz" Aldrin
Command/Service Module	Columbia
Command Module Pilot	Mike Collins
Launch Date	July 16, 1969
Lunar Landing Date	July 20, 1969
Return Date	July 24, 1969
Mission Duration	8 days 3.3 hours
Lunar Orbit Duration	2 days 11.6 hours
Lunar Surface Duration	21.6 hours
Lunar EVA Duration	2.5 hours
EVA Traverse Distance	0.25 km

Apollo 11 was not without problems however. The previous flights had improved the model of the Moon's gravitational field. But Apollo 10, which conducted a test of an aborted lunar landing, still would have missed its target by a significant amount. The model was better for Apollo 11. However, several on-board computer alarms, triggered by overloaded computers, prevented Armstrong and Aldrin from visually monitoring their descent. When they rotated the Eagle lander during decent and just before touching down, they were in unfamiliar territory, 8 km downtrack and 2 km crosstrack from their target due to orbit uncertainty — which didn't matter, since the primary purpose was to land safely and not at a particular spot.

What did matter was that the spot they were approaching was in a 250-meter-wide debris zone of large boulders surrounding a 180-meter-diameter crater (later called West crater). Armstrong manually reduced the rate of descent so that they would fly further downrange, looking for a safe landing spot. There was another 25-meter crater (Little West) just beyond the debris blanket, forcing him to fly another 45 meters to a clear area, landing with only seconds of fuel left. Meanwhile, mission controllers, who had engineering telemetry, but no images, could only watch the fuel indicators decrease and wonder what was happening. Collins, flying overhead in the command module, unsuccessfully tried to locate Eagle with a telescopic sextant. Geologists finally identified the site from TV images, but only after Apollo 11 had left lunar orbit. The 16 mm camera that recorded the descent from Aldrin's window of the lunar lander confirmed this.

The first scientific observations made after landing were Aldrin's comments that intense backscatter in the down-sun (zero phase) direction made it difficult to see details, and the color of the rocks depended on the angle of observation with respect to the Sun. The first experimental result was obtained when Armstrong put one foot on the surface, then picked it up and observed that the dust retained a sharp imprint; the imprint was only a fraction of an inch deep, and when he kicked the surface, the dust coated his boot like powdered charcoal. (Upon re-entering Eagle, this dust was released from their suits and filled the air with a smell like gunpowder.)

During extravehicular activity (EVA), in addition to taking pictures and collecting samples, Armstrong and Aldrin set up three experiments. One, the Solar Wind Collector, (SWC, a sheet of aluminum foil) was returned to Earth after 77 minutes exposure facing the Sun, absorbing solar wind particles. Two were left on the Moon, the Passive Seismic Experiment (PSE) and the Laser Ranging Retro-reflector (LRRR).

The LRRR is a totally passive, square array of 100 retroreflectors set up facing the Earth. These are the only experiments left on the Moon that are still functional. They — along with those left by Apollo 14 & 15 — have been used to measure the orbital motion of the Moon, tidal flexure of the lunar and terrestrial crust, terrestrial continental drift, and the mass distribution within the Moon.

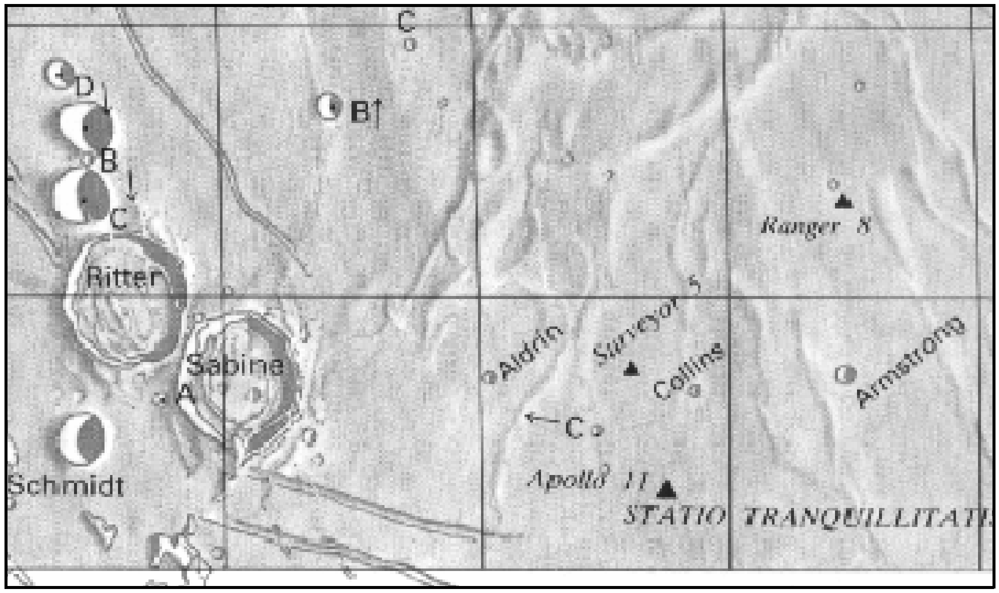


Figure 1. Bottom portion of Section 35 from Antonin Rukl's "Atlas of the Moon", showing the Apollo 11 landing site, the Ranger impact site and nearby features. For comparison purposes, the crater Sabine is 30 km wide. Note that Apollo 11 crew members Aldrin, Collins and Armstrong have been honored with small craters near their historic landing

The PSE was more difficult to set up. It had to be leveled and its solar arrays oriented to the Sun. The seismometer was intended to record meteoritic impacts and any lunar seismic activity that might exist. It was sensitive enough to record the activity of the astronauts during their EVA. It operated normally until it was turned off just before sunset on August 3, 1969. When reactivated after sunrise, the electronics had been damaged by the cold. It failed on August 27, 1969 near noon of the second lunar day.

The best-known product of the Apollo missions is probably the lunar samples that were returned to Earth. Despite the single, short EVA, Armstrong and Aldrin collected 22 kg of material from their Mare Tranquilitatis landing site. Because of time constraints, much of the planned in-situ photo documentation of the samples had to be skipped, but the selection of samples was good. The existence of two different basalts showed that the Mare was filled by multiple lava flows, and not formed by a single impact melt. The high-titanium, low-sodium content of the basalt indicated low viscosity lava that would account for the extent of the flows and the lack of vertical relief.

The regolith (soil) material was mostly pulverized basalt with very little meteoritic material. This is consistent with gardening, the process in which a large impact digs up the bedrock, which is then reduced by smaller impacts to form the regolith. The regolith also contained a small amount of light-colored plagioclase feldspar. This material was distributed over the mare by impacts in the highlands, the closest of which are only 40 km from Eagle's landing site. Samples composed of consolidated soil showed the effect of impacts, as did glassy material within apparently fresh impact craters.

Apollo 11 returned safely to Earth, landing in the Pacific Ocean and was picked up by the recovery ship USS Hornet. There was some sentiment for using the USS John F. Kennedy as the recovery ship, but President Nixon or his staff apparently vetoed this.

Overall, the science return was pretty good for an exploratory mission, especially considering that the primary goal was simply to land and return safely. Five more successful lunar landings (and one aborted flight) followed Apollo 11.

Feature Story: Jupiter

Observations During the 2005 - 2006 Apparition

By: Richard W. Schmude, Jr., coordinator, ALPO Jupiter Section
schmude@gdn.edu

This paper includes Jupiter images submitted by a number of observers.

Abstract

Drift rates for 133 features in over a dozen currents are summarized. Several features oscillated in longitude. High-resolution, visible-light images show a dark belt between ~65º S and 70º S, a bright zone between ~70º S and 75º S and a dark cap poleward of 75º S. The width of the NEB decreased from 15º to 12º of latitude during the apparition. The selected normalized magnitudes of Jupiter for 2005-06 are: B(1,0) = -8.51±0.05, V(1,0) = -9.37±0.01, R(1,0) = -9.80±0.01 and I(1,0) = -9.63±0.02. The selected solar phase angle coefficients are c_B = 0.0060±0.0030, c_V = 0.0063±0.0013, c_R = 0.0047±0.0015 and c_I = -0.0020 ±0.0033.

Introduction

Observations and measurements of Jupiter taken during the 2005-2006 apparition are listed in Table 2, along with the list of contributors and their locations. The characteristics of Jupiter for 2005-06 are listed in Table 1.

This paper will follow certain conventions. The planetographic latitude is always used. West refers to the direction of increasing longitude, which is designated with the Greek letter λ, followed by a subscript Roman numeral that is the longitude system. For example, $\lambda_I = 54°$ means that the system I longitude equals 54° W. The three longitude systems are described in (Rogers, 1995, 11; 2006, 334), (Astronomical Almanac, 2003, L9). All dates and times are in Universal Time (UT). Belts and currents are abbreviated; for example, the North Equatorial Belt is the "NEB", the South Tropical Current is the "STrC" and the North North North North Temperate Current is the "N^4TC". A few belts and zones are shown in Figure 1G. Except where otherwise noted, all data are based on visible light images. All methane band images were made in the near-infrared with a wavelength centered at 0.89 µm. All currents, except where noted, are named in accordance with Rogers (1990, 88).

Disk Appearance

Adamoli, Cudnik, Heath and Roussell made over 200 intensity estimates of Jupiter's features. The average light intensities based on the ALPO scale (10 = white and 0 = black) are: SPR (6.5), SSTZ (7.5), SSTB (5.7), STZ (8.6), STB (5.8), STrZ (9.0), SEB-south component (4.3), SEBz (8.0), SEB-north component (4.6), EZs (7.1), EB (6.5), EZn (8.2), NEB (4.4), NTrZ (8.8), NTZ (9.0), NNTB (6.3), NNTZ (6.8), NPR (6.5) and GRS (6.9). All measurements were made in integrated light. Heath made intensity estimates with a red (W25) and two blue filters (W44a and W47). According to Heath, the GRS was reddest followed by the NEB, SEB

Table 1: Characteristics of the 2005 - 06 Apparition of Jupiter

First conjunction with the Sun	2005 Oct 22
Opposition date	2006 May 4
Second conjunction with the Sun	2006 Nov 21
Apparent equatorial diameter (opposition)	44.7 arc-seconds
Visual stellar magnitude (opposition)	-2.5
Planetographic declination of the Sun (opposition)	3.0ºS
Planetographic declination of the Earth (opposition)	3.9ºS
Geocentric declination of Jupiter	14.8ºS

All Readers

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

Online Features

Left-click your mouse on:

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

Observing Scales

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

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

Scale of Transparency Conditions:
- Magnitude of the faintest star visible near Jupiter when allowing for moonlight and twilight

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

Table 2: Contributors to This Report [a] (2005 - 06 Apparition)

Name; Location	Type*	Name; Location	Type*	Name; Location	Type*
F. Acquarone; Italy	I	M. Adachi; Japan	I	G. Adamoli; Italy	D, TT,N
B. Adcock; Australia	I	J. Adelaar; Netherlands	I	T. Akutsu; Philippines	I
E. Allen; CA, USA	I	V. Amadori; Italy	I	D. Arditti; UK	I
P. Baldoni; Italy	I	D. Barucco; Italy	I	G. Bertrand; France	I
R. Bhanukitsiri; CA USA	I	K. Bhattacharya; UK	I	N. Biver; France	D
S. Bonifacio; Italy	I	M. Boschat; ON, Canada	I	R. Bosman; Netherlands	I
T. Bossaller	I	S. Bruno; Romania	I	S. Buda; Australia	I
A. Carbognani; Italy	I	F. Carvalho; Brazil	I	P. Casquinha; Portugal	I
C. Cellini; Italy	I	B. Chang; Hong Kong, China	I	D. Chang, Hong Kong, China	I
E. Chasiotis; Greece	I	R. Chavez; GA USA	I	H. Chen; Taiwan	I
G. Chester; DC & VA USA	I	B. Colville, ON Canada	I	R. Cosenza; Italy	I
B. Cudnik; TX USA	D,TT	J. Davidson; Saudi Arabia	I	M. Delcroix; France	I
B. Dickinson; VA USA	I	R. Di Nasso; Italy	I	P. Edwards; UK	I
H. Einaga; Japan	I	K. Fabian; IL USA	I	C. Fattinnanzi; Italy	I
H. Fukui; Japan	I	G. Gaherty; ON Canada	N	C. Go; Philippines	I
F. Gómez	I	E. Grafton; TX USA	I	G. Grassmann; Brazil	I
B. Haberman, Jr.; CA USA	I	A. Hatanaka; Japan	I	J. Hatton; Netherlands	I
T. Hayashi; Japan	I	A. Heath; UK	D,N	R. Heffner; Japan	I
C. Hernandez; FL USA	D	R. Hill; AZ USA	I	T. Ikemura; Japan	I
M. Jacquesson, France	I	R. Jakiel; GA USA	I	E. Jamison	D,N
J. Jefferson; UK	I	K. Ju; Korea	I	M. Justice; Australia	I
S. Kanno; Japan	I	M. Kardasis; Greece	I	J. Kazanas; Australia	I
A. Kazemoto; Japan	I	B. Kendrick	I	B. Kingsley; UK & Barbados	I
M. Koishikawa; Japan	I	M. Konishi; Argentina	I	L. Kostas; Greece	I
T. Kumamori; Japan	I	H. Kusakai; Japan	I	C. Lau; Hong Kong, China	I
P. Lawrence; UK	I	P. Lazzarotti; Italy & Thailand	I	M. Lewis; UK	I
E. Lomeli; CA USA	I	R. Lunsford; CA USA	I	R. Mackintosh; Argentina	I
P. Maxson; AZ USA	I	C. Mazzotti; Italy	I	F. Mazzotti; Italy	I
A. Medugno; Italy	I	F. Melillo; NY USA	I	J. Melka; MO USA	I
M. Mingo; Italy	I	T. Mishina; Japan	I	I. Miyazaki; Japan	I
M. Mobberley; UK	I	R. Mollise; AL USA	I	J. Moody; MO USA	I
D. Moore; AZ USA	I	P. Morelli; Italy	I	K. Nakai; Japan	I
K.-H. Nam; Korea	I	D. Niechoy; Germany	D	A. Nishina; Japan	I
T. Nonoguchi; Japan	I	G. Nowell; NY USA	I	J. Olivarez; FL USA	N
T. Olivetti; Thailand	I	L. Owens; GA USA	I	D. Parker; FL USA	I
D. Peach; Barbados	I	R. Pechereau; France	I	C. Pellier; France	I
J. Phillips; SC USA	I	D. Pretorius; Australia	I	Z. Pujic; Australia	I
K. Quin; VA USA	I	J. Rhodes; Italy	I	E. Rivera; PR USA	I
S. Robbins; NJ USA	D	J. Rogers; UK	N	S. Romualdo; Italy	I
C. Roussell, ON Canada	D, N, TT	V. Russo; Italy	I	M. Salway; Australia	I
J. Sánchez; Spain	I	J. Sanford; CA USA	I	G. Santacana; PR USA	I

Table 2: Contributors to This Report [a] (2005 - 06 Apparition) (Continued)

R. Schmude, Jr.; GA USA	PP,D	P. C. Sherrod; AS USA	I	K. Silvia; Germany	I
A. Sonka; Romania	I	I. Takimoto; Japan	I	A. Tasselli; UK	I
R. Tatum; VA USA	I	T. Tomita; Japan	I	D. Trapani; NJ USA	I
B. Turner; Australia	I	D. Tyler; UK & Barbados	I	G. Uri; Italy	I
M. Valimberti; Australia	I	R. Vandebergh; Netherlands	I	G. Vandenbulcke; Belgium	I
M. Vedovato; Italy	I	S. Walker	I	Walkey; CO USA	I
J. Warren; TX USA	I	A. Wesley; Australia	I	R. Wessling; OH USA	D
D. West; KS USA	I	T. Yamaoka; Japan	I	S. Yoneyama; Japan	I
H. Yoon; Republic of Korea	I	K. Yunoki; Japan	I	C. Zannelli; Italy	I
F. Zanotti; Italy	I				

*Type = Type of observation: D = drawing, I = image, N = descriptive notes, TT = transit time and PP = photoelectric photometry.
[a]Many of these people posted material on websites that I used in this report. Not everyone in this table sent material directly to the writer.

Table 3: Belt Latitudes (visible light)

Feature	Latitude	Feature	Latitude
SPZs	75° S ± 3°	SPZn	70° S ± 3°
SPBs	70° S ± 3°	SPBn	65° S ± 3°
SSSTBs	50.9° S ± 1°	SSSTBn	46.9° S ± 1°
SEBs	23.6° S ± 0.2°	SEBn	8.6° S ± 0.2°
NEBs	7.3° N ± 0.1°	NEBn	20.0° N ± 0.2°
NNTBs	34.5° N ± 0.5°	NNTBn	37.6° N ± 1°
EB	3.5° S ± 0.5°		

Table 4: Belt and Zone Latitudes (methane band, 0.89μm light)

Feature	Latitude	Feature	Latitude
SPRn	68.4° S ± 1°	STrZs	28.7° S ± 1°
SEBs	21.3° S ± 1°	SEBn	6.6° S ± 1°
NEBs	7.2° N ± 1°	NEBn	17.8° N ± 1°
NTBs	21.9° N ± 1°	NTBn	27.6° N ± 1°
NNTBs	35.1° N ± 1°	NNTBn	37.7° N ± 1°
NNNTBs	42.2° N ± 1°	NPRs	65.0° N ± 1°

(both components), NPR = SPR, STB, EZ, STrZ and NTrZ in that order.

The writer measured latitudes of Jovian features from images in the same way as in Peek (1981, 49) (see Table 3). The EB was farther south than in the previous apparition. Other belt and zone boundaries were similar to what they were in the 2004-05 apparition.

The writer also measured the latitudes of Jovian features from methane band images (see Table 4). The two largest changes compared to the previous apparition are the southward shifting of the SPRn and NEBs.

Table 5 lists the dimensions of several oval features and Table 6 lists the dimensions of several dark ovals in the NNTC-jetstream. In all cases, measurements were made by the writer using the same method as in Schmude (2002, 26).

Figures 1 and 2 show a selection of drawings and images made of the planet. Figure 3 shows the longitude-versus-date graphs for all features except S10 (see page 38 for this data). Figure 4 shows miscellaneous graphs and Figure 5 shows a map of Jupiter and its polar regions made by Peach. Tables 7 through 9 list feature names and respective drift rates. Table 10 summarizes wind speeds, Tables 11 and 12 summarize whole-disc photometric measurements and Table 13 lists several oscillating spots.

Some feature names are arbitrarily assigned in each apparition. For example, the feature B1 in the 2005-06 apparition was probably not the same feature as B1 in the previous one.

Region I: Great Red Spot

Heath described the GRS as having a delicate pink hue on several dates. Adamoli stated that it had a pale color. The GRS generally had a light orange color in red-green-blue (RGB) images. Its

Table 5: Shapes and Sizes of Oval Features on Jupiter[a,b] (2005 - 06 Apparition)

Feature	Area (10^6 km^2)	Aspect	NS × EW Dimension (km)	Feature	Area (10^6 km^2)	Aspect	NS × EW Dimension (km)
A1	15±2	0.95	4200 × 4500	A2	13±2	0.86	3700 × 4300
A3	9±2	1.02	3500 × 3400	A4	4±1	0.89	2200 × 2500
A5	9±2	0.86	3100 × 3600	A6	7±2	1.02	3000 × 2900
B1	16±3	0.76	3900 × 5100	B2	18±3	0.70	4000 × 5600
B3	14±2	0.74	3700 × 5000	B4	13±2	0.71	3400 × 4800
B5	20±3	0.81	4500 × 5600	B6	5±1	0.77	2100 × 2800
B8	6±2	0.69	2300 × 3400	B9	7±2	0.79	2700 × 3500
B12	111±10	0.24	5800 × 24,400	B14	8±2	0.91	3100 × 3400
B18	21±3	0.54	3800 × 5100	C2	10±2	0.78	3100 × 4000
C3	6±2	0.60	2200 × 3700	C5	2±1	0.60	1400 × 2300
Oval BA	94±7	0.57	8200 × 14,600	N1	9±2	0.63	2600 × 4200
N2	7±2	0.62	2400 × 3800	N3	15±3	0.66	3600 × 5400
N4	14±3	0.57	3200 × 5600	N5	17±3	0.68	3800 × 5600
N6	27±4	0.46	4000 × 8700	N7	10±2	0.66	3000 × 4500
N8	7±2	0.70	2400 × 3500	N9	16±3	0.65	3600 × 5500
N11	8±2	0.66	2500 × 3900	N12	34±4	0.63	5200 × 8300
H23	18±3	0.76	4200 × 5500	H25	7±2	0.59	2400 × 4000
H26	25±3	0.62	4400 × 7100	H29	4±1	0.87	2200 × 2600
I1	8±2	0.87	3000 × 3400	I4	6±2	0.96	2700 × 2800
I6	6±2	0.93	2700 × 2800	I7	7±2	0.69	2500 × 3600
I2	8±2	0.84	2900 × 3500	GRS Methane	160±9	0.59	10,900 × 18,600

[a]The Aspect is the north south dimension (to four significant figures) divided by the east-west dimension (to four significant figures). The aspect is reported to two significant figures and the dimensions are reported to the nearest 100 km.

[b]Uncertainties are 500 km for the NS and EW dimensions.

general appearance is shown in Figures 1A, 1E, 1F, 2D, 2J and 5B.

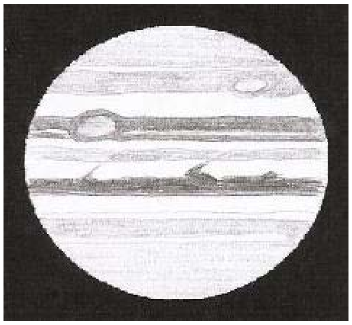
The GRS area in methane-band light was 160 ± 9 million km^2 (62 million square miles). This is similar to what it was in the previous apparition, but was ~10% smaller than the average area for 1998-2004 (Schmude, 2007a, 39; 2007b, 31; 2008a, 35, 2008b) (Schmude and McAnally, 2006, 49). Rogers (2008, 14) reports that the internal circulation period in the GRS has decreased from ~7 days in 1979 to ~4.5 days in 2006. He also reports that the GRS is shrinking. The changing size is consistent with the smaller area measured in the methane band.

The system II drift rate of the GRS in 2006 was 1.1°/30 days. This is similar to what it was in the previous apparition. Its latitude, 22.1° S, is in good agreement with the values reported by Rogers (2008, 19).

Region II: South Polar Region to the South Tropical Zone

White light intensity estimates are consistent with both polar regions being equally dark. The SPR, however, was a bit brighter than the NPR in several images including an April 3 blue filter image by Parker (see Figure 2A). Both polar regions, however, were almost equally dark in Parker's April 3 red and green filter images. The SPR was also brighter than the NPR in an April 18 ultraviolet image (wavelength = 0.365 µm) by Pellier.

Peach constructed a map of Jupiter and its polar regions from his April images in visible-light and the software package WINJUPOS (see figures 5A and 5B). His south polar map shows a dark south polar cap, with a radius of ~15 degrees of latitude, surrounded by a bright zone and then by a dark belt. The dark belt is the South Polar Band (SPB) described in Schmude (2008b, 30) and recorded earlier by Rogers and Foulkes in 1996. The bright zone is not in the 1996 map of the SPR (Rogers and Foulkes, 2001, 68). Peach (Apr. 19), Carvalho (Apr. 24) and Pellier (Apr. 28) have all imaged this



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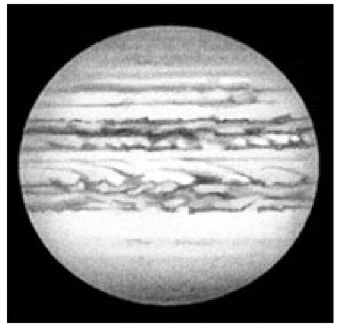

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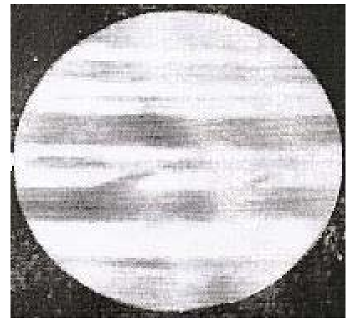

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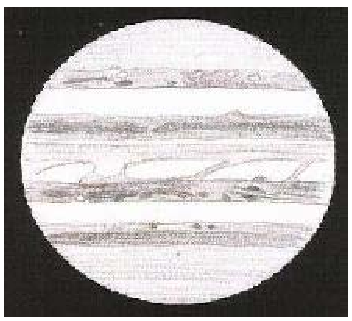

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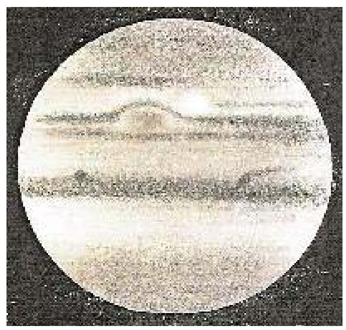

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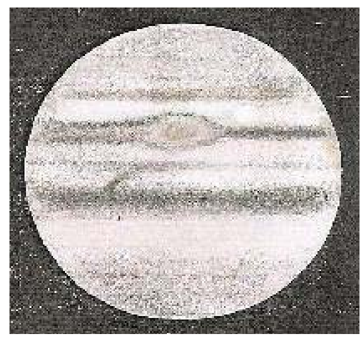

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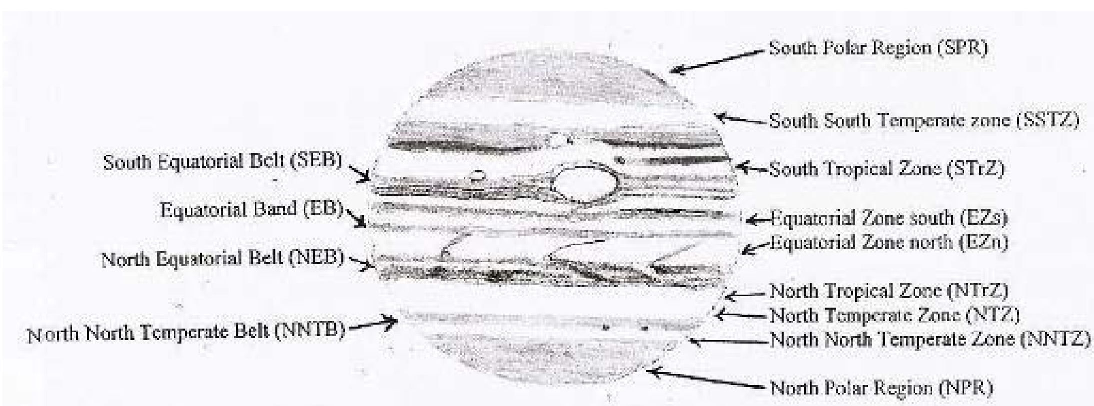

G

Figure 1: Drawings of Jupiter made in 2006. In all cases, south is at the top. The preceding limb is at the left for all figures except for B where this limb is on the right. A: Apr. 8 (11:35 UT) by Brian Cudnik, 0.32 m (12.5 inch) reflector, seeing = 6-8, no filter, λ_I = 333º, λ_{II} = 125º; B: Apr. 10 (4:42-5:07 UT) by Sol Robbins, 0.15 m Refractor, no filter, seeing = 7-8, λ_I = 45º, λ_{II} = 183º; C: May 18 (21:20 UT) by Gianluigi Adamoli, 0.13 m (5 inch) Maksutov-Cassegrain, seeing = ~7, λ_I = 171º, λ_{II} = 14º; D: May 25 (1:30 UT) by Brian Cudnik, 0.32 m (12.5 inch) Reflector, seeing = 7-10, λ_I = 192º, λ_{II} = 348º; E: June 2 (22:00 UT) by Alan Heath, 0.25 m (10 inch) reflector, seeing = fair, λ_I = 45º, λ_{II} = 134º; F: June 9 (22:05 UT) by Alan Heath, 0.25 m (10 inch) reflector, seeing = fair, λ_I = 74º, λ_{II} = 109º; G: May 25 (4:45 UT) by Brian Cudnik, 0.32m (12.5 inch) reflector, seeing = fair, λ_I = 311º, λ_{II} = 106º.

Table 6: Shapes and Sizes of Dark Oval Storms in the NNTBs Jetstream. [a,b] (2005 - 06 Apparition)

Feature	Area (10^6 km^2)	Aspect	NS × EW Dimension (km)	Feature	Area (10^6 km^2)	Aspect	NS × EW Dimension (km)
H1	6±2	0.73	2500 × 3400	H2	5±1	0.72	2100 × 2900
H3	6±2	0.59	2040 × 3500	H4	4±1	0.70	1800 × 2600
H5	3±1	0.81	1700 × 2000	H6	4±1	0.70	1900 × 2700
H7	4±1	0.91	2100 × 2300	H8	7±2	0.80	2700 × 3400
H9	9±2	0.85	3100 × 3600	H11	11±2	0.71	3100 × 4400
H12	13±2	0.96	4100 × 4200	H13	7±2	0.96	3000 × 3100
H14	5±1	0.88	2400 × 2700	H15	6±2	0.68	2200 × 3300
H16	8±2	0.96	3100 × 3200	H17	7±2	0.66	2500 × 3700
H18	6±2	0.91	2600 × 2900	H19	7±2	0.95	2900 × 3000
H20	10±2	0.97	3500 × 3600	H21	7±2	0.88	2800 × 3100
H22	6±2	0.70	2400 × 3400				

[a]The aspect is described in Table 5.

[b]Uncertainties are 500 km for the NS and EW dimensions.

bright zone in 2006, and Biver drew this feature on July 1, 2006. This bright ring is tentatively called the South Polar Zone (SPZ). Its approximate latitudes are listed in Table 3.

The SPR was consistently brighter than the NPR in methane band light. The NPR brightening, however, had a greater east-west dimension than the SPR brightening. Northward projections from the SPR were imaged by Parker (see Figure 2K) and by the Hubble Space Telescope (Rogers, 2003, 138).

The white ovals (A1, A3, A6) near 61° S had an average system II drift rate of -4.7°/30 days. This is different than the rates between 1996 and 2005, average =-20.1°/30 days (Schmude, 2004a, 38; 2007a, 45; 2007b, 36; 2008a, 40), (Schmude and McAnally, 2006, 57) and the rate measured by Rogers and co-workers in 2000-01, -17°/30 days (Rogers et al. 2004, 203). One possible reason for this difference is the oscillating drift rate of A1 (see figures 3 and 4H). This oscillation is similar to spots described by Peek (1981, 186). Oval A1 may have oscillated because its latitude changed. Figure 4I shows the planetographic latitude of this feature for different dates. There was a tendency for A1 to have a system II drift rate of ~ -15° to -40°/30 days when the latitude was around 61° S, but the drift rate approached 0°/30 days when the latitude of A1 reached 64° S. García-Melendo and Sánchez-Lavega (2001, 324) report that winds on Jupiter between 1995 and 1998 dropped from 25.8 m/s at 60.9° S to 7.5 m/s at 63.9° S; this is consistent with the movements of A1.

Two white ovals (A2 and A5) and one dark spot (A10) near 53° S followed the S^4TC even though their latitudes are consistent with the southern edge of the S^3TC. These features had an average system II drift rate of -16.7°/30 days. This is similar to the S^4TC drift rate between 2001 and 2004 (Schmude, 2003, 47; 2007b, 36; 2008a, 40).

A white oval (A4) at latitude 50.8° S followed the S^3TC (South) or S^3TC (S) and two dark spots (A7, A8) at latitude ~48° S followed the S^3TC (North) or S^3TC (N). These two currents are described elsewhere (Rogers, 1995, 240). Feature A4 in the S^3TC (S) had a system II drift rate of 0.2°/30 days. The corresponding average rate for A7 and A8 is -18.5°/30 days.

The 11 white ovals B1-B6, B8, B9, B12, B14, and B18 followed the SSTC. The average system II drift rate for this current was -26.3°/30 days. This is consistent with previous rates (Rogers, 1995, 238).

The mean area and aspect values of the SSTC white ovals, excluding the unique feature, B12, are 13 million km^2 (5 million square miles) and 0.74. The respective values in the previous four apparitions, averaged together, are 15 million km^2 and 0.84 (Schmude, 2003, 45; 2007a, 31; 2008a, 35; 2008b).

Four white ovals (C2, C3, C5, C14) along with Oval BA and a dark spot (C1) followed the STC. The average system II drift rate for this current was -13.5°/30 days. This is consistent with historical values (Peek, 1981, 118-119). Oval BA is shown in Figures 1A and 1B.

The color of Oval BA changed from white to orange during the second half of 2005. Christopher Go pointed out this change in early 2006. Oval BA soon became informally known as the “Little Red Spot” due to its apparent resemblance to the larger GRS. But what caused this shift in color? In an attempt to answer this, the writer carried out measurements of Oval BA’s length, area and drift rate. Length and area measurements were made monthly between 2000 and 2006 and the results are shown in Figures 4F and 4G. Both figures show that Oval BA grew larger during the second half of 2005. The system II drift rates (apparition averages in degrees/30 days) were: 2000-01 (-11.9), 2001-02 (-12.2), 2002-03 (-9.3), 2003-04

Table 7: Drift Rates of Features South of the Equatorial Zone (2005 - 06 Apparition)

Feature	Number of Points	Planetographic Latitude	Drift Rate Deg/30 days System II	Feature	Number of Points	Planetographic Latitude	Drift Rate Deg/30 days System II
South Polar Current [SPC]							
A1	48	60.4° S	-7.5	A3	8	61.9° S	0.0
A6	16	61.7° S	-6.6				
Average		61.3° S	-4.7				
South South South South Temperate Current [S^4TC]							
A2	15	53.9° S	-10.8	A5	26	52.2° S	-19.2
A10	10	51.9° S	-20.0				
Average		52.7° S	-16.7				
South South South Temperate Current (S) [S^3TC (S)]							
A4	17	50.8° S	0.2				
South South South Temperate Current (N) [S^3TC (N)]							
A7	10	47.3° S	-25.1	A8	21	48.3° S	-11.9
Average		47.8° S	-18.5				
South South Temperate Current [SSTC]							
B1	83	42.1° S	-26.2	B2	65	41.8° S	-27.1
B3	58	41.3° S	-26.0	B4	63	41.5° S	-26.7
B5	73	42.6° S	-26.1	B6	27	41.9° S	-23.9
B8	53	42.1° S	-26.6	B9	58	42.4° S	-26.9
B12	24	39.9° S	-26.9	B18	39	40.0° S	-25.0
B14	47	40.1° S	-27.9				
Average		41.4° S	-26.3				
South Temperate Current [STC]							
Oval BA	92	33.9° S	-13.4	C1	80	31.1° S	-17.7
C2	46	34.3° S	-12.3	C3	69	34.4° S	-13.4
C5	11	33.3° S	-8.3	C14	10	33.9° S	-15.9
Average		33.5° S	-13.5				
South Temperate Current-Special [STC-Special]							
C7	8	35.1° S	13.9	C8	14	35.4° S	29.4
C9	8	34.8° S	19.1	C10	10	34.3° S	15.9
C11	10	34.5° S	16.6	C12	9	34.2° S	15.0
Average		34.7° S	18.3				
South Tropical Current [STrC]							
S1	25	23.6° S	4.5	S2	22	23.6° S	8.5
S3	6	23.6° S	5.8	S4	23	23.6° S	8.0
S5	16	23.6° S	22.5	S6	11	23.6° S	23.6
S7	33	17.6° S	3.3	S8	12	17.7° S	5.8
S9	14	23.6° S	0.7	S11	9	23.6° S	1.3
S13	10	23.7° S	-4.7	GRS	127	22.1° S	1.1
S10	8	23.6° S	5.2				
Average		22.6° S	6.6				
South Equatorial Belt Current Following the GRS [SEBC white spots following GRS]							
S14	7	16.4° S	-32.3	S15	7	16.6° S	-40.1
S16	9	12.8° S	-57.2	S17	10	13.7° S	-60.9
S18	9	13.3° S	-72.5	S19	18	12.0° S	-59.7
S30	5	13.6° S	-45.2	S23	8	13.1° S	-73.1

Table 7: Drift Rates of Features South of the Equatorial Zone (2005 - 06 Apparition) (Continued)

S24	7	12.3° S	-72.2	S25	6	14.5° S	-62.8
S26	6	13.2° S	-69.0	S27	18	12.2° S	-71.1
S28	11	11.7° S	-55.5	S29	5	13.0° S	-43.4
Average		13.5° S	-58.2				

(-13.0), 2004-05 (-12.9) and 2005-06 (-13.4) (Rogers et al. 2004, 202; 2008, 205), (Schmude, 2007a, 45; 2003, 47; 2007b, 36; 2008a, 40). The drift rate of oval BA was highest in an eastward direction in 2005-06. Therefore oval BA increased in size and its average drift rate increased at about the same time that its color changed.

A string of small dark spots developed just following a dark section of the STB (see Figure 2B). These spots had an average system II drift rate of 18.3°/30 days. This is different than the STC, even though these dark spots were near the latitude of the STC. They are placed in the "South Temperate Current-Special" category in Figure 3 and Table 7. More data, however, are needed to confirm if this is a new current or if other factors are at work.

Four white ovals (S1-S3, S13), four low projections (S4-S6, S9), two condensations on the SEBn (S10, S11), one condensation in the SEB (S8) and one low projection or condensation in the SEB (S7) were present between 17° S and 24° S. In all cases, the descriptions follow Schmude (2004b, 4). The average system II drift rate for all of these features plus the GRS was 6.6°/30 days. Even though S7 and S8 were ~5° north of the other features, their drift rates were consistent with them. The dates and longitudes for S10 are not shown in Figure 3 and so they are given here: May 28.1 (163°); June 1.3 (164°); June 2.1 (162°); June 4.2 (159°); June 7.9 (160°); June 9.5 (159°); June 12.4 (168°) and June 12.9 (166°).

Region III: South Equatorial Belt

Fourteen bright spots (S14-S19, S23-S30) developed at longitudes following the GRS. In all cases, they developed in the SEB and underwent large changes in appearance in just a day or two. The average system II drift rate of all 14 features in degrees/30 days is -58.2, but individual drift rates ranged from -32.3 to -73.1. Historically, drift rates for bright spots following the GRS ranged from -25.5°/30 days (1930) to -66°/30 days (1981) (Rogers, 1995, 184-185).

Heath described the SEB as being "closely double" on June 7, 2006 (λ_2 = 157° W) but single a day later at λ_2 = 307° W. This is consistent with Figure 5B. He described its color as brownish. Niechoy usually drew the SEB as a single dark belt. Roussell drew the SEB as two dark belts separated by a light gray SEB zone on May 28. Cudnik noted a similar appearance on Aug. 26.

Region IV: Equatorial Zone

Eighteen festoons (E1-E18) in the EZn had an average system I drift rate of 2.1°/30 days. This is consistent with the historical record (Rogers, 1995, 144).

The writer attempted to measure the drift rates of the NEBs blue features but was not successful. These features changed in shape and appearance. The cause of the change is unknown.

Heath described the EZ as "quite shaded and equal to the SPR and NPR" on May 3. He made a similar statement on June 11. Roussell described the EZ as "decidedly dark" on May 4. Jamison reported that the EZ appeared veiled or shaded. Adamoli noted that the southern half of the EZ was darker than the northern half. On several occasions, bright spots were imaged near festoons (see Figure 2B). Heath reported a bright spot preceding festoon E1 on June 4.

Region V: North Equatorial Belt

Figures 1, 2 and 5B show the general appearance of the NEB. Heath described its color as brownish. Adamoli reported the NEB as the darkest belt with a brownish color. Nowell reports that the NEB had a different color than the SEB on May 28.

The writer measured the widths and positions of the south and north edges (NEBs and NEBn) of the NEB. These measurements were made at several different longitudes and were combined into monthly averages. The results are shown in Figures 4A, 4B and 4C. The NEB spanned 15° of latitude in October 2005 but became ~3° narrower by late 2006. Most of this change was due to the shifting position of the NEBn. There may have also been a small northward movement, ~1°, of the NEBs. Figures 4B and 4C are consistent with Peek's plate II which shows that most of the changing NEB width from 1908 to 1947 was due to the changing latitude of the NEBn.

Eleven white NEB ovals (N1-N9, N11-N12) had an average system II drift rate of -3.8/30 days. This is consistent with the NTrC (Rogers, 1995, 114-115).

During mid-2006, N6 overtook N5 and merged with it. Their diminishing distances are shown in Figures 2E through 2H and in Figure 4D. Once N5 and N6 merged, the new oval was named N12 (see Figure 2I). Its area was 77% of the combined areas of N5 and N6. Therefore N12 had a smaller area than the combined areas of N5 and N6. This is consistent with previous white oval mergers (Schmude, 2002, 29; 2007a, 39-41), (Schmude and McAnally, 2006, 47-49).

Six barges (N13-N16, N18-N19) had an average system II drift rate of 0.4°/30 days. This is consistent with the NTrC (Rogers, 1995, 114-115; 2004, 209).

Region VI: North Tropical Zone to the North Polar Region

The NTB was not obvious in visible light. Warren may have imaged this belt on

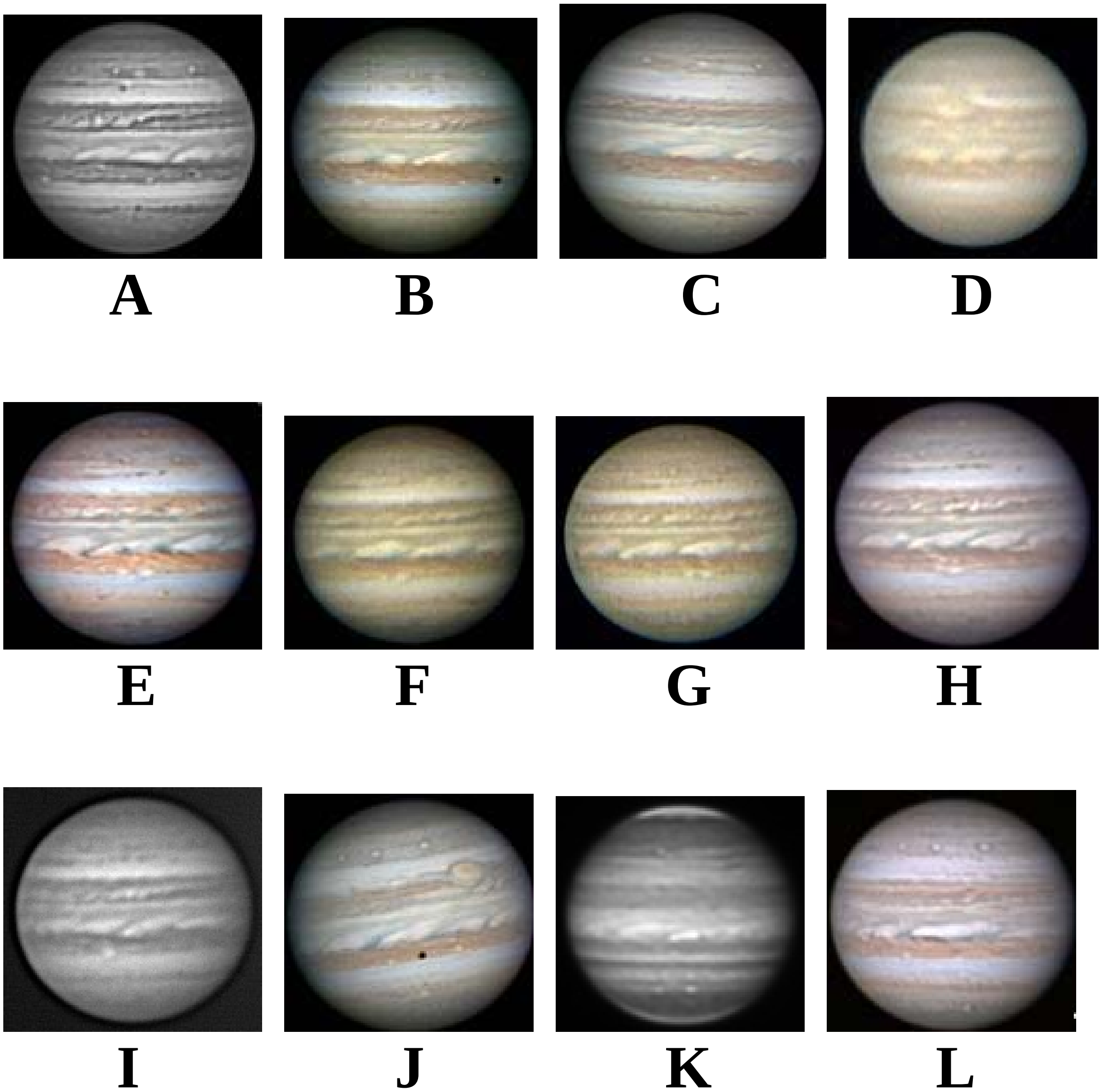

Figure 2: Images of Jupiter made in 2006. In all cases, south is at the top and the preceding limb is on the left. All images were made with RGB filters except where noted. A: Apr. 3 (7:32 UT) by Don Parker, 0.41 m (16 inch) reflector, blue filter, λ_I = 115º, λ_{II} = 306º; B: May 19 (13:53 UT) by Christopher Go, 0.28 m (11 inch) Schmidt-Cassegrain, λ_I = 57º, λ_{II} = 255º; C: Apr. 11 (5:48 UT) by Damian Peach, 0.36 m (14 inch) Schmidt-Cassegrain, λ_I = 236º, λ_{II} = 6º; D: June 18 (5:05 UT) by Joel Warren, 0.20 m (8 inch) Schmidt-Cassegrain, λ_I = 153º, λ_{II} = 125º; E: June 7 (3:31 UT) by Larry Owens, 0.36 m (14 inch) Schmidt-Cassegrain, λ_I = 159º, λ_{II} = 215º; F: June 12 (2:50 UT) by Rolando Chavez, 0.25 m (10 inch) Maksutov-Cassegrain, λ_I = 204º, λ_{II} = 222º; G: June 19 (3:03 UT) by Rolando Chavez, 0.25 m (10 inch) Maksutov-Cassegrain, λ_I = 237º, λ_{II} = 202º; H: June 24 (2:34 UT) by Don Parker, 0.41 m (16 inch) Newtonian, λ_I = 289º, λ_{II} = 215º; I: June 27 (20:03 UT) by Christophe Pellier, 0.21 m (8 inch) Newtonian, Green light, λ_I = 322º, λ_{II} = 220º; J: Apr. 14 (5:15 UT) by Damian Peach, 0.36 m (14 inch) Schmidt-Cassegrain, λ_I = 330º, λ_{II} = 78º; K: June 27 (1:51 UT) by Don Parker, 0.41 m (16 inch) Reflector, methane band light – 0.889 µm, λ_I = 16º, λ_{II} = 280º; L: Aug. 5 (0:38 UT) by Don Parker, 0.41 m (16 inch) Reflector, λ_I = 6º, λ_{II} = 333º.

Table 8: Drift Rates of Festoons in the Equatorial Zone (2005 - 06 Apparition)

Feature	Number of Points	Planetographic Latitude	Drift Rate Deg/30 days System I	Feature	Number of Points	Planetographic Latitude	Drift Rate Deg/30 days System I
E1	80	7.3° N	1.2	E2	66	7.3° N	0.5
E3	47	7.3° N	5.4	E4	62	7.3° N	-0.6
E5	85	7.3° N	2.0	E6	80	7.3° N	5.4
E7	77	7.3° N	6.8	E8	77	7.3° N	6.5
E9	87	7.3° N	5.2	E10	96	7.3° N	3.0
E11	98	7.3° N	1.5	E12	87	7.3° N	0.3
E13	58	7.3° N	-0.7	E14	11	7.3° N	7.7
E15	13	7.3° N	4.4	E16	16	7.3° N	-6.3
E17	18	7.3° N	-4.9	E18	10	7.3° N	-0.2
Average		7.3° N	2.1				

June 18 (see Figure 2D). There were faint belts that may be the NTB in other images as well; however, they were not distinct. Adachi may have drawn this belt on March 20. Heath and Adamoli, however, did not observe this belt on several dates.

Due to the absence of the NTB, the NTrZ and NTZ appeared as one zone. Heath described the NTrZ as dull. He also stated that the STrZ was brighter than the NTrZ.

Almost two dozen dark ovals (H1-H9, H11-H22) at the south edge of the NNTB followed the NNTBs jetstream. Three of these are shown in Figure 1D. The average system II drift rate for these ovals was -84.3°/30 days. This is similar to rates measured between 1929 and 1991 (Rogers, 1995, 97) and 2004-05 (Schmude, 2008b). The average area and aspect values for these ovals were 7 million km^2 (a little less than 3 million square miles) and 0.81 respectively. The corresponding values in 2004-05 were 8 million km^2 and 0.82 (Schmude, 2008b). The drift rates of NNTBs jetstream ovals in 2006 did not change with the oval area, aspect or latitude.

The NNTB was drawn by Adamoli (Figure 1C) and was imaged by several observers (see figures 2A, 2C, 2H, 2I and 2L). This feature was discontinuous on April 11 (see Figure 2C).

Five white ovals (H23, H25, H26, H29, H30) one dark rod (H24), two barges (H28, H31) and one condensation (H27) followed the NNTC. The average system II drift rate of these nine features was -2.2°/30 days. This is consistent with historical rates (Rogers, 1995, 88-89).

Six white ovals (I1-I3, I5-I7) followed the NNNTC. Their average system II drift rate was -18.3°/30 days. This is consistent with rates measured between 1900 and 1990 (Rogers, 1995, 90). Ovals I5 and I6 merged in mid-2006. Figure 4E shows their diminishing distances.

The white ovals I4, I8 and I9 followed the N^{4}TC. Their average system II drift rate was 8.8°/30 days. The average rate of the N^{4}TC between 1881 and 1991 is 1.4°/30 days. (Rogers, 1995, 90).

Wind Speeds

Table 10 summarizes wind speeds. The wind speeds are with respect to the system III longitude. They were computed in the same way as in Rogers (1995, 392). Uncertainties were computed in the same way as in Schmude (2003, 50).

Satellite Observations

Several observers imaged Jupiter's moons. Parker imaged Ganymede transiting Jupiter on Aug. 5, 2006 (see Figure 2L). Ganymede was brighter than the NPR, an aspect which was unexpected. In past studies that moon is always darker than surrounding Jovian surface features when it is near Jupiter's central meridian. Peach imaged Ganymede in a half-phase on April 14. That moon had a half-phase because it was partially covered by Jupiter's shadow. Go imaged Io transiting Jupiter's NEB and NTrZ (see Figure 2B). Io's polar caps were dark and appeared to extend down to about 30° N and 30° S. The dark caps in 2006 appeared smaller than in 2001 (Rogers, 2003, 126).

Photoelectric Photometry

The writer used an SSP-3 photometer along with a 0.09 m (3.5 inch) Maksutov telescope and color filters transformed to the Johnson B, V, R and I system in making all magnitude measurements in Table 11. The equipment is described elsewhere (Schmude, 1992), (Optec, 1997). All measurements were corrected for both atmospheric extinction and color transformation in the same way as in Hall and Genet (1988, Chapter 13). The comparison star for all measurements was alpha-Serpentis. The check star on April 28 and May 2 was zeta-Ophiuchi. The measured magnitudes for the check star were B = 2.67, V = 2.59, R = 2.48 and I = 2.53. The V, R and I magnitudes are close to the accepted values but the B magnitude is 0.08 magnitudes brighter than expected. For this reason, a larger uncertainty is assigned to the selected B(1,0) value. In all cases, star magnitudes are from Iriarte et al. (1965).

Normalized magnitudes, X(1,α), were computed in the same way as in Schmude and Lesser (2000, 68); X represents the B,

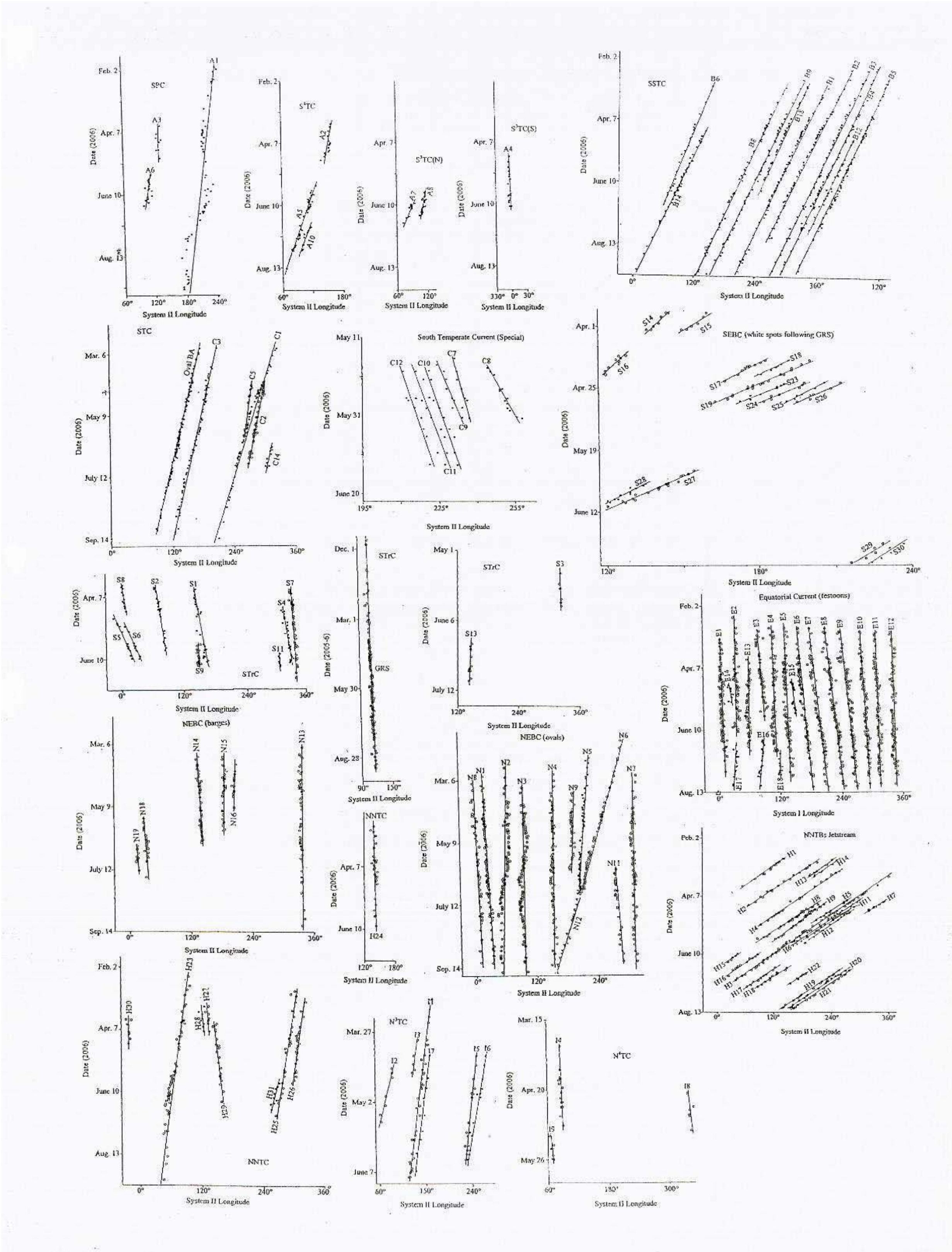

Figure 3: Drift rates for various features on Jupiter during the 2005-06 apparition.

Table 9: Drift Rates of Features North of the Equatorial Zone (2005 - 06 Apparition)

Feature	Number of Points	Planetographic Latitude	Drift Rate Deg/30 days System II	Feature	Number of Points	Planetographic Latitude	Drift Rate Deg/30 days System II
North Tropical Current (NTrC ovals) or North Equatorial Belt Current, ovals							
N1	75	17.7° N	2.8	N2	82	17.7° N	-3.8
N3	95	17.4° N	-1.6	N4	84	18.5° N	-0.3
N5	72	17.8° N	-5.0	N6	67	19.8° N	-16.6
N7	70	17.8° N	-0.1	N8	48	18.1° N	2.7
N9	36	18.0° N	-1.2	N11	25	18.8° N	0.0
N12	20	19.0° N	-18.6				
Average		18.2° N	-3.8				
North Tropical Current (NTrC barges) or North Equatorial Belt Current, barges							
N13	52	15.9° N	0.0	N14	51	14.9° N	2.6
N15	32	15.1° N	-1.5	N16	14	14.2° N	-2.7
N18	20	15.7° N	3.6	N19	12	15.2° N	0.2
Average		15.2° N	0.4				
North North Temperate Current B (or the NNTBs Jetstream)							
H1	14	34.0° N	-79.5	H2	20	34.4° N	-86.4
H3	57	35.0° N	-83.8	H4	24	33.6° N	-80.8
H5	9	34.6° N	-89.4	H6	26	34.7° N	-89.9
H7	7	35.2° N	-105.2	H8	24	33.5° N	-89.5
H9	27	33.6° N	-74.6	H11	18	35.0° N	-88.3
H12	12	34.9° N	-82.4	H13	7	32.7° N	-80.4
H14	7	33.0° N	-80.9	H15	5	34.7° N	-63.6
H16	11	35.4° N	-84.8	H17	11	34.7° N	-86.3
H18	12	33.8° N	-89.0	H19	15	34.6° N	-87.5
H20	15	34.8° N	-85.1	H21	15	34.6° N	-84.0
H22	7	34.9° N	-79.7				
Average		34.4° N	-84.3				
North North Temperate Current [NNTC]							
H23	61	40.5° N	-8.5	H24	34	39.4° N	1.3
H25	25	41.0° N	-9.0	H26	24	40.7° N	-7.4
H27	7	41.3° N	6.7	H28	8	41.6° N	3.4
H29	25	42.5° N	5.7	H30	7	40.8° N	3.4
H31	9	37.1° N	-15.2				
Average		40.5° N	-2.2				
North North North Temperate Current [N^3TC]							
I1	37	45.8° N	-15.6	I2	8	45.9° N	-27.6
I3	6	46.2° N	-13.9	I5	14	46.4° N	-14.4
I6	14	46.2° N	-22.5	I7	11	45.7° N	-15.5
Average		46.0° N	-18.3				
North North North North Temperate Current [N^4TC]							
I4	16	52.0° N	3.8	I8	6	52.8° N	9.5
I9	7	53.5° N	13.1				
Average		52.8° N	8.8				

Table 10: Average Drift Rates, Rotation Periods and Wind Speeds* for Several Currents on Jupiter (2005-06 apparition)

Current	Feature(s)	Drift Rate (deg/30 days)			Rotation Period	Wind Speed (m/s)
		System I	System II	System III		
SPC	A1, A3, A6	224.2	-4.7	3.3	9h 55m 34s	0.8 ± 0.3[a]
S^4TC	A2, A5, A10	212.2	-16.7	-8.7	9h 55m 18s	2.6 ± 0.4
S^3TC (S)	A4	229.1	0.2	8.2	9h 55m 41s	-2.6 ± 1.0[a]
S^3TC (N)	A7, A8	210.4	-18.5	-10.5	9h 55m 15s	3.5 ± 1.1
SSTC	B1-B6, B8, B9, B12, B14, B18	202.6	-26.3	-18.3	9h 55m 05s	6.8 ± 0.2
STC	Oval BA, C1-C3, C5, C14	215.4	-13.5	-5.5	9h 55m 22s	2.2 ± 0.3
STC-Special	C7-C12	247.2	18.3	26.3	9h 56m 06s	-10.6 ± 0.4
STrC	S1-S11, S13, GRS	235.5	6.6	14.6	9h 55m 50s	-6.5 ± 0.3
SEBC white spots following the GRS	S14-S19, S23-S30	170.7	-58.2	-50.2	9h 54m 21s	23.9 ± 0.5
EC	E1-E18	2.1	-226.8	-218.8	9h 50m 33s	104.4 ± 0.3
NTrC ovals	N1-N9, N11, N12	225.1	-3.8	4.2	9h 55m 36s	-1.9 ± 0.4
NTrC barges	N13-N16, N18, N19	229.3	0.4	8.4	9h 55m 41s	-3.9 ± 0.3
NNTBs Jetstream	H1-H9, H11-H22	144.6	-84.3	-76.3	9h 53m 46s	30.9 ± 0.2
NNTC	H23-H31	226.7	-2.2	5.8	9h 55m 38s	-2.2 ± 0.4
N^3TC	I1-I3, I5-I7	210.6	-18.3	-10.3	9h 55m 16s	3.6 ± 0.3
N^4TC	I4, I8, I9	237.7	8.8	16.8	9h 55m 53s	-5.1 ± 0.4

*The wind speed is the speed that a current moves with respect to the system III longitude; it is computed from the equation in Table A1.2 on p. 392 of Rogers (1995).

[a]Estimated uncertainty

V, R or I filter. The X(1,α) and α values were fitted to linear equations using a least squares routine (Schmude and Lesser, 2000, 68-69). The resulting solar phase angle coefficients c_X and normalized magnitudes X(1,0) are summarized in Table 12. Uncertainties for the V, R and I filter results were computed in the same way as in Schmude (1998, 178-179). Larger uncertainties were selected for the B filter results because of the inconsistency with the check star measurement. The selected B(1,0) and V(1,0) values for Jupiter are similar to those between 1999 and 2005, but the R(1,0) and I(1,0) values are dimmer than expected (Schmude, 2003, 41; 2007a, 31; 2007b, 33; 2008a, 45); (Schmude and Lesser, 2000, 67). The solar phase angle coefficients in the B, V and R filters are close to the values in 1999-2005 but the I filter value is lower than expected.

West used a 0.25 m (10 inch) Schmidt-Cassegrain telescope along with an SSP-4 photometer to measure the J and H magnitudes of Jupiter. He reported magnitudes of J = -1.94±0.05 and H = -1.46±0.05 on Dec. 12, 2005 and J = -2.00±0.05 and H = -1.55±0.05 on Jan. 7, 2006. These values were not corrected for extinction or transformation.

Oscillating Spots

Several spots oscillated in longitude during 2006. A few of the obvious examples are listed in Table 13 along with examples from previous apparitions. Several other spots had suspected oscillations but were not listed in Table 13. Peek (1981, 187) pointed out that the oscillating spot in 1941-42 changed in both longitude and latitude. This was also the case for A1 in 2005-06.

Acknowledgements

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Table 11: Photometric Magnitude Measurements of Jupiter (2005 - 06 Apparition)

Date (2006)	Filter	α	Measured Magnitude	X(1,α)	Date (2006)	Filter	α	Measured Magnitude	X(1,α)
Feb. 5.429	V	10.5°	-2.00	-9.32	Feb. 5.442	B	10.5°	-1.10	-8.42
Feb. 5.460	R	10.5°	-2.43	-9.75	Feb. 5.474	I	10.5°	-2.33	-9.65
Feb. 27.382	V	10.1°	-2.13	-9.30	Feb. 27.401	B	10.1°	-1.30	-8.46
Feb. 27.413	R	10.1°	-2.57	-9.74	Feb. 27.424	I	10.1°	-2.46	-9.63
Mar. 26.301	V	7.2°	-2.32	-9.34	Mar. 26.311	B	7.2°	-1.44	-8.45
Mar. 26.322	R	7.2°	-2.76	-9.77	Mar. 26.332	I	7.2°	-2.65	-9.66
Apr. 5.216	R	5.6°	-2.83	-9.80	Apr. 5.226	I	5.6°	-2.69	-9.66
Apr. 5.245	V	5.6°	-2.36	-9.33	Apr. 5.254	B	5.6°	-1.55	-8.51
Apr. 10.253	V	4.7°	-2.40	-9.34	Apr. 10.264	B	4.7°	-1.55	-8.50
Apr. 10.274	R	4.7°	-2.85	-9.79	Apr. 10.283	I	4.7°	-2.72	-9.67
Apr. 18.212	V	3.3°	-2.42	-9.34	Apr. 18.231	R	3.3°	-2.85	-9.77
Apr. 18.240	I	3.3°	-2.67	-9.59	Apr. 23.157	R	2.4°	-2.89	-9.80
Apr. 23.174	I	2.4°	-2.73	-9.64	Apr. 23.197	V	2.4°	-2.46	-9.37
Apr. 23.215	B	2.4°	-1.60	-8.51	Apr. 25.206	V	2.0°	-2.46	-9.37
Apr. 28.187	V	1.4°	-2.46	-9.36	Apr. 28.203	B	1.4°	-1.58	-8.48
Apr. 28.217	R	1.4°	-2.89	-9.79	Apr. 28.233	I	1.4°	-2.74	-9.64
May 2.182	V	0.6°	-2.49	-9.38	May 2.201	B	0.6°	-1.61	-8.50
May 2.214	R	0.6°	-2.90	-9.80	May 2.229	I	0.6°	-2.74	-9.63

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Table 12: Photometric Constants of Jupiter (2005 - 06 Apparition)

Filter	X(1,0)	c_x (magnitude/degree)
B	-8.51 ± 0.05[a]	0.0060 ± 0.0030[a]
V	-9.37 ± 0.01	0.0063 ± 0.0013
R	-9.80 ± 0.01	0.0047 ± 0.0015
I	-9.63 ± 0.02	-0.0020 ± 0.0033

[a]These are estimated uncertainties; see text for details.

Table 13: Oscillating Spots on Jupiter (2005 - 06 and Other Apparition)

Feature Description	Feature Name	Apparition	Amplitude (Degrees Longitude)	Period (days)	Location	Amplitude (Degrees Latitude)
White oval	A1	2005-06	19	150	SPC	1
Festoon	E5	2005-06	5	180	EC	---
White oval	N2	2005-06	8	180	NTrC	--
White oval	N3	2005-06	8	140	NTrC	---
White oval	H23	2005-06	6	190	NNTC	---
GRS[a]	GRS	2001-06	0.5	89-91	STrC	0.1
Barge	N11	2002-03	1-2	70	NTrC	---
White oval	N7	2002-03	3	110	NTrC	---
Barge	C4	1990-91	3	17	STC	---
Dark oval	Oscillating Spot	1987-88	4	18	STC	---
White oval[b]	Oval BC	1983-1988	10	1000	STC	1
White oval[b]	Oval DE	1984-1988	6	800	STC	1
Dark spot[c]	---	1940	2-6	60	STC	---
Dark spot[c]	--	1941-42	3-9	60	STC/STrC	2-3

[a]Rogers (2008, 19)
[b](Rogers, 1995, Fig. 11.13)
[c](Peek, 1981, p. 186, 188)

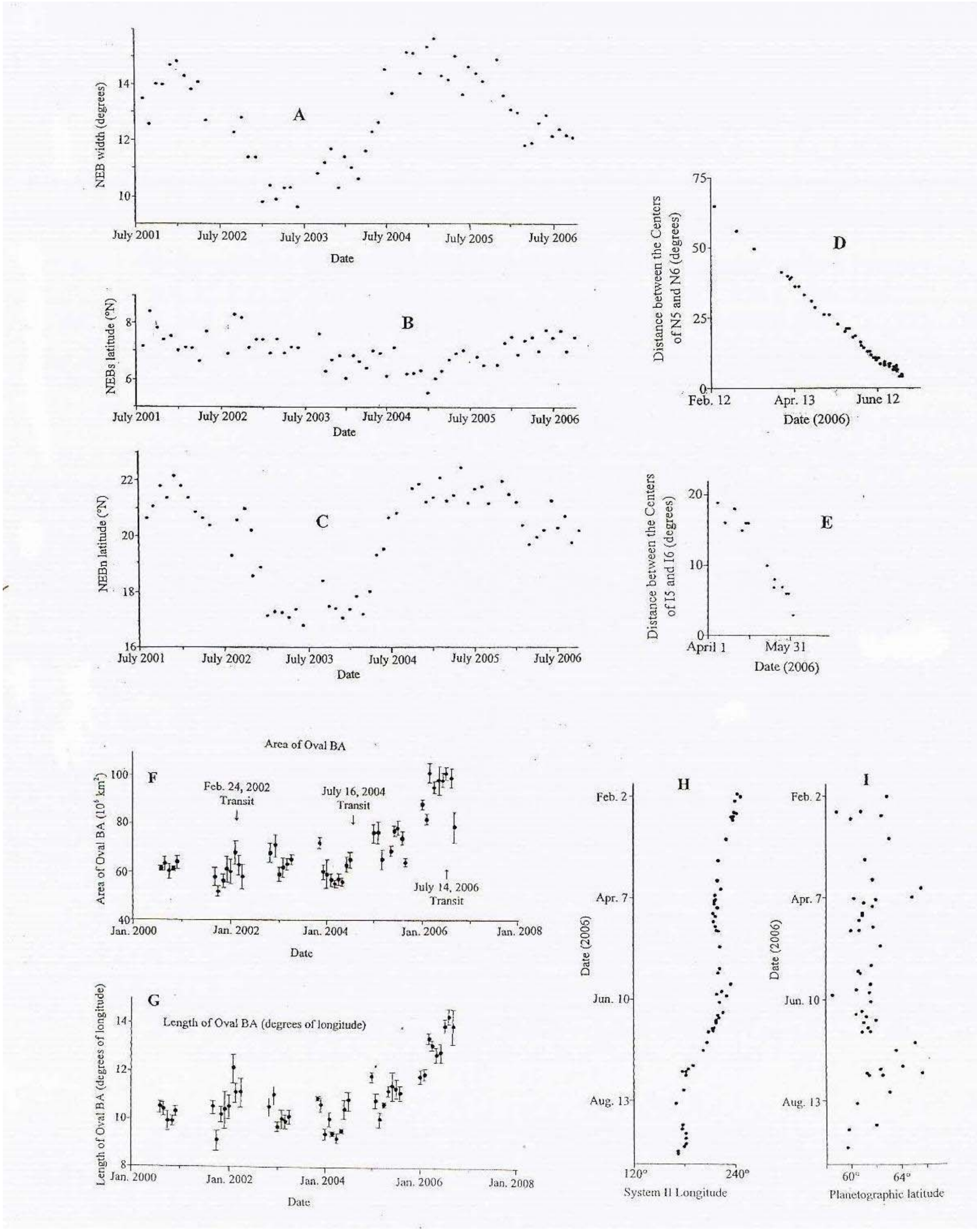
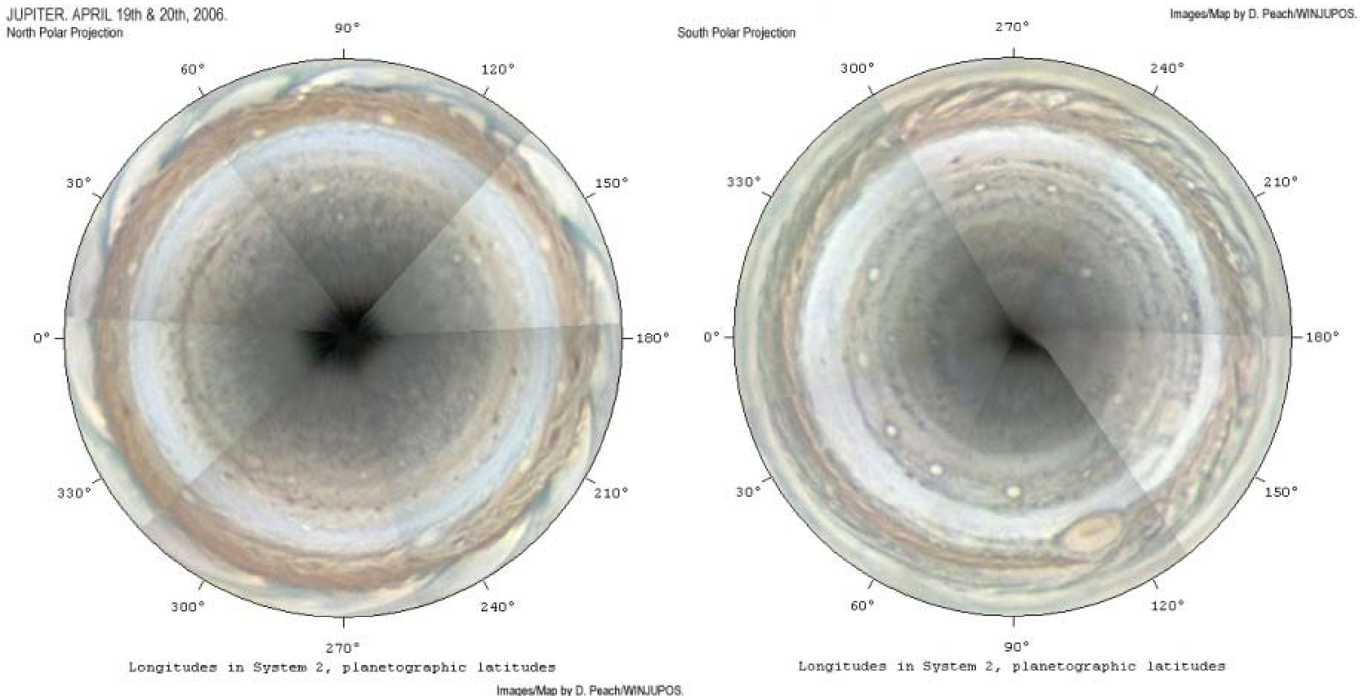
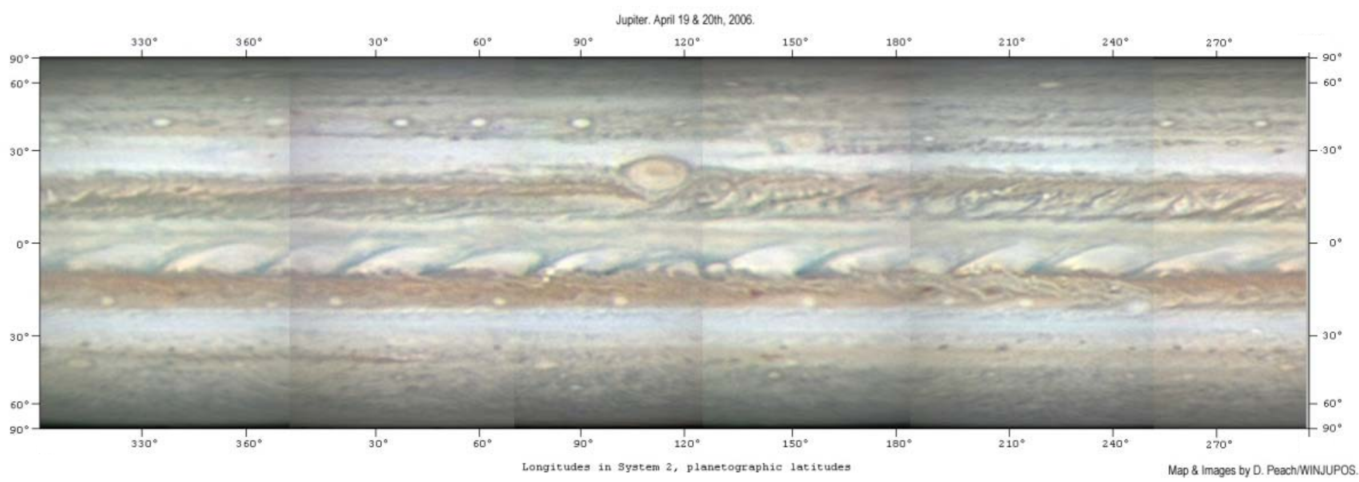


Figure 4: All graphs are based on visible-light images. A: The NEB width plotted against the date; B: the NEBs latitude plotted against the date; C: the NEBn latitude plotted against the date; D: the distance between the centers of N5 and N6 plotted against the date; E: the distance between the centers of I5 and I6 plotted against the date; F: The area of oval BA plotted against the date; G: The length of Oval BA plotted against the date; H: The date plotted against the system II longitude of the polar oval A1, I: the date plotted against the planetographic latitude of the polar oval A1.



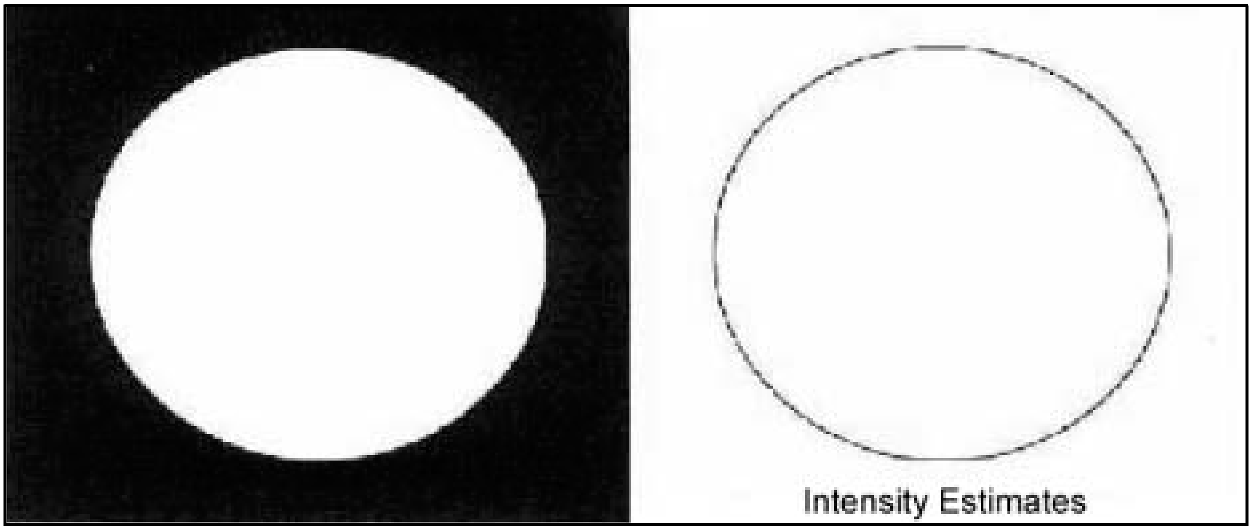
A



B

Figure 5: Maps of Jupiter constructed by Damian Peach from his visible-light Jupiter images. The polar regions are shown in Frame A and all other areas are shown in Frame B.

ALPO Jupiter Section Observation Form No. ______



Date (UT): ____

Name: ____

Time (UT): _______________________________________

Address: ____

CM I _____ CM II ____ CM III _______

____

Begin (UT): ______________ End (UT) _____________

City, State, ZIP: ________________________________

Telescope: f/ ___ Size: ___________ (in./cm.; RL/RR/SC)

____

Magnification: _______x ________x ________x

Observing Site: ________________________________

Filters: ___________________________________(W / S)

____

Trnasparency (1 - 5): ____ (Clear / Hazy / Int. Clouds)

E-mail: ____

Seeing (1 - 10): _________ Antoniadi (I - V): _________

No.	Time (UT)	S I (°)	S II (°)	S III (°)	Remarks

Notes

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Time (UT): ______________________________

S I (°): ______________________________

S II (°): ______________________________

S III (°): ______________________________

Date (UT): ______________________

Time (UT): ______________________

CM I _____ CM II ____ CM III ________

Date (UT): ______________________

Begin (UT): ___________ End (UT) ________

Telescope: f/ ____ Size: ______ (in./cm.; RL/RR/SC)

Magnification: ________ x ________ x ________x

Filters: ______________________(W / S)

Seeing (1 - 10): ________ Antoniadi (I - V): ________

Tranparency (1 - 6) _____ (Clear / Haze / Int. Clouds)

Name: ______________________

Address: ______________________

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City, State, ZIP: ______________________

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Observing Site: ______________________

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E-mail: ______________________

No.	Time (UT)	S I (°)	S II (°)	S III (°)	Remarks

Notes

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Describe your time source(s) and estimated accuracy	Observer Name: Apparition: 20_____-20_____ (conjunction to conjunction)

Event Type (a)	Predicted UT		Observed UT Time (9d)	Telescope Data (e)			Sky Conditions (0-2 scale) (f)			Notes (g)
	Date (b)	Time (c)		Type	Aperture (cm)	Mag.	Seeing	Transparency	Field Brightness	

(a) 1 = Io, 2 = Europa, 3 = Ganymede, 4 = Callisto; D = Disappearance, R = Reappearance
(b) Month and Day
(c) *Predicted* UT to 1 minute
(d) *Observed* UT to 1 second; corrected to watch error if applicable; indicate in "Notes" if Observed UT date differs from Predicted UT date
(e) R = Refractor, N = Newtonian Reflector, C = Cassegrain Reflector, X = Compound/Catadioptric System; indicate in "Notes" if other type.
(f) These conditions, including field brightness (due to moonlight, twilight, etc.), should be described as they apply to the actual field of view, rather than to general sky conditions. Use whole numbers only, as follows:
  0 = Condition not perceptible; no effect on timing accuracy
  1 = Condition perceptible; possible minor effect on timing accuracy
  2 = Condition serious; definite effect on timing accuracy
(g) Include here such factors as wind, drifting cloud(s), satellite near Jupiter's limb, moonlight interference, etc.

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

- Coordinator; Wayne Bailey, 17 Autumn Lane, Sewell, NJ 08080
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Lunar Meteoritic Impacts Search Program

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

- Coordinator; Brian Cudnik, 11851 Leaf Oak Drive, Houston, TX 77065

Lunar Transient Phenomena

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

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

Lunar Dome Survey Program

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Saturn Section

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

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Remote Planets Section

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- Coordinator; Gary Kronk, 132 Jessica Dr, St. Jacob, IL 62281-1246

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

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

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

Eclipse Section

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

- Coordinator; Michael D. Reynolds, dean, Math & Science, Florida Community College, 3939 Roosevelt Blvd, E-345, Jacksonville, FL 32205

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

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- **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 megabytes.
- **Monograph No. 2**. *Proceedings of the 44th Convention of the Association of*

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Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994. 52 pages. File size approx. 6.0 megabytes.

- **Monograph No. 3**. *H.P. Wilkins 300-inch Moon Map.* 3rd Edition (1951). Available as one comprehensive file (approx. 48 megabytes) or five section files (Part 1, 11.6 megabytes; Part 2, 11.7 megabytes; Part 3, 10.2 megabytes; Part 4, 7.8 megabytes; Part 5, 6.5 megabytes)
- **Monograph No. 4.** *Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.127* pages. Hard copy $17 for the United States, Canada, and Mexico; $26 elsewhere. File size approx. 2.6 megabytes.
- **Monograph No. *5.*** *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir; 1877-1878.* By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Hard copy $10 for the United States, Canada, and Mexico; $15 elsewhere. File size approx. 2.6 megabytes.
- **Monograph No. *6.*** *Proceedings of the 47th Convention of the Association of Lunar and Planetary Observers, Tucson, Arizona, October 19-21, 1996.20* pages. Hard copy $3 for the United States, Canada, and Mexico; $4 elsewhere.File size approx. 2.6 megabytes.
- **Monograph No. 7.** *Proceedings of the 48th Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.76* pages. Hard copy $12 for the United States, Canada, and Mexico; $16 elsewhere.File size approx. 2.6 mega-

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

- **Monograph Number 9**. *Does Anything Ever Happen on the Moon?* By Walter H. Haas. Reprint of 1942 article. 54 pages.Hard copy $6 for the United States, Canada, and Mexico; $8 elsewhere.File size approx. 2.6 megabytes.

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

- **Monograph No. 11**. *The Charte des Gebirge des Mondes* (Chart of the Mountains of the Moon) by J. F. Julius Schmidt, this monograph edited by John Westfall. Nine files including an accompanying guidebook in German. Note files sizes: Schmidt0001.pdf, approx. 20.1 mb; Schmidt0204.pdf, approx. 32.6 mb; Schmidt0507.pdf, approx. 32.1 mb; Schmidt0810.pdf, approx. 31.1 mb; Schmidt1113.pdf, approx. 22.7 mb; Schmidt1416.pdf, approx. 28.2 mb; Schmidt1719.pdf, approx. 22.2 mb; Schmidt2022.pdf, approx. 21.1 mb; Schmidt2325.pdf, approx. 22.9 mb; SchmidtGuide.pdf, approx. 10.2 mb

ALPO Observing Section Publications

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- **Solar:** Totally revised *Guidelines for the Observation and Reporting of Solar Phenomena*, $10 USD; includes CD with 100 page-manual in pdf with up-to-date techniques, images, and links to many solar references. Produced by ALPO Solar Section Assistant Coordinator and Archivist Jamey Jenkins, this publication replaces *Observe and Understand the Sun* and its predecessor, *The Association of Lunar& Planetary Observer's Solar Section Handbook for the White Light Observation of Solar Phenomena*, both by the ALPO's own Rik Hill. To order, send check or US money order made payable to Jamey Jenkins, 308 West First Street, Homer, Illinois 61849; e-mail to *jenkinsjl@yahoo.com*

- **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, 2010 Hillgate Way #L, Simi Valley, CA 93065; e-mail *cometman@cometman.net*.

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

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

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

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

- **Mars:** *(1) ALPO Mars Observers Handbook,* send check or money order for $15 per book (postage and handling included) to Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-

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DEEP-SKY (816-333-7759); e-mail *leaguesales@astroleague.org*. *(2) Observing Forms;* send SASE to obtain one form for you to copy; otherwise send $3.60 to obtain 25 copies (send and make checks payable to “Deborah Hines”, see address under “Mars Section”).

- **Jupiter:** *(1) Jupiter Observer’s Handbook*, $15 from the Astronomical League Sales, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114; phone 816-DEEP-SKY (816-333-7759); e-mail *leaguesales@astroleague.org*. (2) *Jupiter*, the ALPO section newsletter, available online only via the ALPO website at *http://mysite.verizon.net/macdouc/alpo/jovenews.htm;* (3) *J-Net*, the ALPO Jupiter Section e-mail network; send an e-mail message to Craig MacDougal. (4) *Timing the Eclipses of Jupiter’s Galilean Satellites* free at *http://www.alpo-astronomy.org/jupiter/GaliInstr.pdf*, report form online at *http://www.alpo-astronomy.org/jupiter/GaliForm.pdf*; send SASE to John Westfall for observing kit and report form via regular mail. (5) *Jupiter Observer’s Startup Kit*, $3 from Richard Schmude, Jupiter Section coordinator.

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

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

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

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

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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.

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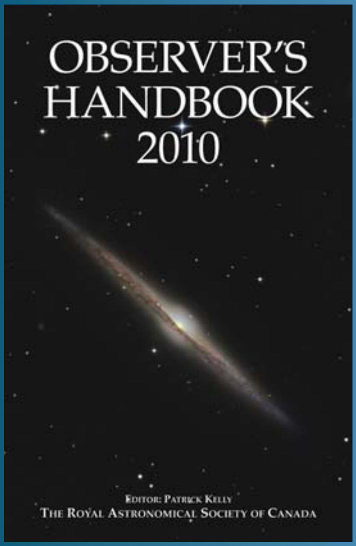

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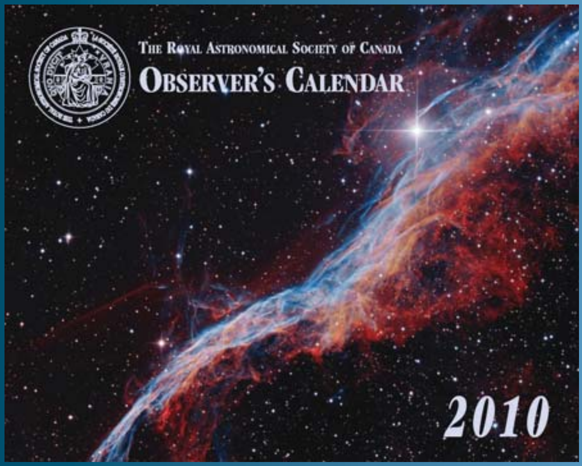

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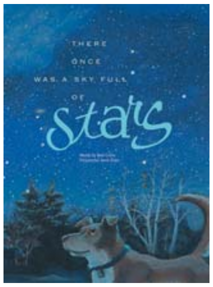

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